

CURRICULUM STRUCTURE
Vth Semester Scheme of Studies Diploma in Civil Engineering [C-20]

Pathway	Course Category / Teaching Department	Course Code	Pathway Title	Hours per Semester			Total contact hrs /Semester	Credits	CIE Marks		SEE-1 Marks (Theory)		SEE-2 Mark (Practical)		Total Marks	Min Marks for Passing (including CIE marks)	Assigned Grade	Grade Point	SGPA and CGPA
				L	T	P			Max	Min	Max	Min	Max	Min					
Programme Specialization Pathway																			
1	CE Specialization pathways in emerging areas Student may select any one of the specializations	20CE51 I	Structural Engineering	104	52	312	468	24	240	96	60	24	100	40	400	160			Both SGPA & CGPA
		20CE52 I	Town Planning and Green Building	104	52	312	468	24	240	96	60	24	100	40	400	160			
		20CE53 I	Transportation Engineering	104	52	312	468	24	240	96	60	24	100	40	400	160			
		20CE54 I	Built Environment	104	52	312	468	24	240	96	60	24	100	40	400	160			
Science and Research Pathway				L	T	P	Total	Credits	CIE Marks		SEE Marks								
									Max	Min	Max	Min							
2	BS/SC/CE Specialization pathway in Science and Research (Student need to take all four papers in this pathway)	20SC51T	Paper 1-Applied Mathematics	52	26	0	78	6	50	20	50	20	100	40					
		20SC52T	Paper 2 – Applied Science	52	0	52	104	6	50	20	50	20	100	40					
		20RM53T	Paper 3 – Research Methodology	52	0	52	104	6	50	20	50	20	100	40					
		20TW54P	Paper 4 – Technical Writing	39	13	52	104	6	60	24	40	16	100	40					
			Total	195	39	156	390	24	210	84	190	76	400	160					
Entrepreneurship Pathway																			
3	ES/CE	20ET51I	Entrepreneurship and Start up	104	52	312	468	24	240	96	160	64	400	160					

L:- Lecture T:- Tutorial P:- Practical BS- Basic Science:: ES-Engineering Science:: SC: Science

Note : In 5th Semester student need to select any one of the pathways consisting of 24 credits

Students can continue their higher education irrespective of the Pathway selected



Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Civil Engineering	Semester	5th
Course Code	20CE51I	Type of Course	Specialization Pathway
Course Name	Structural Engineering	Contact Hours	36 hours per week
L: T:P	104: 52: 312	Credits	24
CIE Marks	240	SEE Marks	160

Introduction: Welcome to the curriculum for Structural Engineering 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 plan, analyse, design, drafting, estimation and costing. Additionally, it considers the technical, economic, environmental, aesthetic, and social aspects of the structures. Structural engineering is a profession that offers a great opportunity to make a real difference in the lives of people and their environment.

Leading to the successful completion of this bootcamp, you shall be equipped to either do an internship at an organization working in Structural Engineering related industry or do a project in Structural Engineering related sectors. After the completion of your Diploma, you shall be ready to take up roles like Junior Engineer, Assistant design engineer, Draftsman, Site Engineer, Quality controller, Auditor.

This course will teach you Fundamentals of referring IS Codes, understanding details, analysis of data, design, drafting, cost estimation, transportation, erection and assembly of steel structures. Details of the curriculum is presented in the sections below.

Instruction to course coordinator:

1. Each Pathway is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. Single faculty shall be the Cohort Owner.
3. This course shall be delivered in boot camp mode.
4. The industry session shall be addressed experts (in contact mode/online / recorded video mode) by industry experts only.

5. The cohort owner shall identify experts from the relevant field and organize industry sessions as per schedule.
6. Cohort owner shall plan and accompany the cohort for industrial visits.
7. Cohort owners shall maintain and document the industrial assignments and weekly assessments, practices and mini projects.
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 the classroom can augment or use for supplementally teaching online courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM, etc.
10. Cohort owner shall guide the cohorts for the execution of mini project.

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

C01	Collect necessary data, analyze, refer relevant IS codes, design simple indeterminate structural elements, portal frames, steel structures and masonry structures.
C02	Prepare working drawings, design drawings, fabrication drawings, erection drawings, estimates, BOQ, BOM, MTO.
C03	Monitor transportation, lifting, erection, connection processes of steel and PSC structures
C04	Use appropriate modern tools and design software's

Detailed course plan

Week	CO	PO	Days	1 st session (9am to 1 pm)	L	T	P	2 nd session (1.30pm to 4.30pm)	L	T	P
1	1	1,2	1	Introduction - Structural Engineering as a responsible career. - Role of structural Engineer. - Need of structural analysis and design. - Introduction to analysis and design software's. - Prevailing Codes of practice. Present roles of structural engineer at site by showing videos, images. Identify the various sectors of civil engineering where structural engineers plays a role.	2	2		Structural analysis - Types of structure - Conditions of equilibrium, Degrees of Freedom - Determinate and indeterminate structures-examples. - Static determinacy and kinematic determinacy - Stable and Unstable structures – examples. - Degree of indeterminacy - Concept of Analysis of Indeterminate beams. Prepare models/prototypes to present determinate and indeterminate structures using any available materials	1		2
	1	1,2	2	Analysis of Fixed beams - Fixed beam, Degree of indeterminacy of fixed beam- Sagging and Hogging bending moments - Determination of fixed end/support moments by Area Moment method - Drawing SF and BM diagrams for Fixed beams subjected to UDL, point load- simple problems	2		2	- Determination of Slope and Deflection of fixed beams subjected to UDL, point load by area moment method. - Simple Problems.			3
	1	1,2	3	Analysis of Continuous beams - Continuous beams, applications. - Introduction to Carry over factor, Stiffness factor and Distribution factor –Stiffness Ratio or Relative Stiffness.							

			• Concept of distribution of unbalanced moments at joints - Sign conventions. • Application of Moment Distribution method to Continuous beams of two spans only (Maximum of three cycles of distribution) • Finding Support Reactions- Problems • Sketch SFD and BMD for two span beams	2		2	• Continuation			3
1	1,2	4	Analysis of Portal frames • Portal Frames, Types, Bays and Storey • Sketch Single and Multi Storey Frames, Single and Multi Bay Frames • Portal Frame – Sway and Non-Sway Frames • Analysis of Non sway Symmetrical Portal Frames-single Bay and single Storey- for Joint moments by Moment Distribution Method and draw SFD and BMD.	1		3	• Continuation	1		2
		5	Developmental Assessment				Assessment Review and corrective action			3
		6	Industry Session		2	3	Industry assignment			
4	4,7	1	Peer review on industry class.		4		• Introduction to Modelling of structural elements using any <i>Open Source (STAAD Pro/Ansys)</i> analysis software. • Recall from EM & SOM	1		2
4	4,7	2	• Model and analyze fixed beam, Continuous beam and Portal frame using any <i>Open Source (STAAD Pro/Ansys)</i> analysis software. • Compare the results with manual calculations.			4	• Continuation			3
1	1,2	3	Buildings and By-laws • Types of building and purpose	2		2	RCC structures	2		1

2				• Building by-laws, floor area ratio (FAR), Set back, Height limitations of building, Fire safety. Types of Drawings. • Plan approval procedure. <i>Collect, Study and prepare a report on local municipal or city corporation building by-laws.</i>			• Types of structures, structural components- Definition and their role in structural system • Tensile and compression members, Zones of tension and compression in a Beam • Role of concrete and reinforcement in RC structures, • Loads on structures, types, selection of load and load combination, • Effective span, Breadth and depth requirements of beam, thickness of slab, Column size and orientation, Footing size, depth of footing, selection of footing type. <i>Study IS 875-2016 and prepare a report on selection of load and load combination.</i>			
	1	1,3	4	Design specifications of RC structures • Reinforcement – types, percentage of reinforcement, Spacing requirements, Selection of suitable diameter • Development length and its calculation. • Anchorage bends and hooks and their values. • Curtailment of reinforcement. • Lapping/Splicing, Spacer bars, Chairs • Cover requirements <i>Collect and read existing Blue Print drawings of any type of building and prepare report.</i>	2	2	Ductile detailing • Introduction to ductile detailing of RC structures as per IS 13920-2016 • Salient features of Ductile detailing • Difference between RC detailing and Ductile detailing using SP-34 and IS 13920-2016 <i>Read IS 456-2000, SP-34, IS 13920-2016 and prepare typical RC detailing drawings</i>	2		1
			5	Developmental Assessment			Assessment Review and corrective action			3

			6	Industry Session			5	Weekly industry assignment.			
3	1,4	2,7	1	Peer review on industry class.		4		Planning of a Residential (2BHK)/School/Commercial building with staircase Ask students to prepare their own • Site plan • Single line diagram • Architectural plan • Elevation (From all four directions) • Sectional elevation Using AutoCAD. Follow building by-laws.	2		1
			2	• Continuation	1	3		• Continuation			3
	1,4	2,7	3	Design of a Residential (2BHK)/School/Commercial building with staircase Design the structural members of the above planned building manually as per IS 456:2000 • Slab • Beam • Column • Lintel with chejja • Footing • Staircase	1	3		• Continuation			3
	1,4	7	4	• Introduction to use of Design software like STAAD Pro/ETABS and SAFE (Footing design)	2	2		• Practice of Design software like STAAD Pro/ETABS and SAFE (Footing design)	1		2
			5	CIE 1- Written and practice test				Assessment Review and corrective action			3

			6	Industry class	2		3	Industry weekly assignment			
4	1,4	7	1	Peer review on industry class		4		- Model, Analyze and Design the above planned building using STAAD Pro/ETABS and SAFE (Footing design) software. - Compare with manual design values.	1		2
	1,4	7	2	Continuation	1		3	Prepare Detailed reinforcement drawings for the above designed building using AutoCAD	1		2
	1,4	7	3	Continuation	1		3	Continuation			3
	1,4	7	4	Prepare drawings of - Column layout - Beam layout - Sectional details - Structural drawings - General notes Using AutoCAD	2		2	- Continuation - Print "GOOD FOR CONSTRUCTION" drawings.			3
			5	Developmental Assessment				Assessment Review and corrective action			3
			6	Industry class	3		2	Industry weekly assignment			
5	1,2	3	1	Peer review on industry class		4		Estimate the quantities and Prepare BOQ making use of local Schedule of rates (SR) for the above designed 2BHK residential building	1		2
	1,2	3	2	Continuation	1		3	Continuation			3

	1		3	Visit nearby construction site and expose students to different construction activities	1		3	Visit nearby construction site and expose students to different construction activities	1		2
	1	3	4	Design of T-beam - Definition, where and when T-beams are provided - Structural behavior of T-beam, - Cross section of T-beam and L-beam, Effective width of flange, Neutral axis - Design of Singly reinforced T-beam for flexure. - Sketch reinforcement details.	2		2	Design of Combined footing - Definition, necessity, design concept - Design a combined footing to carry equal loads from two columns. - Sketch reinforcement details	1		2
			5	CIE 2- Written and practice test				Assessment Review and corrective action			3
			6	<i>Industry class</i>	2		3	<i>Industry weekly assignment</i>			
6	1,3	3	1	<i>Peer review on industry class</i>			4	Pre-stressed concrete (PSC) - Principle of pre-stressing - Advantages and disadvantages of PSC - Difference b/w RCC and PSC - Applications of PSC - Materials used and their characteristics, Stress-strain curve. - Methods of pre-stressing - Pre-tensioning, Post tensioning Show images and videos of pre-stressing and materials used.	2		1
	1,3	3	2	- Loss of pre-stress- Types, total loss and measures to minimize pre-stress loss - Anchoring devices - Step by step procedure of Pre-tensioning Prepare a report on stages of Pre-tensioning	1		3	- Form work for PSC at site as well as pre-casting plants – types, materials, selection of type of form work - Step by step procedure of post-tensioning	1		2

							Prepare a report on stages of post-tensioning			
	1,3	3	3	• Concreting of PSC elements • Grouting of ducts -Definition, properties, types, materials, proportion and testing. • Curing methods- latest • Transportation of PSC members Prepare a report on grouting, curing and transportation of PSC members.	2	2	• Lifting and erection of PSC members, machineries involved, standard practice, safety precautions • Bearings- Definition, necessity, properties, types of bearings, materials, selection of bearings, installation and maintenance Prepare checklist for lifting and erection of PSC members	2		1
	1,3	3	4	• Visit nearest PSC elements manufacturing plant and prepare a report. (Accompanied by cohort owner)		4	• Visit nearest precast concrete elements manufacturing plant and prepare a report. (Accompanied by cohort owner)			3
			5	Developmental Assessment			Assessment Review and corrective action			3
			6	Industry Class	1	4	Industry weekly assignment			
	1	3	1	Peer review on industry class		4	Introduction to Limit state design of steel structures: • Advantages and disadvantages of Steel structures • Structural steel sections • Loads and load combinations. • Limit state design- Design considerations, Failure criteria for steel, specifications and section classifications as per IS 800-2007. Collect and Read IS 800-2007	2		1

7	1,3	3	2	Bolted Connections: • Introduction • Advantages and disadvantages of bolted connections • Difference between unfinished bolts and High strength friction grip bolts (HSFG) • Behavior of bolted joints • Failure of bolted joints. Prepare a report on types of bolts, behavior and suitability.	2		2	• Simple problems on finding • Shear strength • Bearing strength • Tensile strength of bolts (bearing type only). • Tensile strength of plate • Efficiency of joints. • Simple Lap joint design problems.			3
	1,3	3	3	• For the given bolted connection snap, identify the possible joint failures. Propose an alternative type of joint to increase the connection strength. Prepare a lap joint using card board and nail. Apply the tension force and prepare a report on the failure mode.	1		3	Welded Connections • Introduction • Advantages and disadvantages • Types of welding • Weld symbols, specifications, effective area of weld • Design strength of fillet weld, simple problems on welded joints (fillet weld only).	1		2
	1,3	3	4	• Introduction to welding process and welding machine and accessories. • Practice welding for the above designed fillet weld.	1		3	• Visit the nearest construction site/railway station/any steel structure and identify the various types of connections used in steel structure. For the identified connections, list out the possible failure criteria and prepare a report.			3
			5	CIE 3– Written and practice test				Assessment Review and corrective action			3

			6	Industry Class	2		3	Industry weekly assignment			
8	1,3	3	1	Weekly assignment review			4	Flexural Members: • Introduction, • Lateral buckling, Web buckling and crippling • Difference between laterally restrained and unrestrained beams • Determination of the moment capacity of laterally restrained beams List different types of failures in beam sections with sketches	2		1
	1,3	3	2	• Design of laterally restrained simple beams using standard rolled steel sections only. • Problems on design of simple beam shear connection.	1		3	• Design and analyze a simply supported beam carrying UDL, point load at center, calculate the end reactions and design the fin plate connection for end reaction. • Draw respective sketches in AutoCAD.	1		2
	1,3	3	3	• Continuation			4	Tension Members • Introduction, types of tension members, slenderness ratio and net area. • Behavior of tension members. • Modes of failure. • Factors affecting the strength of tension member. Show images and videos of tension members and their failure modes.	2		1
	1,3	3	4		1		3	Compression Members	1		2

				- Design strength of tension member due to yielding of gross section, due to rupture of critical sections and block shear. - Design of tension members.				- Columns –Classification, Boundary conditions, effective length, slenderness ratio. - Design strength of Columns. - Design of axially loaded Columns (Excluding Built up sections)			
			5	Developmental Assessment				Assessment Review and corrective action			3
			6	<i>Industry Class</i>	1		4	<i>Industry weekly assignment</i>			
9	1,3	3	1	<i>Peer review on industry class</i>			4	Struts Design of Continuous and Discontinuous strut for given end conditions for axial load only.	1		2
	1,3	3	2	Practice design of Columns and struts	1		3	Column Bases - Introduction - Types of Column Bases, Slab base, Gusseted Base. - Design of Slab base for axial Load.	1		2
	1,3	3	3	Design connections and members of a steel truss for vehicle parking in your college campus	1		3	Continuation			3
	1,3	3	4	Introduction to steel detailing and fabrication - Basic information on steel detailing. - Importance of detailing - Process involved in detailing - Structural drawing review, preliminary questions/ RFI's. Tutorial video to be shown to students to show sample design drawings, sample RFI's and how to find missing information's.	2		2	Based on the tutorial video, students to review the design drawings and find out the missing information and prepare relevant RFI's (Request for Information).	1		2
			5	CIE 4- Written and practice test				Assessment Review and corrective action			3

			6	Industry Class	2		3	Industry weekly assignment			
10	1,3	3	1	Peer review on industry class			4	Introduction to fabrication and erection drawings • Basic requirement in fabrication drawings • Basic terminologies used in fabrication drawings • Title, Symbols used in fabrication drawings. • Difference between approval drawings and fabrication drawings. • Present and explain existing fabrication drawings of any steel structure, images and videos.	1		2
	1,3	3	2	• Assembly drawings, part drawings and general arrangement (GA) drawings. • Fabrication process • Importance of coordination between fabricator and detailer. • Real time problems during fabrication. • Shop queries. Present and explain existing Assembly drawings, Part drawings and General arrangement drawings.	2		2	• Erection process • Requirements in erection drawings • Co-ordination between the fabrication drawings and erection drawings • Sequence of erection • Real time problems during erection. Present and explain existing Erection drawings.	1		2
	1,3	3	3	Visit nearby steel fabrication shops and prepare a report on real time problems of fabrication.	1		3	Visit to nearby steel structures construction site and prepare a report on erection process			3

	1,3	3	4	• Introduction to Pre-engineered Buildings • Advantages over Hot rolled steel structures • Light gauged members as structural and non-structural elements • Industrial Applications Study existing Pre-Engineered drawings.	2		2	• Safety precautions in erection of steel structures • Maintenance of steel structures • Inspectional tests on steel structures Prepare a report on tests on steel structures and checklist	1		2
			5	Developmental Assessment				Assessment Review and corrective action			3
			6	<i>Industry Class</i>	1		4	<i>Industry weekly assignment</i>			
11	1,2	2	1	<i>Peer review on industry class</i>			4	Pre-material take off • Introduction to Material Take Off (MTO) • Importance and use of MTO • Information to be included in MTO extraction • Special materials and available lengths in the market. • Extraction of MTO Tutorial video to be shown to students on MTO extraction.	2		1
	1,2	2	2	• Based on the tutorial video shown, students to extract the MTO manually from existing design drawing.	1		3	• Continuation			3
	1,2,4	2,3,4	3	Model, Analyze and Design a simple Steel Truss required for vehicle parking in your college campus using STAAD Pro.	2		2	Prepare design and fabrication drawings.			3

	1	2,3	4	Design of Masonry structures • Permissible stresses- Types of walls, permissible compressive stress, stress reduction and shape modification factors, permissible tensile stress and shear stress. • Design Considerations: Effective height of walls, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. • Load considerations • Design criteria Collect and read IS 1905:1987	2	2	Design of Masonry solid walls subjected to axial UDL loads supported at the ends by cross wall, and walls with piers.	1	2
			5	CIE 5– Written and practice test			Assessment Review and corrective action		3
			6	<i>Industry Class</i>	1	4	<i>Industry weekly assignment</i>		
12			1	<i>Peer review on industry class</i>		4	• Continuation of Design of Masonry solid walls.		3
	1	1,2,3	2	Design of Masonry & RC Retaining wall • Theory of earth pressure • Calculation of earth pressure by Rankine's method with and without surcharge • Conditions of stability for no tension • Middle one third rule • Distribution of pressure at foundation • Design of masonry retaining wall.	2	2	• Design of RC retaining wall (Use appropriate code & Software)		3
	1	2,3		Earthquake engineering					

		3	• Classification of Earthquakes • Major past earthquakes and their effect • Types and characteristics of seismic waves • Magnitude and intensity of earthquakes • Local site effects • Richter Scale, Seismograph • Seismic zoning map of India Study and prepare a report on any one previous earth quake in India or outside of India.	2	2	• Typical failures of RC frame structures • Types of damages to building observed during past Earthquakes • Classification of damages to buildings • Plan irregularities, mass irregularity, stiffness irregularity • Concept of soft and weak storey. Prepare a PPT on failure and typical damages to buildings due to Earth quake.	1		2
1,4	2,3	4	• Torsional irregularity and their consequences. • Configuration problems, continuous load path. • Architectural aspects of earthquake resistant buildings • Lateral load resistant systems. • General guidelines for earthquake resistant design Prepare models of irregularities in buildings as per IS 1893-2016 using card board and present	2	2	• Continuation			3
		5	Developmental Assessment			Assessment Review and corrective action			3
		6	<i>Industry Class</i>	2	3	<i>Industry weekly assignment</i>			

13			1	Internship 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. 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.	Project 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. 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.
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Note: Saturday session from 9 AM -2 PM

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
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

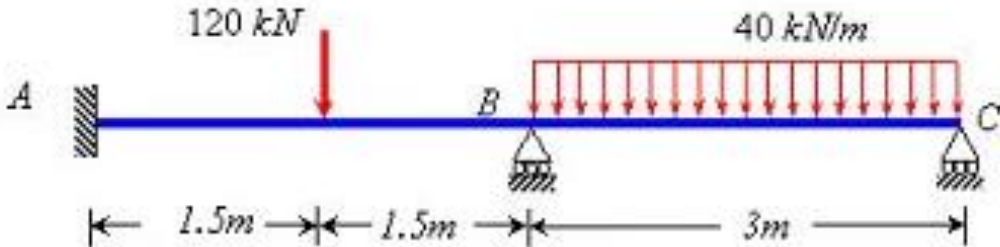
* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration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

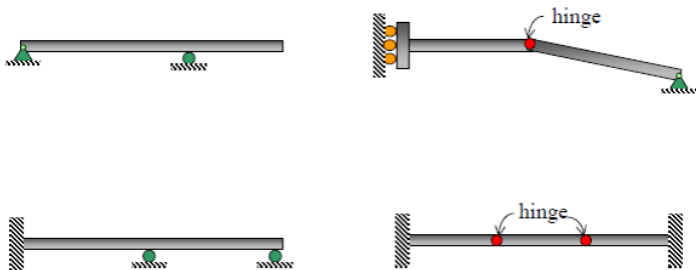
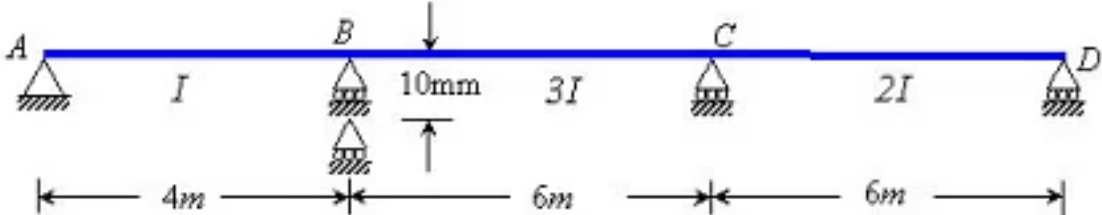
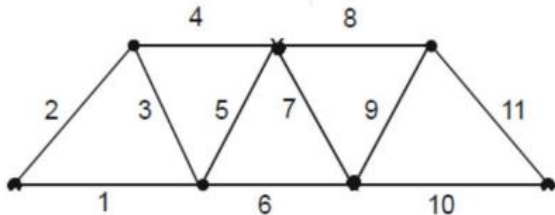
Assessment framework for CIE (1 to 5)

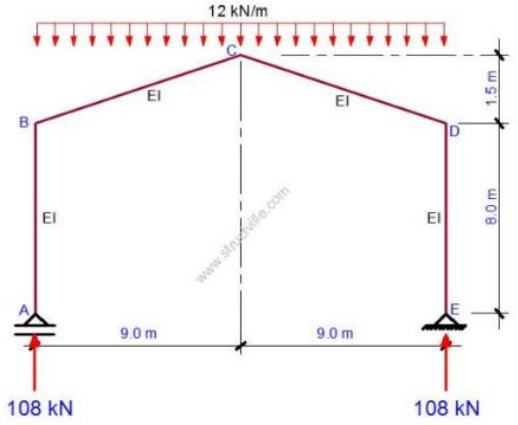
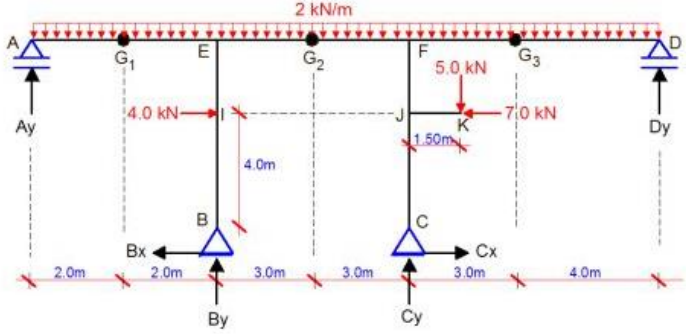
Note: Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam - 4 hours

Programme	Civil Engineering	Semester	V
Course	Structural Engineering	Max Marks	30
Course Code	20CE51I	Duration	4 hours
Name of the course coordinator		CIE	1(3 RD WEEK)

Note: Answer one full question from each section.

Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) - 10 marks					
1.a)	Analyze the Continuous beam shown in figure by the three moment equation. Draw shear force and Bending Moment Diagram. 	3			6
b)	Classify if each of the following beams is determinate or indeterminate. If statically indeterminate, what is the number of degree of indeterminacy?	3			4

					
2.a)	Analyze the Continuous beam shown in figure by the three moment equation method if support B sinks by an amount of 10mm. Draw shear force and bending moment diagram. Take flexural rigidity $EI=48000\text{KN.m}$ 	4			6
b)	Classify the following frame is determinate or indeterminate Take $r=3$.  For the truss shown, determine if the truss is I-Stable II-Indeterminate III- Determinate A-I ONLY B-II ONLY	4			4

	C-I and III D-I and II				
Section-2 (Practical) - 20 marks					
3)	Model and Analyze frame with suitable software for stress, Deflection and stability. Tabulate the results and draw inferences from the results 	4	4		20
4)	Model and Analyze frame with suitable software for stress, Deflection. Tabulate the results and draw inferences from the results 	4	4		20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory) – 100 Marks / 3 hours (Reduced to 60 marks)

Program : Civil Engineering

Course : STRUCTURAL ENGINEERING

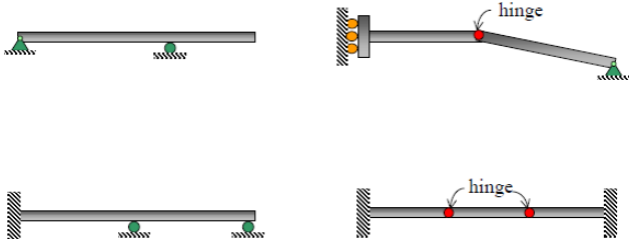
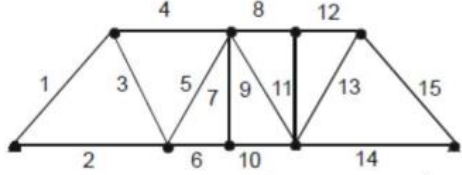
Course Code : 20CE54I

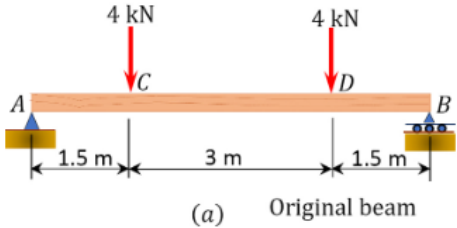
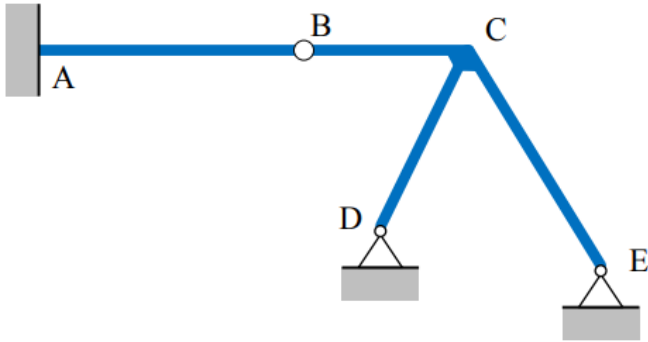
Semester: Vth

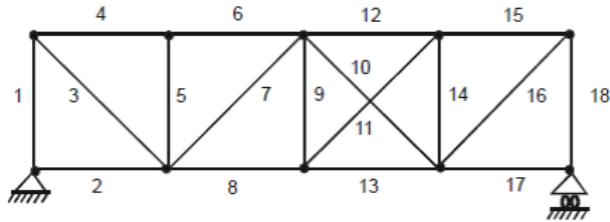
Max Marks : 100

Duration: 3 Hrs

Instruction to the Candidate: Answer one full question from each section.

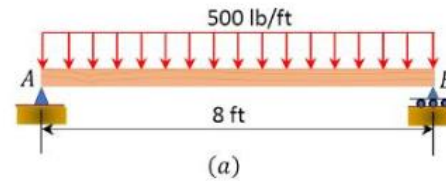
Q. No	Question	CL	CO	Marks
Section-1				
1.a)	Classify if each of the following beams is determinate or indeterminate. If statically indeterminate, what is the number of degree of indeterminacy? 	3	1	5
b)	Classify the following frame is determinate or indeterminate Take $r=3$. 	3		5

1C	A prismatic timber beam is subjected to two concentrated loads of equal magnitude, as shown in Figure. Using the moment-area method, determine the slope at AA and the deflection at point C.  (a) Original beam	3		10
2.a)	1. Find whether the structure/frame statically determinate or Indeterminate 	3		4
b)	1. Classify the following frame is determinate or indeterminate Take $r=3$.	4		6



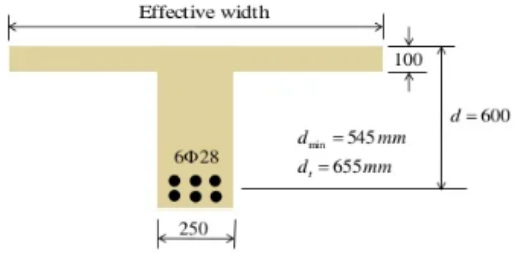
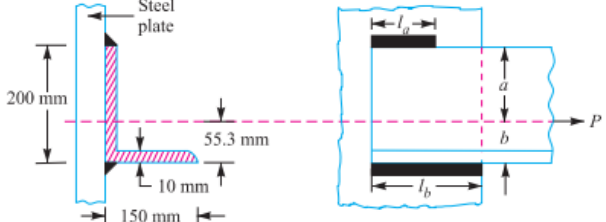
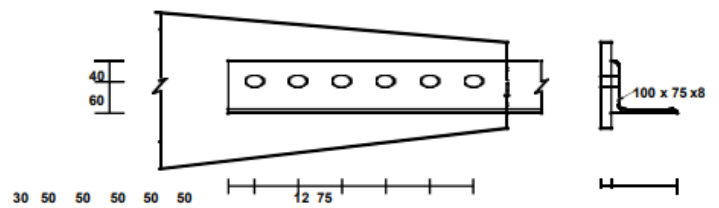
2C

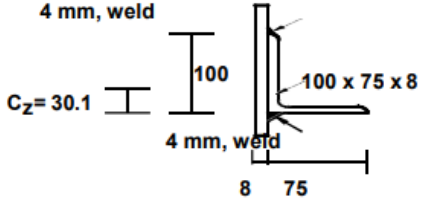
A simply supported timber beam with a length of 8 ft will carry a distributed floor load of 500 lb/ft over its entire length, as shown Figure (a) Using the moment area theorem; determine the slope at end B and the maximum deflection.



Section-2

3.a	Two Columns having Cross section of 250 x 250 mm and 300 x 300 mm are loaded 300kn and 500kn respectively. The c/c distance between the columns is 4m and the bearing capacity of soil 100kn/m ² . Design rectangular combined footing without beam.	3	1	10
3.b	A T-beam has a flanged width of 1200 mm and flanged thickness being 100 mm. Steel reinforcement of area 1272 mm² is placed at an effective depth of 400 mm. The stresses in concrete and steel shall not exceed 5 N/mm². Find moment of resistance of beam. Take m = 18.67	3		10
4.a	Draw Pre engineered structural shapes RC frames and Steel frames and elaborate on their performance during earth quakes.	3		10
4.b	Determine design moment of interior T beam shown in the figure $f'_c=30$ Mpa and $f_y=420$ Mpa. The beam with 9m span cast integrally with a floor slab that is 100mm thick beam tributary width is 1.5m.	3		10

				
Section- 3				
5.a)	Explain the Erection procedure for Post tensioning in Pre-stressing	2	1,3	8
b)	Design a lap joint to connect two plates each of width 100 mm, if the thickness of one plate is 12 mm and the other is 10 mm. The joint has to transfer a working load of 100 kN. The plates are of fe 410 grade. Use bearing type of bolts and draw connection details.	4		12
6.a)	What are the losses in pre-stress & How Losses in pre-stress can be reduced.	2		10
b)	A 200 x 150 x 10 mm angle is to be welded to a steel plate by a fillet welds as shown in figure. If the angle is subjected to a static load of 200Kn, find the length of weld at the top and bottom. The allowable shear stress for static loading may be taken as 75 MPa	3		10
				
Section-4				
7.a)	A single unequal angle 100 x 75 x 8 mm is connected to a 12 mm thick gusset plate at the ends with 6 numbers of 20 mm diameter bolts to transfer tension as shown in Fig. 13. Determine the design tensile strength of the angle if the gusset is connected to the 100 mm leg. The yield strength and ultimate strength of the steel used are 250 MPa and 400 MPa. The diameter of the bolts used is 20 mm	3	1	8
	 Fig. 13 Details of end connection			

b)	Design a suitable 'T' beam for a simply supported span of 3 m and carrying a dead or permanent load of 17.78 kN/m and an imposed load of 40 kN/m. Assume full lateral restraint and stiff support bearing of 100 mm.	4		12
8.a)	A single unequal angle 100 x 75 x 6 mm is connected to a 8 mm thick gusset plate at the ends by 4 mm welds as shown in Fig. The average length of the weld is 225 mm. Determine the design tensile strength of the angle if the gusset is connected to the 100 mm leg. The yield strength and ultimate strength of the steel used are 250 MPa and 400 MPa  Fig. 17 Details of connection at end	3		8
b)	A simply supported beam has an effective span of 7m and carries a uniformly distributed load of 50 kN/m (i.e DL = 25kN/m and LL = 25 kN/m) . Taking $f_y = 250 \text{ N/mm}^2$ and $E = 2 \times 10^5 \text{ N/mm}^2$, design the beam, if it is laterally supported.	4		12
Section-5				
9.	Design a wall of a room with openings. The wall is of 1 brick thick. The height of floor to ceiling is 2.8 m and height of plinth is 1.2 m. The RCC roof slab is 100 mm thick with clear span of 3.0 m. Height of 100 mm thick parapet above roof slab is 0.8 m. Height of taller door opening is 2.0 m. Unit weight of masonry and concrete may be taken as 20 kN/m ³ and 25 kN/m ³ respectively. Assume live load as 1.5 kN/m ² .	4	1	20
10.	Design a cantilever retaining wall (T type) to retain earth for a height of 4m. The backfill is horizontal. The density of soil is 18kN/m ³ . Safe bearing capacity of soil is 200 kN/m ² . Take the co-efficient of friction between concrete and soil as 0.6. The angle of repose is 30°. Use M20 concrete and Fe415 steel.	4		20

Scheme of Evaluation for SEE 2

Programme		Civil Engineering	Semester		V	
Course		Structural Engineering	Max Marks		100	
Course Code		20CE51I	Duration		3 hours	
Name of the course coordinator						
Note: Answer one full question from each section.						
Qn.No	Question		CL L3/L4	CO	PO	Marks
NOTE: 1. Use suitable Software and codal Provisions 2. Relevant Code books and Handbooks can be provided						
1.	Problem statement		3,4	1,4,2	1,3,4	
	A Client who residing in Bangalore wanted to build a residential apartment in his site 9 x 12 m, G+2, with satisfying to local body bye laws and Seismic Zone factor					
	1. Prepare bubble diagram & Prepare working plan					20
	2. Provide column layout					10
	3. Analyze the frame & provide Details with column and beam details					20
	4. Check safety for seismic zone factor					10
	5. Provide Steel details for structural elements using Appropriate tools					40
	OR				Total	100
2.	Problem statement		3,4	1,4,2	2,4,5	
	A Client require to build a small logistic shed within a month in an area 20m x 30m in Gujarat of using Steel sections without any RCC , with satisfying to local body bye laws and Seismic Zone factor					
	1. Prepare a layout plan					20
	2. Model and analyze the frame					20

	3. Check the safety of structure/frame for seismic zone factor				20
	4. Provide structural details of Columns , perlins and joints				30
	5. Provide approximate quantity of steel to be procured				10
				Toatl	100



Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Civil Engineering	Semester	V
Course Code	20CE52I	Type of Course	Specialization Pathway
Course Name	Town Planning and Green Building	Contact Hours	36 hours per week
L:T:P	104 : 52 : 312	Credits	24
CIE Marks	240	SEE Marks	160

Introduction

Welcome to the curriculum for Town planning and Green Building 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 foster innovative and responsive urban & regional development policies and practices for planned development. Leading to the successful completion of this boot camp, you shall be equipped to either do an internship at an organization working in Town planning and green building related industry or do a project in Town planning & Green building. After the completion of your Diploma, you shall be ready to take up roles like Town Planner, Green Engineer, Junior Engineer, Site Engineer.

This course will teach you Methods of data collection, data analysis, forecasting, designing, evaluating, management and maintenance of different components of City and Green Buildings. 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.

Instruction to course coordinator:

1. Each Pathway is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. Single faculty shall be the Cohort Owner.
3. This course shall be delivered in boot camp mode.
4. The industry session shall be addressed (in contact mode/online / recorded video mode) by industry experts only.
5. The cohort owner shall identify experts from the relevant field and organize industry sessions as per schedule.
6. Cohort owner shall plan and accompany the cohort for industrial visits.
7. Cohort owners shall maintain and document the industrial assignments and weekly assessments, practices and mini projects.
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 the classroom can augment or use for supplementally teaching online courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM, etc.
10. Cohort owner shall guide the cohorts for the execution of mini project.

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

C01	Identify the need for planned development by adhering to legal implications of law/standards.
C02	Collect essential data from reliable sources analyze & interpret
C03	Conduct various types of Survey and handle spatial data by using tools and software's
C04	Identify the suitable location & apply the technology used in smart city concept
C05	Apply green building rating system to evaluate the level of sustainability of a building project.

Detailed course plan

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 nd session (1.30pm to 4.30pm)	L	T	P
1	1	1	1	Introduction History of Town Planning, Time as a dimension of built form, Human settlements-civilization, Origin of human settlement, Society, Social stratification, Agrarian classes, Industry and labor, Tribe: profile and location, Village structure and change, Forms- caste, class, power & gender. Reference & links 1. file:///C:/Users/PC%203/Downloads/TownPlanningScheme 24-05-2020.pdf 2. https://www.drishtiiias.com/pdf/indus-valley-civilization.pdf 3. https://dhsgsu.edu.in/images/Reading-Material/Anthropology/ANT-CC-223-UNIT-4IV.pdf <i>Demonstrate using any of online sources</i> Case Exercise: City pattern Study-Short trip to city/town covering old parts as well as recently planned developments and understand how a settlement grows and driving forces behind the growth.	1	1	2	Urban Processes - Criteria's of location and development of towns in history, Political, economic, technological, social and cultural factors which have shaped settlements through history. - Indian city typologies and study of urban growth, decline, renewal in different cities based on function, location etc. - Town and country planning- Goals and objectives of planning; - Components of planning; - Benefits of planning; - Arguments for and against planning Case Exercise: Presentation on stages in the evolution of the city. Identify what has made the city unique and understand how social & economic forces (port, tourism, industries etc.) has shaped the city.	1		2

	1,2		2	Development plan: • Types of development plans. • Master plan. • City development plan. • Structure plan. • District plan. • Action area plan. • Subject plan. • Town planning scheme. • Regional & sub-regional plan. • Sector plans and spatial plans. Reference & links 1file:///C:/Users/PC%203/Desktop/CIVIL%20&%20Allied%20CRW/TP/research%20paper-%20development%20plan.pdf Case Exercise: Distance, Area & Space Perception-Conduct survey of college campus/any area with varying characters using Total Station/Survey instruments.	1	1	2	Case Exercise: • Prepare a plan indicating plot sizes, FAR, building height and open space using CADD SOFTWARE using the data obtained from field. • Prepare contour map for the data obtained from field	1		2
	1,2	1,4,5	3	Physical and Socio-Economic Surveys: • Preparation of Base maps at different scales, • Contents of base maps, • Techniques for conducting surveys for land use, • Building use, density planning and other surveys	2		2	Case Exercise: Prepare base plan using QGIS (for the data obtained from field) https://www.youtube.com/watch?v=x-rNnlAiCFY https://youtu.be/Ij7JS_Vu6Uc	1	1	1

				Case Exercise: QGIS –Introduction to QGIS, Applications, Installation & Demonstration.						
	1,2	1,4	4	QGIS Case Exercise Continued..			4	QGIS Case Exercise Continued.		3
			5	Developmental Assessment				Assessment Review and corrective action		3
	1,2		6	<i>Industry Session- Demonstration of Maps, survey Formats/Checklists, Base maps etc.</i>	1	1	3	<i>Industry class and assignment</i>		
2	1,2	1,2	1	<i>Peer review on industry class.</i>			4	Types of Data and Sources: - Difference between data, information and knowledge. - Distinction between facts and opinions. - Data requirements for urban and regional planning. - Sources of primary and secondary data-e.g. Census, NSSO etc. - Problems on Moving Average Method in Time Series	2	1

1,2	1,4,5	2	Data Presentation: case exercise 1. - Collect population data (5 decades) from census records and perform trend analysis by moving average method manually and using spreadsheet. - Present the results in the form of tables and charts using spreadsheet - Preparation of tables and charts, interpreting statistical, qualitative and spatial data to identify trends, patterns and processes.	2	2	Case Exercise 2. - Introduction to KGIS, Extraction of cadastral data from KGIS - Collect demographic details of an area from Spatial data and perform trend analysis by using spreadsheet. - Present the results in the form of tables and charts using spreadsheet. - Preparation of tables and charts, interpreting statistical, qualitative and spatial data to identify trends, patterns and processes https://kgis.ksrsac.in/kgis/home.aspx			3
1,2		3	Development and development control: - Regulations. - Types of development control. - Implications of violations of development control regulations. - Conforming and Nonconforming land uses. - Compatible and non-compatible land uses. - Concept of Locally Unwanted Land Use(LULU) and Not in my Backyard (NIMBY) Case studies on Above topics.	2	2	Governance of Planning - District Planning Committees, - Metropolitan Planning Committees, - Objects & Principles of town planning. Case Exercise: Collect data from local government body & Prepare a presentation on organization structure of Town & Country Planning Authority and the activities performed by it. http://www.dtcp.gov.in/en	1		2
1,2	1,3,4	4	Planning Legislation and Regulations			Case Exercise:			3

				- Town Planning Legislation 73rd and 74th amendment Outlining KTCP Act 1961 and KUDA Act 1.Laws related to Change of Land Use: 2.Laws related with Zoning, 3.Planning Permissions and Building Permission. 4.Identification of land use conflict and methods of resolution- 1.http://www.dtcp.gov.in/en 2.https://prsindia.org/files/bills_acts/acts_states/karnataka/1963/1963KR11.pdf 3.Karnataka Urban Development Authorities Act 1987.pdf (dtcp.gov.in) Examples and Case Studies	1		3	1. Refer to KTCP act 1961 and KUDA Act Collect data on Common Zonal regulations w.r.t - Hierarchy of Land use - Change of Land use- Procedure, check list and documents required. 2. Collect/obtain the masterplan of the city /village map (Visit nearest TPA)/town and outline the features. http://www.dtcp.gov.in/en			
	1,2	1,2	5	Developmental Assessment				Assessment Review and corrective action			3
			6	Industry Session- Land conversion Process and Documentation.			5	Weekly industry assignment.			
Week	C O	P O	D a y s	1st session (9am to 1 pm)	L	T	P	2ND session (1.30pm to 4.30pm)	L	T	P
3	3	1,4,5	1	Peer review on industry class.		4		Topographical Surveying: Concepts and Techniques and GPS - Procedure for topographic surveying. - Applications of topographical maps. - Relief-methods of representing relief	1		2

							Maps – Types of Maps. https://www.youtube.com/watch?v=EnbWVDM4JeM			
2,3	1,4,5	2	Case Exercise: Collect study and Demonstrate features like terrain, natural resources, Transportation networks etc from the Topo sheet.	1		3	Case exercise Continuation			3
2,3	1,4,5	3	GPS-Global Positioning System - Application of GPS in Urban planning - Various Satellites used by GPS - GPS Receivers- Pictorial Representation of working principle. - Hand held GPS Receiver - Demonstration, - Functions. Field procedure- Accuracy, Errors	2		2	Case Exercise: Using handheld GPS instrument Establish co-ordinates of important station points of a given boundary and perform survey. 1. Obtain length between two station points. Calculate area of the boundary using GPS instrument.	1		2
3	1,3,5	4	Spatial Data Infrastructure - Introduction - Roles of NNRMS, NUIS, National Urban Observatory, - Introduction to GIS - Concept, Components and Functions of GIS Case Exercise: Exposure to Spatial data handling tools. Prepare a report on uses and applications of GIS in Urban Planning Spatial data handling tools: - BHUVAN, KGIS etc.,	2		2	Case Exercise: Demonstrate the collection of cadastral information of a sample (neighborhood/residence) by using any of the tools.			3

				• DISHANK, BHOOMI etc.,						
			5	CIE 1- Written and practice test				Assessment Review and corrective action		3
	3		6	<i>Industry class- Case study on spatial data handling tools.</i>	1		4			
4	2,3	1,4,5	1	<i>Peer review on industry class</i>		4		Aerial survey: • Limitations of Traditional Surveys for Planning • Type of aerial Survey-Introduction to UAV survey. • Merits & demerits of UAV(drones) survey, • Application of drones in civil engineering. • Video demonstration of drones in urban planning; • ORI Images- QGIS software- conversion procedure from ORI sheets to maps- Swamitva central govt scheme – Commissioner survey settlement and land records, KR circle	1	2
	3	1,4,5	2	Purpose of 3D animation & visualization system. System architecture (Process of drone survey)	2	1	1	Video Demonstration on 3D animation. Types of drone used for civil engineering field.	2	1
	2,3	1,4,5	3	Process of terrain creation & building model distribution.	2		2	Integration of 3D modeling from UAV survey in BIM.(can use video demonstration)	1	2

				Video demonstration						
	2,3	1,3 ,5	4	Introduction to remote sensing. Objectives of remote sensing, working process of remote sensing , Types of remote sensing system.	2	2		Application of remote sensing. Remote sensing platforms .	1	2
		1,4 ,5	5	Developmental Assessment				Assessment Review and corrective action		3
	3		6	<i>Industry class-Drone Survey</i>	2		3			
5	1,2, 3	1,4 ,5	1	<i>Peer review on industry class</i>		4		INFRASTRUCTURE PLANNING • Role of physical planner in planning of utilities and services, • Objectives of utilities and services Case Exercise: List the various utilities and services required for a Town.	1	2
	1,2, 3	1,2 ,5	2	Provisions of Utilities & Services • Transportation Systems- Hierarchy of roads and its legal policies in planning	3		1	• Water supply systems- Location and space requirements for water distribution systems, Legal and government policy for urban and rural water supply, Familiarizing to CPHEEO manual and guidance-	1	2
	1,2, 3	1,4 ,5	3	• Sanitation and sewer systems Location criteria. • Innovative approaches in waste management	1		3	• Social Infrastructure-Education, health, safety, security and other public services.		3

							- Telecommunication services - Location criteria for mobile phone towers			
	1,2,3	1,4,5	4	Recreation- Play grounds, Parks, Religious centers, Club house, Theaters, Stadiums, Spa's, Swimming pools etc	1	3	Other Underground Services (Provision of gas and oil pipelines).			3
		1,4,5	5	CIE 2- Written and practice test			Assessment Review and corrective action			3
	1,2,3		6	<i>Industry class</i>	1	4	<i>Industry weekly assignment</i>			
Learning Outcomes: At the end of the week 6, students will be able to,										
6	1,2,3	1,2,5	1	<i>Peer review on industry class</i>		4	Case Exercise: Mini Project - Select a suitable site for a residential/commercial/Industrial layout. - Conduct Boundary Survey Continued- Conduct Boundary Survey	2		1
	1,2,3	1,4,5	2	Prepare layout plan of Infrastructure required as per the Town planning norm's.	2	2	Continued-			3
	1,2,3	1,4,5	3	Make provision for services and other utilities as per town planning norm's.	1	3	Continued-			3
	1,2,3	1,2,3	4	Prepare a master plan for the above using AutoCAD	1	3	Continued-			3

			5	Developmental Assessment				Assessment Review and corrective action			3
	1,2,3		6	Industry class	2		3	Industry weekly assignment			
7		1,4,5	1	Peer review on industry class		4		Concept of Smart City: https://mohua.gov.in/ https://smartcities.gov.in/ • What is smart city • Why is a Smart city. • How is a Smart city. https://smartnet.niua.org/sites/default/files/resources/making_a_city_smart_mar2021.pdf			3
	4	1,4,5	2	What is smart city Case Exercise: Study the Smart city concept by GOI and using https://smartcities.gov.in/ Why is a Smart city. Case Exercise: Concept of Area based development(three model), core element of smart city infrastructure, component of area based development.	3		1	Prepare & present benefits of smart city. Field visit			3
	4	1,4,5	3	How is a Smart city. Case Exercise:				Field visit			3

				Smart city selection process, Process of smart city proposal(SCP). Process of implementation & financing. Citizen collaboration. Challenges in smart city.	2		2				
	4	1,4,5	4	Assessment/Evaluation: Introduction about smart city technologies. Smart city component, Importance of smart city. Smart city thematic areas. Strategic roadmap assessment. Fostering sustainability with smart cities. Features of a smart city.			4	Concept of DPR. Download a DPR prepared and sample DPR report. considering other city.	2		1
			5	CIE 3 – Written and Practice Test				Assessment Review and corrective action			3
	4		6	Industry Class	2		3	Industry weekly assignment			
Week	C O	P O	D a y s	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P
8	4	1,4,5	1	Weekly Assignment review		4		Field visit and mini Project: - List out the recognized smart cities in Karnataka state. - Selection criteria for Smart Cities.	1		2
	4	1,4,5	2	Select a nearby Smart city. Identify the Smart works planned and implemented.	2	2		Case Exercise : Field site/Video demonstration			3

	4		3	Architecture Conceptualization Smart City Sensors Monitoring in smart city	2	2		Smart City Challenges. Presentation on steps involve to make a normal city into smart city	1		2
	4	1,4,5	4	Concept of IOT models used in smart city.(video demonstration)	2		2	Case excises : Present how smart city secured & Trusted			3
			5	Developmental Assessment				Assessment Review and corrective action			3
	4	1,4,5	6	Industry Class	2	1	2	Industry weekly assignment			
9	5	1,4,5	1	Weekly Assignment review		4		Green Building: Introduction, Need & Scope for green building and sustainable development. Reference YouTube video links: 1: https://www.youtube.com/watch?v=YkfpYeVQXxA 2: https://youtu.be/IJ9qvOKEQ9A <u>Case exercise:</u> 1. Conduct a local survey to identify an ecofriendly home in a nearby locality and prepare a report. 2. http://www.asiabusinesscouncil.org/docs/BEE/GBCS/GBCS_CII.pdf	1		2

							3. https://nzeb.in/case-studies/nzebs-in-india/nzebs-in-india-case-studies-list/ipb-case-study/ 3. Prepare a presentation on need for Green building? (Considering Global warming, energy crunch, resource crunch, global economy) <i>(Note: Conclusions and recommendations are must)</i>			
5	1,4,5	2	- Principles - Features - Tangible and intangible benefits towards sustainable development. <u>Case exercise:</u> 3. Conduct a comparative study on green building over other conventional building. <i>(Note: Prepare a presentation and present)</i> 4. Prepare a report on effects of population density on biodiversity. <i>(Note: Conclusions and recommendations are must)</i>	2		2	Sustainable site selection and Planning: - Criteria for site selection. - Storm water management. - Effects of the building on light pollution. - Heat island effect Location and transportation: - Sensitive land protection, - Neighborhood density, - Green transportation. Promotion of MRTS. <u>Case exercise:</u> 5. Select a site for construction of Green building and analyze the possibility of fulfilling the site selection criteria. 6. Prepare selected site key plan using Auto CAD. <i>(Note: Conclusions and recommendations are must)</i>	2		1

5	1,4,5	3	Shape of building: • Orientation of the building on the site relative to sun and wind, • Size and compactness of building (e.g., occupants per square foot/meter), • Door and window locations, • Concept of SBC. <u>Case exercise:</u> 7. Indicate the Orientation of building & water source location in key Plan using Auto CAD.	1	3	8. Measure and compare solar gain through windows that face various cardinal directions using Revit. 9. Determine the SBC of selected Site. <i>(Note: Conclusions and recommendations are must)</i> Energy and atmosphere: • Fundamentals of Energy, • Primary Energy use in Buildings, energy efficiency, Energy reduction, • Energy from Wind Turbines. 10. Measure kilowatt hours and determine energy-saving solutions & compare with solar panel energy production.	1	2
5	1,4,5	4	Carbon Foot Print: • The carbon footprint and its significance, • Carbon footprints that results from the building construction and operations. • Reducing carbon footprint. <u>Case exercise:</u> 11. Calculate carbon footprint of an individual person per day.	1	3	<u>Case exercise:</u> 12. Calculate Carbon Footprints of various construction materials and Prioritize ecofriendly materials.		3

				(Write your recommendations to reduce carbon footprint) (Write your recommendations on replacing solar panels as alternative)						
		1,4,5	5	CIE 4 – Written and Practice Test				Assessment Review and corrective action		3
	5		6	Industry Class		5		Industry weekly assignment		
10	5	1,4,5	1	Weekly Assignment review		4		Introduction to Autodesk Green Studio: Demonstration and practice of Energy analysis and arriving for an energy efficiency check. Prepare a 3D model of 1BHK Residential building using Revit/AutoCAD.	2	1
	5	1,4,5	2	Hands-on- Analyze energy efficiency of selected building using Autodesk Green Studio. Reference video links: https://www.linkedin.com/learning/green-building-studio-energy-analysis/welcome-to-green-building-studio?autoplay=true&trk=course_preview&upsellOrderOrigin=default_guest_learning	2		2	Continuation		3
	5	1,4,5	3	Water: - Water efficient plumbing systems, - Water metering, - Reclaimed water, - Water treatment,	1		3	Water: - Rainwater harvesting & recharging methods for roof & non-roof, - Water issues in the landscape. - Waste water treatment and disposal.	1	2

			Recycle and reuse systems. https://youtu.be/UcyprU5ZrHE <u>Case exercise:</u> 11. Identify naturally available sustainable water sources in and around the site. (Note: Conclusions and recommendations are must) 12. How do you make use of reclaimed water efficiently in your household? 13. Conduct a market survey on water-saving plumbing fixtures.			<u>Case exercise:</u> 14. Prepare a Presentation showing the methodology applied to implement grey recycled water for an individual home and community building. (Note: Conclusions and recommendations are must) 15. Estimate quantity of Rain water can be harvested for a selected building for available rainfall data.			
5	1,4,5	4	Materials and waste management: - Identification of Eco-friendly Building material. - Recyclable, Rapidly renewable, sustainable wood products. - Local materials, re-purposed materials; overall reduction in material. <u>Case exercise:</u> 15. Conduct a survey to identify materials that can be reclaimed and used. 16. Prepare a comparative estimate in excel showing the cost difference between any of the ecofriendly method of	1	3	Waste Management- Segregation of waste, 3R concept. - Bio methanation, - Plastic waste recycling technology, - Recycling technology for C&D waste. <u>Case exercise:</u> 18. Conduct market survey for cost analysis and compare it with CC block and table moulded bricks using excel. (Note: Conclusions and recommendations are must)	1		2

				flooring with Vitrified or Granite flooring and prepare a report on it.								
			5	Developmental Assessment				Assessment Review and corrective action				3
	5		6	Industry Class1.			5					
Week	C O	P O	D a y s	1 st session (9am to 1 pm)	L	T	P	2 ND session (1.30pm to 4.30pm)	L	T	P	
11	5	1.4 .5	1	Peer review on industry class		4		Indoor environment quality - Indoor air quality, - Moisture and temperature control, - Connect occupants to nature via daylight, views and biophilic design. <u>Case exercise:</u> 17. Visit nearby Pollution control board /Municipal office/ Corporation/ Gram panchayat & Collect data to Control environmental toxins such as mold and radon. 18. Prepare a report on Study of psychological impact of daylight. (Note: Conclusions and recommendations are must)	1			2
	5	1,3 ,5	2	Social justice: - Affordability, - Accessibility,				Life cycle assessment: Ecological impacts across the life of building materials from creation to use to end-of-life.				

			Positive or negative impacts to communities locally and globally due to green building design choices. <u>Case exercise:</u> 19. Prepare a BOQ with Rate analysis for Green building components (at least 5no's) and compare it with same Conventional building components.	2		2	Embodied energy in furniture and building materials. <u>Case exercise:</u> 20. Follow a building product from "cradle to grave" or "cradle to cradle". 21. Compare old and new building practice.	1		2
5	1,4,5	3	Economics: - Cost-saving features, - Long-term budgeting, - Trade-offs between cost and performance. <u>Case exercise:</u> 22. Calculate amount of energy savings by adopting use of reclaimed water, solar panels & wind turbines. 23. Compare costs of green building materials.	2		2	Operations and metrics: - Green cleaning, occupant education and training. - Building information modeling (BIM). - Performance monitoring. 24. Differentiate and compare environmental effects of various cleaning products on air and water quality. 25. Prepare a checklist to monitor Electronics Appliances in a green building.	2		1
5	1,4,5	4	Site Visit: 25. Conduct survey to identify the nearest existing building which complies at least any 5 green building concepts incorporated and make a detailed report showing comparative study with conventional method.			4	Site Visit: 26. Prepare a detailed AutoCAD drawing for a residential building showing Green building components and also prepare detailed BOQ incorporating Green Infrastructure.			3
		5	CIE 5- Written and practice test				Assessment Review and corrective action			3

	5		6	Industry Class			5	Industry weekly assignment			
12	5		1	Peer review on industry class		4		Green building certification: - Building assessment and eco labels – ISO-14001 & ISO- 14064. - GHG removal & Verification process of GHG. Case exercise: 27. List the standards of code of practice related to above ISO's	1		2
	5	1,3,5		Assessment structure and process- GRIHA- Implementation of PMAY Scheme. GRIHA Online Registration process.	3		1	Case exercise: 26. Collect schedule of Ratings for Green building from agencies like GRIHA and Compare the collected ratings for the nearest Green project. <i>(Note: Conclusions and recommendations are must)</i>			3
	5	1,4,5		Assessment structure and process- IGBC IGBC- Online Registration process, Levels of Certification,	2		2	Case exercise: 27. Prepare a mock presentation showing the Green measures adopted for IGBC Certification of a nearest public building. <i>(Note: Conclusions and recommendations are must)</i>			3
	5	1,4,5		Assessment structure and process- LEED-INDIA-	1		3	Case exercise: 28. Collect schedule of Ratings for Eco friendly home ratings from different agencies like LEED-INDIA and Compare the	1		2

			Requirements to get LEED-INDIA certificate for a school building.			collected ratings schedule and prepare a schedule for the nearest school building project. <i>(Note: Conclusions and recommendations are must)</i>			
		5	Developmental Assessment			Assessment Review and corrective action			3
	5	6	Industry Class		5	Industry weekly assignment			
13		1	Internship 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.	Project 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.					

Note: Saturday session from 9 AM -2 PM

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
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* 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**

Programme	Civil Engineering	Semester	V
Course	Town Planning & Green building	Max Marks	30
Course Code	20CE52I	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)	As a Town Planner what are the Techniques used for conducting surveys for land use & Contents of base maps.	L3	1	1,3,4	5
b)	As project Manager how you assign a Role of physical planner in planning of utilities and services	L4	1,3	1,2,5	5
2.a)	Town planning department switching to do Arial survey, what are the merits & demerits will face while using UAV(unmanned Arial vehicle) in the town.	L3	1,2,4	1,4,5	5
b)	As own builder how you will take Concept of Planning Permissions and Building Permission and apply Laws related with Zoning.	L4	3,4	1,3,4	5
Section-2 (Practical) - 20 marks					
3)	Town planning department given a permission to do layout ,assume your developer/Civil engg, write the Procedure and Calculate area of the given boundary using GPS instrument.	L3 & L4	1,3	4,5	20
4)	Prepare layout plan of Infrastructure required as per the Town planning norm's using any BIM software like CADD/Sketchup/3DXmax etc	L4	1,4,5	1,4,5	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme :	Civil Engineering	Max Marks :	100
Semester :	V	Duration :	3 Hrs
Course :	Town Planning & Green building		
Course Code :	20CE52I		

Instruction to the Candidate: Answer one full question from each section.				
Q.No	Question	CL	CO	Marks
Section-1				
1.a)	There is a new hostel building going to start by next week, how topographical survey will do to prepare the topographical map. Also explain method of relief ?	L4	1,2,3	10
b)	In an smart city how GPS equipment will help & its principle ,also major challenges occur while using GPS ?	L3		10
2.a)	Town planning department switching to do Arial survey, what are the merits & demerits will face while using UAV(unmanned Arial vehicle) in the town.	L3		10
b)	In urban planning department hire a 2 fresher engineers to do the Arial survey, as a executive engg explain drone survey procedures and its types for fresh engg?	L4		10
Section-2				
3.a)	If you are a town planning engg, which types of Arial survey will do like remote sensing or drone survey and justify?	L3	2,3	10
b)	Karnataka Government planning to lift the water from KRS to Bengaluru for drinking purpose , explain the legal & government policies for urban & rural water supply system as per CPHEEO manual.	L4		10
4.a)	Government of Karnataka planning to do Smart city in Mandya , as a Town planner what are the concepts should consider to do smarty City as per the GOI norm's	L3		10
b)	Explain the infrastructure required as per the Town Planning norm's for new layout of having 1200plots	L4		10
Section- 3				
5.a)	As a Project manager , what are the challenges will occur during the development of Smart City.	L3	3,4	10
b)	As a civil engg , explain the IOT model used in the smarty city.	L4		10
6.a)	If you are an Project manager how will you explain scope of green building & sustainability development for client.	L4		10
b)	From past 2year in a village suffered from water scarcity, as a civil engg how will manage storm water and reduce the water scarcity.	L3		10
Section-4				
7.a)	If you are civil engineer , how you will orient the building, doors and windows with respect to wind & sun & justify.	L4	3,4,5	10
b)	As a engineer how you will suggest concept of energy efficiency in the building	L3		10

8.a)	What are the precaution will take to reduce the carbon footprints from constructions & operation?	L3		10
b)	Explain the concept of ecofriendly building materials & how you will create awareness to the people.	L4		10
Section-5				
9.a)	How psychological impact of daylight will effects on human being & how to balance impact of daylight.	L4	4,5	10
b)	What are the features help to save the cost & performance of the building?	L3		10
10.a)	As civil engineer how you will explain concept of GRIHA and IGBC.	L4		10
b)	There is an new polytechnic constructed at Mandya, how you will do assessment and process to provide LEED India certificate.	L3		10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks: 100
Problem statement	Urban and Town planning department decided to do layout with all amenities, as a civil engineer prepare Master plan & highlights of your layout to attract the customer.	
1	Procedure for topographical survey	20
2	Identify the boundary & calculate the area using GPS instruments.	20
3	Prepare a master plan for the above using AutoCAD(Make provision for services and other utilities as per town planning norm's.)	30
4	Prepare a BOQ with Rate analysis for Green building components (at least 2no's) and compare it with same Conventional building components.	20
5	Viva	10
Total		100

Sl no	References
1	<i>History of Human Settlements, Sengupta, B.K., New Delhi, Institute of Town Planners, India 2002</i>
2	<i>Introduction to Settlement Geography, Sumita Ghosh, Orient BlackSwan, 1998</i>
3	<i>Fundamentals of Town Planning, G.K. Hiraskar, Dhanpat Rai Publications, 2012</i>
4	<i>Architecture and town planning- by, Sajjan V Wagh & pravin R Minde. Tech-Neo Publications.</i>
5	<i>Principles of Town planning and Architecture- by Hirannay Biswas.</i>
6	
4	<i>URDPFI Guidelines (Volume I and II), Ministry of Urban Development, Government of India, 2015</i>
5	<i>Cities, Urbanization & Urban Systems (Settlement Systems), K.Siddhartha and S.Mukherjee, Kitab Mahal, 2016</i>
6	<i>How to Conduct Survey, Arlene Fink, Sage, 2013</i>
7	<i>The Survey Methods Workbook, A. Buckingham and Peter Saunders, Rawat, 2014</i>
8	<i>Fundamentals of Statistics, S.C. Gupta, Himalaya Publishing House, 2013</i>
9	<i>Surveying Vol. I & II, B.C.Punmia, Standard Book House, New Delhi, 1983</i>
10	<i>Surveying (Volume I), S. K. Duggal, TMH</i>



Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Programme	Civil Engineering	Semester	V
Course Code	20CE53I	Type of Course	Specialization Pathway
Course Name	Transportation Engineering	Contact Hours	36 hours per week
L:T:P	104 : 52 : 312	Credits	24
CIE Marks	240	SEE Marks	160

Introduction: Welcome to the curriculum for Transportation Engineering Specialization. This specialization course is taught in Boot camp mode. Boot camps 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 to investigate, plan, analyze, design, execute, and maintain Transportation systems.

Leading to the successful completion of this boot camp, you shall be equipped to either do an internship at an organization working in Transportation Engineering related industry or do a project on Transportation Engineering.

After the completion of your Diploma, you shall be ready to take up roles like Junior Engineer, Transport Planning Data Surveyor, Designer, Entrepreneur, Consultant, Contractor, Road Safety Auditor or can work or have your own Consultancy Services for Material Testing, Planning, Construction and Management of Transportation facility.

This course will teach you Fundamentals of data collection, data analysis, forecasting, design, drafting, evaluation, estimating and costing, Construction, management and maintenance of different components of Transportation System. Details of the curriculum is presented in the sections below.

Transportation engineering is the application of technology and scientific principles to the planning, functional design, construction, operation, maintenance and management of facilities for any mode of transportation in order to provide safe, efficient, rapid, comfortable, convenient, economical, and environmentally compatible movement of people and goods with respect to time and space.

The facilities support Surface (Road and Railways), air and water transportation. The design aspects of transportation engineering include the sizing of transportation facilities how many lanes or how much capacity the facility has, determining the materials and thickness used in pavement, designing the geometry (vertical and horizontal alignment) of the roadway or track. Operations and management involve traffic engineering, so that vehicles move smoothly on the road or track, transportation Structures like Bridges, Tunnels, Retaining Walls, Flyover and Underpasses. Transportation engineering emphasizes on Road safety and assess environmental and health impacts.

Pre-requisites:

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.

Instruction to course coordinator:

1. Each Pathway is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. Single faculty shall be the Cohort Owner.
3. This course shall be delivered in boot camp mode.
4. The industry session shall be addressed (in contact mode/online / recorded video mode) by industry experts only.
5. The cohort owner shall identify experts from the relevant field and organize industry sessions as per schedule.
6. Cohort owner shall plan and accompany the cohort for industrial visits.
7. Cohort owners shall maintain and document the industrial assignments and weekly assessments, practices and mini projects.
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 the classroom can augment or use for supplementally teaching online courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM, etc.
10. Cohort owner shall guide the cohorts for the execution of mini project.

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

C01	Conduct Surveys to fix the alignment of the road and prepare Geometric design required for the alignment of road construction and study the traffic flow and behavior of vehicular movement at intersection, traffic engineering characteristics, regulations and control which helps to collect various traffic data and conduct accident analysis
C02	Investigate Soil and pavement materials , Prepare Alignment Drawings, Pavement design and select suitable equipment/ machinery and Suggest suitable pavement construction methodology for road construction and take required safety precautions during road construction
C03	Design suitable surface drainage system for road construction Estimate the road works to determine construction, operation and annual cost and suggest suitable soil stabilization technique and recommend suitable repairs technique with regular maintenance skills having a knowledge of highway financing
C04	Compare between different types of railway systems with Local Bus transport system and differentiate between different modes of transportation system(surface, water and air) and suggest suitable transportation structure for the transportation project
C05	Conduct road safety auditing and Assess environmental and health impact and Select the appropriate tools, production environment and deploy the model.

Detailed course plan

Week	CO	PO	Days	1 st session (9am to 1 pm)	L	T	P	2 nd session (1.30pm to 4.30pm)	L	T	P
1	1	1,2	1	Audio-Visual Presentation on Introduction to Specialization : Importance of transportation Engineering, Role of Transportation in national development- Economic, Social, Spatial, Cultural and Political Development Road Transportation – Surface Transportation 1. Formation of Jayakar Committee and its recommendations and Implementations 2. Importance of Indian Road Congress (IRC) Committees and Sub committees, Importance of IRC Codal Provisions 3. Characteristics of Road Transportation , Saturation system, its advantages and limitations Case Exercise (Tutorial) • Study and prepare report on Ongoing National Level highway Development Plan (NHDP) and Improvement of	3		1	Audio-Visual Presentation on 1. Highway alignment, Major ideal requirements of highway alignment 2. Factors affecting Highway alignment, Steps to be followed in new highway alignment 3. Engineering Surveys for New highway alignment, Drawings and Report 4. Phases of New Highway Project Case Exercise (Tutorial) • Study Different Class of roads- National Highway (NH), State Highway(SH), Major District Roads(MDR), Other District Roads(ODR) and Village roads(VR) • Study on detailed report preparation of New Highway Project (Real Time Project Report)	2	1	

				Riding Quality Programme(IRQP) Study and prepare report on Present Scenario of Road Development in India							
	1	1,2	2	Audio-Visual Presentation on - Realignment of highways, Objectives of Realignment, Steps to be followed in highway realignment - Study of Different Road Patterns- Rectangular , Radial or Star and Block , Radial or Star and Circular, Hexagonal Pattern - Importance of Curves in Road and Railway alignment, Curves- Elements of Curves, relation between Radius and Degree of a curve - Types of curves – Horizontal and vertical curves.	2		2	- Elements of Horizontal Curves- - Simple Curve - Compound Curve - Reverse Curve - Transition curves - Procedure for Setting out Simple curve by Rankine’s method using Total Station (Deflection Angle Method) - Procedure for Setting out Compound curve by Rankine’s method using Total Station (Deflection Angle Method) - Procedure for Setting out Reverse Curve between Two Parallel Lines using Total Station (Deflection Angle Method)			3
	1	3	3	Field Practice Set out simple curve by Rankine’s method using Total Station in field			4	Audio-Visual Presentation on Geometric Design – IRC 38 - Importance of highway geometrics Geometric Design Control and Criteria: Design Speed, Topography or terrain, Traffic factors, Design			3

			2. Set out Compound curve by Rankine's method using Total Station in field 3. Set out Reverse Curve between Two Parallel Lines by Deflection Angle Method using Total Station in field			hourly Volume and Capacity, Environmental and other factors 3. Highway Cross Section Characteristics : Pavement Surface Characteristics, Friction, Pavement unevenness, Light Reflecting Characteristics			
1	4	4	Audio-Visual Presentation on 1. Cross Sectional elements – Cross slope or Camber, Width of carriage way, Medians, Kerb 2. Road Margins : Shoulders, guard rail, Foot path, drive way, cycle track, parking lane, bus bay, frontage roads and embankment slopes, cut slopes 3. Right of Way or Width of Formation: Factors affecting Right of way Case Exercise: Refer the following 1. IRC recommendations of Right of Way Width for different types of roads 2. IRC 38 - Guidelines for Design of Horizontal Curves for Highways and Design Tables	1	3	1. Drawing and detailing of typical Cross section of roads • Cross Section in Embankment • Cross Section in Cutting • Cross section of VR or ODR in embankment in rural area • Cross section of MDR in cutting in Rural area • Cross section of two lanes in city in Urban area Audio-Visual Presentation on 1. Types of Sight Distance: • Stopping Sight Distance(SSD) • Over Taking distance(OSD), • Sight Distance at Intersections • Intermediate Sight Distance(ISD) • Head Light sight distance(HSD) for night driving			3
1		5	Developmental Assessment			Assessment Review and corrective action			3
1	7	6	Industry Session:	1	4	<i>Industry assignment</i>			

				1.Importance and Applications of transportation engineering studies in Industry 3. Establish link between Transport Planning, Traffic studies, Designs , Material Testing for Quality Control, Construction and Maintenance of Transportation system 4. Phases of Highway Project and its Report Preparation							
2	1	3,7	1	1. Peer review on industry class. 2. Review of Case exercises 3. Refer Law resources IRC codal Provisions : https://law.resource.org/pub/in/bis/irc		4	Audio-Visual Presentation on 1.Factors affecting SSD and OSD, Standard values of SSD and OSD for different design speed as per IRC ,Expressions for calculating SSD , ISD, HSD, OSD, Overtaking zones 2. Elements of Horizontal Alignment – Objectives and Expressions for the following • Design speed • Type of Curve provided • Super elevation • Extra width at curve • Setback distances and Curve resistance			3	
	1	3	2	1. Numerical problems on the following • Cross sectional elements • Types of sight distances • Design of elements of horizontal alignment	1		3	Types of Vertical curves: Summit Curves or crest curves, Valley curves or Sag curves 1. Length of Summit curves and Valley curves, and its expressions 2. Design criteria for summit curve and Valley curves	1		2

				2. Audio-Visual Presentation on Vertical alignment- 1. Types of gradient : Ruling gradient, Limiting gradient, Exceptional gradient and minimum gradient 2. Grade Compensation at curves			3. Numerical Problems on design of elements of Vertical alignment Reference : IRC SP 23			
1	3	3	Audio – Visual Presentation on Traffic Engineering • Introduction to Scope of Traffic Engineering • Road User characteristics • Vehicular characteristics • Fundamental Parameters and Relations of Traffic Flow (Q), Density (K) and Speed (V), Travel Time. • Spot speed, Time Mean Speed, Space mean speed, Time headway and Distance headway • Simple numerical problems	1		3	Audio – Visual Presentation on Traffic Engineering Studies 1. Traffic Volume Characteristics • Traffic Flow- PCU, PHF, PCU values recommended by IRC • Traffic Volume studies and Pedestrian Volume studies • Manual and Automatic traffic volume counting methods • Measurement and analysis of Traffic Volume data- AADT, ADT, AAWT, AWT • Simple Numerical Problems on Peak hour Volume and Peak hour factor using PCU values 2. Spot Speed studies • Uses and factors affecting spot speed studies • Measurement of spot speed study- a) Stopwatch method b) Radar meter method	1		2

								c) Pneumatic road tube method • Frequency Distribution diagram of Spot speed from data • Simple Numerical Problems			
1	3	4	Audio – Visual Presentation on 3.Speed and Delay studies • Objects and uses of speed and delay studies • Methods of conducting Speed and delay studies a) Floating car / moving observer method. b) License plate method c) Interview technique d) Elevated Observations e) Photographic technique • Simple numerical problems on Determination of Flow, Density and Speed using Moving observer method 4.Origin and Destination Studies • Objects, types and applications of Origin and Destination studies • Methods of conducting Origin and Destination studies- data collection a) Home Interview method b) Road side Interview method c) License plate method	1	3	Audio – Visual Presentation on 5.Parking studies • Need and effect of parking • Investigations for parking studies • Parking characteristics • Parking demand • Method to determine parking demand 6.Accident Studies • Importance of accident studies • Causes of accidents • Collection of accident data, report and records • Accident Investigations • Accidental analysis • Measures of reduction of accident rate a) Engineering b) Enforcement c) Education • Simple problems on accidental analysis Case exercise(Tutorial)	1		2		

				d) Return post card method e) Tag on vehicle method • Sampling in O-D studies			1.Study real time Accidental investigation and analysis report to understand the methods and steps followed and measures suggested to reduce the accident			
	1		5	Developmental Assessment			Assessment Review and corrective action			3
	1	7	6	<i>Industry session-</i> Introduction to highway geometric design softwares and its application • MX ROAD • CIVIL 3D	1	4	<i>Weekly industry assignment.</i>			
3	1	1	1	1. Peer review on industry class. 2. Review of Case exercises		4	Audio Visual presentation on Capacity and Level of Service - Factors affecting level of service - Design Capacity and design service volumes for different capacity roads Inventory of Transport Facilities - Inventory of Streets - Traffic Volume - Travel Time Studies - Inventory of Public Transport Buses - Inventory of Rail Transport Facilities - Parking Inventory - Accident Data	1		2

							Land Use and Economic Activities			
							Case exercise(Tutorial) 1. Prepare a presentation on Traffic Regulations and Control measures 2. Economic loss caused by Inferior traffic facilities			
1	4	2	Project 1 : Traffic Engineering							21
		3	Field survey : Conduct the following surveys and collect data in a given area on selected stretch of major road to determine the Level of Service of that road as per IRC standards							
		4								
			1.Traffic Volume and composition study by Manual counting method 2.Spot speed study by manual method 3.Origin and Destination survey of an area by Home Interview survey and Road side Interview survey 4. Parking Vehicle Compositions							
			Graded Exercise and Report 1.Classified traffic Volume count by converting count into PCU values using tables 2.Representation of traffic composition using tables and charts (Pie charts/ Bar charts) 3. Representation of spot speed of vehicles in frequency distribution diagram using tables and charts (Line chart) 4.Representation of Parking vehicle composition using tables and charts (Pie chart / Bard chart) 5.Home interview and road side interview data on O-D study using standard formats and tables 6.Collection of accidental data of that selected major road of a given area from relevant sources and prepare Vehicle interference diagram related to accident analysis 7.Determination Level of Service of the given road as per IRC standards based on data 8.Representation of Projected yearly traffic growth using bar chart							
		5	CIE 1- Written and practice test				Assessment Review and corrective action			3
1	4	6	<i>Industry class- -</i>	1		4	<i>Weekly industry assignment.</i>			

				1 Introduction to Traffic study and simulation softwares and its application • DATA FROM SKY • VISSIM						
4	2	4	1	1. Peer review on industry class 2. Presentation by students on Traffic Regulations and Control measures		4	Types of Pavements- Audio Visual Presentation 1. Need for highway pavement 2. Structure of flexible pavement and Rigid Pavement 3. Functions of flexible and rigid pavements 4. Basic Difference between rigid and flexible pavement 5. Advantages of flexible and Rigid pavements 6. Limitations of flexible and Rigid pavements	2		1
	2	4	2	Audio-Visual Presentation on FLEXIBLE PAVEMENT 1. Flexible Pavement layers – Subgrade, Sub base, Base course, Surface course, Wearing course and its functions 2. Soil as Subgrade layer - Application of Soil Mechanics in Road Construction	2	2	1. Laboratory procedure to determine following Index properties : • Water content • Specific gravity • Particle Size distribution • Consistency limits • Insitu Density 2. Soil Classification Systems: IS classification system and AASHTO classification 3. Numericals on determining index properties	1		2

			3. Three Phase system of Soil, Water Content, Density, Unit weights, Specific Gravity, Void Ratio, Porosity and Degree of Saturation, its functional relationships 4. Introduction to Index properties and engineering properties of soil.			4.Numerical on Soil Classification by IS system and HRB systems			
2	4	3	LAB EXPERIMENTS 1. Conduction of experiment to determine water content in the given sample of soil by oven drying method and Pycnometer method 2. Conduction of experiment to determine Specific Gravity in the given sample of soil 3. Conduction of experiment to determine Particle Size Distribution in the given sample of soil by Dry Sieve analysis		4	LAB EXPERIMENTS 1. Conduction of experiment to determine liquid limit by Casagrande's apparatus 2. Conduction of experiment to determine Plastic limit by method of rolling 3. Conduction of field experiment on determination of In-situ Density of soil by Core Cutter method / sand replacement method Case Exercise : Importance of soil testing for Index properties in determining type and behavior of soil for road construction			3
2	4	4	Audio Visual Presentation 1. Importance and factors affecting the Engineering properties of soil : Shear	1	3	LAB EXPERIMENTS 1.Conduction of Dynamic Compaction test for the given sample of soil by Modified Proctor test method			3

				strength , Compaction and Permeability of soil 2. Procedure for determining the Optimum moisture content and Maximum Dry density of Soil by Modified Proctor Compaction test 3.Procedure for determining Strength of soil by California Bearing Ratio test (CBR)			2. Conduction of CBR test for the given sample of soil 3.Laboratory Experiments on Soil - Review of results and corrective action Case Exercise : Importance of soil testing for Engineering properties in determining type and behavior of soil for road construction			
	2		5	Developmental Assessment			Assessment Review and corrective action			3
	2	4	6	<i>Industry class – Consultancy Services</i> <i>1.Soil Testing</i> <i>2. Swelling Index Test of Soil – Importance and test procedure</i>	1	4	<i>Weekly industry assignment.</i>			
5	2	2,3	1	1. Peer review on industry class 2. Review of Case exercises 3. Review of Project 1			Introduction to Pavement Materials: Aggregates 1. Origin, Classification and Properties of aggregates to be considered for road construction 2. Laboratory Test procedure on aggregate to be considered for road construction as per IS codes and MORTH specifications • Impact test • Abrasion test • Polished stone Value test(Only for Demonstration) • Crushing test	1		2

							• Flakiness and Elongation Index test and angularity Number • Specific gravity and Water Absorption test				
	2	4,5	2	LAB EXPERIMENTS 1. Conduction of Experiment for determining the toughness / resistance to Impact of aggregates by Aggregate Impact Test 2. Conduction of Experiment for determining the Hardness / Resistance to Abrasion of aggregates by Los Angeles Abrasion test 3. Conduction of Experiment for determining the resistance to crushing of aggregates by Aggregate Crushing Test			4	LAB EXPERIMENTS 1. Conduction of Experiment for determine the Specific Gravity and Water absorption of aggregates 2. Conduction of Experiment for determining the shape of aggregates by Flakiness and Elongation test 3. Conduction of Experiment for determining the shape of aggregates by Angularity Number Case Exercise : Study MORTH Specifications on the results of each tests for inference of its application in road construction			3
	2	4,5	3	Introduction to Pavement Materials- Binder Audio – Visual Presentation 1. Origin of Asphalt , Bitumen and Tar and its types 2. Chemical Composition of Bitumen and Tar, Differences between Bitumen and Tar and its grades	2		2	1. Functions of binder as Pavement Material and desirable properties 2. Laboratory Test procedure on bitumen to be considered for road construction as per IS codes and MORTH specifications • Penetration test • Ductility test • Softening point test • Specific gravity test	1		2

				3. Introduction and Applications of following bitumen used in road Construction • Cut back Bitumen • Bitumen Emulsion • Modified Bitumen			• Viscosity test • Flash and Fire point test • Float test • Water content test • Loss on heating test • Stripping Value test (Adhesion between Bitumen- aggregate)			
	2	3,4,5	4	LAB EXPERIMENTS 1. Conduction of Experiment for determining the consistency of bituminous material by Penetration test 2. Conduction of Experiment for determining the Ductility or malleability of bituminous material by Ductility test 3. Conduction of Experiment for determining the Temperature at which bituminous material softens by Softening point test 4. Conduction of Experiment for determining the Specific Gravity of bituminous material softens by Pycnometer Method		4	LAB EXPERIMENTS 1. Conduction of Experiment to determine the rate of flow of bituminous material by viscosity test using Orifice Viscometer 2. Conduction of Experiment for determining the Temperature at which bituminous material catches flash and fire (Safety)by Flash and Fire Point Test 3. Conduction of Experiment for determining the adhesion of bituminous material on the surface of aggregate by Stripping value test of aggregates Case exercise : IRC and MORTH Specifications on the results of each tests for inference of its application in road construction			3
			5	CIE 2- Written and practice test			Assessment Review and corrective action Laboratory tests on pavement material-Soil,			3

							Aggregate and Bitumen - Review of results and corrective action			
	2	4,5	6	<i>Industry class-</i> <i>1. Consultancy Services – Pavement Material Testing</i> <i>2. Partial Replacement of pavement materials with recycled materials / sustainable materials in pavement construction</i>	1	4	<i>Industry weekly assignment</i>			
6	2	1,3	1	<i>1. Peer review on industry class</i> <i>2. Review of Case exercises</i>		4	Bituminous Paving mix : 1. Gradation and proportioning of aggregates by Rothfutch method 2. Step wise Procedure for preparation of Bituminous trial mix 3. Procedure to determine the Stability, Flow Value and Optimum Binder Content of Bitumen trial mix by Marshal Stability test 4. Demonstration of the experiment to check the Marshal Stability for the Bituminous mix prepared from Mix design	1		2
	2	2,3	2	Audio-Visual Presentation on RIGID PAVEMENT 1. Components of Cement Concrete Pavements and their functions 2. Rigid Pavement Layers- Subgrade, Granular sub base/ Drainage layer, Dry Lean Concrete sub base, Pavement Quality Concrete Slab and its functions	2	2	1. Prepare Dry Lean Concrete (DLC) and Pavement Quality Concrete (PQC) mix design for Pavement as per IS standards 2. Conduct experiment to determine the Compressive and Flexural strength of concrete mix prepared from the mix design as per IRC 44 2017			3

				3.Material Specifications for the construction of Cement Concrete Pavements- Cement, Coarse aggregates, Fine aggregates, Water and admixtures 4. Requirements of Paving Concrete 5. Different Types of Joints and their functions in Cement Concrete pavements							
	2	2,3	3	Design of Flexible Pavement: (IRC 37 2018) 1.Functional and Structural requirements of road pavements 2. Factors governing the design of flexible pavement • Wheel loads of heavy vehicles or traffic loads and contact pressure- ESWL • Sub grade soil • Climatic factors • Pavement Component material • Environmental Factors • Special factors in the design of different types of pavements 3. Design approach and criteria • Estimation of design traffic • Design life • Vehicle Damage Factor (VDF) • Distribution of Commercial Vehicle Traffic	1		3	1. Stresses and deflection in flexible pavements and its expressions 2. Numerical problems on determination of design factors ESWL and VDF 3. Numerical problems on IRC method of Design of Flexible Pavement			3

				• Growth rate						
2	2,3	4	Design of Rigid Pavement: IRC 58 2015 1.Factors governing the design of rigid pavement and its Standard values and expressions as per • Wheel load • Temperature differential • Types of Joints and their spacing • Characteristics of Subgrade and Sub base • Drainage layer 2. Characteristic strength and Fatigue behavior of Concrete 3.Stresses in Rigid Pavements and its analysis	1		3	1. Numerical problems on determination of design factors like design loads 2. Numerical problems on IRC method of Design of Rigid Pavement			3
		5	Developmental Assessment				Assessment Review and corrective action			3
2	2,5	6	<i>Industry Class- Special types of pavements</i> <i>Example :</i> • <i>Semi Rigid pavements</i> • <i>Composite Pavements</i> • <i>Interlocking Cement Block Pavements</i> • <i>Continuously reinforced concrete pavements</i>	1		4	<i>Industry weekly assignment</i>			

				Steel fiber reinforced concrete pavements							
7	2	2,5	1	Peer review on industry class		4	Flexible Pavement Construction: Audio – Visual Presentation as per MORTH Specifications 1.Introduction , Components of Highway in embankment and cutting 2.Embankment and Subgrade: Functions and Design elements of highway Embankment and Subgrade 3. Construction methodology of highway embankment and Subgrade- Material Specifications, Construction Methodology and Quality Control checks 4. Compaction of soil for the construction of Embankment and Subgrade Case Exercise (Tutorial) : Equipments ,Machineries and Rollers used for Compacting soils and Excavation of earth for road construction			3	
	2	7	2	Construction of Flexible Pavement: Audio – Visual Presentation 1. Material Specifications, Construction Methodology and Quality Control checks for the following Components of flexible pavement	1		3	Construction of Flexible Pavement: Audio – Visual Presentation 1. Material Specifications, Construction Methodology and Quality Control checks for the following Components of flexible pavements Prime Coat and Tack coat	1		2

			- Granular sub base drainage layer - Granular Base course - Wet Mix Macadam(WMM) - Water Bound Macadam(WBM)			- Bitumen Base Course- - Bituminous Macadam (BM) - Bituminous Penetration Macadam(BPM) - Built-up Spray Grout(BUSG)		
2	7	3	Construction of Rigid Pavement: Audio – Visual Presentation 1. Material Specifications, Construction Methodology and Quality Control checks for the following Components of flexible pavements - Bitumen Surface Course - Dense Graded Bituminous Mixes - Bitumen Mastic Wearing course - Stone Mastic Asphalt (SMA) Case Exercise : Bitumen Paver Machines and Equipments used in road construction	1	3	Audio – Visual Presentation on Construction of Rigid Pavement 1. Material Specifications, Construction Methodology and Quality Control checks for the following Components of flexible pavements - Subgrade and Drainage layer - Dry Lean Concrete sub base Layer - Separation membrane - Pavement Quality Concrete pavement slab - Construction of joints in rigid pavements Case Exercise : Machines and Equipments used in rigid pavement construction	1	2
3	7	4	Audio – Visual Presentation Introduction to Road Drainage works- IRC -SP- 42 - Objectives of road drainage - Requirement of highway drainage - Types of drainage system - Surface drainage system	1	3	- Standard values and expressions as per IRC - Numerical Problems on Design of Surface drainage for roads Low Volume Roads - General features of low volume roads - Construction of Earthen roads - Construction of Gravel roads	1	2

				b) Sub surface drainage systems c) Cross drainage system 4. Design procedure of surface drainage			• Construction of Surface roads • Construction of Low Volume CC roads			
			5	CIE 3- Written and practice test			Assessment Review and corrective action			3
	3	7	6	<i>Industry Class</i> 1.Subgrade Soil Stabilization techniques and its importance 2. Pavement Repairs 3.Pavement Maintenance 4.Highway Finance	1	4	<i>Industry weekly assignment</i>			
8	3	1,2	1	1. Peer review on industry class- 2.Review of Case Exercises 3.Progress review of Project 1		4	ESTIMATION OF ROAD WORKS Detailed Estimates and Abstract of Cost of Road work. 1. Compute earth work quantities from given cross sectional details. 2. Preparation of Detailed Estimates and Abstract of Cost of Bituminous & concrete Roads 3. Numerical Problems on Estimation of Operational Cost of highway project 4. Numerical Problems on Estimation of Annual cost of Highway project			3
	2	1,2	2	Project 2 : Pavement Construction Site visit						

	2	7	3	- Observe and Study about Constructional aspects and methodology for sub grade, sub base, base, bituminous coarse / concrete pavements - Observe and Study different types of Equipments, Machineries and Rollers used - Observe and Study the Safety precautions taken during Pavement Construction - Collect the data about Project details like Type of Soil and its investigations, Pavement materials used and tests conducted , Preparation of pavement layers, setting / curing period and special techniques and latest technologies if any - Preparation of Report on Site visit						14	
	3	7	4	Assignment 1: Conduct a site visit to make the students to observe the highway maintenance works and prepare a report - To check the riding quality of all types of pavement surfaces represented in terms of unevenness index using response type road roughness measuring equipment like Bump Integrator or any other approved equipment - To conduct structural evaluation of flexible pavements by Benkelman Beam Deflection method						7	
			5	Developmental assessment				Assessment Review and corrective action		3	
	2	7	6	<i>Industry Class-</i> Introduction to PAVEMENT DESIGN and EVALUATION Softwares and its application 1.PAVEMENT DESIGN- - KENPAVE - IITPAVE 2.PAVEMENT DESIGN AND EVALUATION - KJPBACK		1		4	<i>Industry weekly assignment</i>		
9	1,2,3	7	1	1. <i>Peer review on industry class</i> 2.Progress review of Project 2 and assignment 1				4	Project 3 : Proposal of New Highway Alignment Project – Survey, Drawings and Report		

								Field Survey - • Reconnaissance survey of the area • Preliminary survey - Data collection- Primary traverse, Topographical feature study, Levelling work, Drainage studies, hydrological data, soil and material survey			
1,2,3	7	2	Project 3 1. Traffic Survey- Data Collection – Conduct House Hold Interview Survey in nearby area to determine traffic volume on the proposed road 2.Field Survey - Terrain to be chosen for survey such that it should include vertical & Horizontal curve – Conduct Survey using Modern Equipments like Total Station Align a new road between two obligatory points. • Conduct Longitudinal and cross-sectioning surveys • Projecting a road of given gradient. • Blockleveling at the lowest level or valley curve • Connecting to new road alignment, surveying existing road 90m and exploring possibility of widening. 3.Graded Exercise : Preparation of AUTOCAD Drawings / CIVIL 3D software • Key Plan and Index plan • Plan showing alignment with Horizontal Curves of road and Section of Vertical curves • L.S & C.S of Road at different chainages as per IRC standards (Report should justify the selected alignment with details of all geometric designs for horizontal curve and Vertical curves for the traffic volume and design speed to the proposed alignment) • Typical Cross Section of Road as per Pavement Design • Block leveling @ the lowest level or valley curve placing Culvert – Cross Drainage works ○ Half plan at top & half plan at foundation. ○ Half sectional elevation, half front elevation.						21		
1,2,3	7	3									
1,2,3	7	4									

			○ Half Cross section @centre ○ half Cross section @ abutment 3.Quantity surveying • Earthwork Calculation from the cross-section area at different chainages using Spreadsheet. • Estimation of Cost of Construction and Maintenance of Proposed Project using Spreadsheet. 4.Project Planning • Prepare Project Schedule for New Highway Alignment using M S Project / Primavera 5.Experiments • Field sample of soil to be collected and laboratory and insitu experiments to be conducted to determine the Index and engineering properties of soil- Subgrade and results to be reported • Based on Pavement design for type of pavement proposed – Pavement materials to be laboratory tested and results to be reported 6. REPORT • AUTOCAD Drawings • Geometric Design for horizontal curve and Vertical curves proposed • Pavement design for type of pavement proposed • Details of Cross Drainage work proposed • Soil Investigation Report • Pavement Material Testing Report • Quantity Surveying Report – Earthwork Calculation, Estimation of Cost of Construction and Maintenance of Proposed Project • Project Planning report							
		5	CIE 4– Written and practice test				Assessment Review and corrective action			3
1,2 ,3	7	6	Industry Class- 1. Highway Lightings	1		4	Industry weekly assignment			

				2.Sustainable Pavements 3. Economic way of Constructing pavements and its layers and its purpose Ex: Cement Treated Sub Base(CTSB)						
10	4	1,2	1	1.Peer review on industry class 2.Progress review of Project 2, 3 and Assignment 1		4	Audio Visual Presentation on Introduction to Railway Engineering (Surface Transportation) 1. Role and Features of Indian Railways 2. Advantages of Railways- Political, Social and Economical 3. Various components and requirements of a good track 4. Factors to be considered while selecting a good alignment 5. Forces acting on the track 6. Concept of coning of wheels and tilting of rails, Gradient and its types	1		2
	4	1,2	2	Audio Visual Presentation on Functions, Types and requirements of Track Components • Track • Rails • Sleepers • Ballast	2	2	Audio Visual Presentation on Importance and Features of • Subgrade and Embankment • Gauges • Track Alignment ,fittings and Fastening • Rail Joints and Welding of Rails • Railway Stations and Yards	1		2
	4	1,2	3	Audio Visual Presentation on Importance and Features of • Points and Crossing • Turnouts • Track Junctions	2	2	Audio Visual Presentation on Importance and Features of • Track Drainage • Track Maintenance • Safety in Railways	1		2

			• Signaling and Control system			• Modernization of railway track and future trends- High and super high speed railway system Case exercise (Tutorial) Study on Types of Rail Transportation and prepare presentation • Sub urban Rails • Rapid Rail Transit • Light Rail Transit • Monorail			
4	1,2	4	Audio Visual Presentation on Harbour - Water Transportation 1. Introduction to Harbour, Purpose of providing Harbour 2. Terminology - Dock, Port, Sea works for transportation Breakwater, Jetties, Quays, Dredging, Light house, Buoys and Beacons. 3. Types of Harbor- Natural Harbor, Artificial Harbor, Ice-Free Harbors	1	3	Audio Visual Presentation on Airport- Air Transportation 1. Terminology- Aerodrome, Apron, Hanger, Runway, Taxiway, Terminal area, Wind rose 2. Factors affecting selection of site for airport 3. Advantages and Disadvantages of Airport 4. Importance of Airport Lighting	1		2
		5	Developmental Assessment			Assessment Review and corrective action			3
4	1,2	6	<i>Industry Class-</i> Audio Visual Presentation on Construction stages/ phases of following	1	4	<i>Industry weekly assignment</i>			

				1.Railways system and Underground Railways in tunnels 2.Harbour system 3. Airport system							
11	4	1, 2	1	1.Peer review on industry class 2.Presentation on types of railway transportation 2.Progress review of Project 3		4		Audio – Visual Presentation on Introduction to Transportation Structures 1. Bridges – Rail Bridge, Road Bridge and Pedestrian bridge 2. Tunnels and Culverts 3. Grade Separators - Flyovers (Overpass and Underpass) and Interchange 4. Retaining Walls in highways			3
	4	1, 2	2	Audio Visual Presentation on Introduction to Bridges 1. Component parts of a bridge 2. Terminologies - Water way, afflux, economic span of a bridge, scouring, free board, approach 3. Selection of site for bridges 4. Bridge Sub structure and Super structure	1		3	Audio Visual Presentation on 1. Types of Bridges based on Material - Temporary bridges – Timber bridges - Permanent bridges - Masonry, Steel or R.C.C / Pre stressed bridges 2. Types of Bridges based on Structure - Arch bridges and Tied Arch bridges - Beam Bridges - Truss Bridges - Cantilever Bridges	1		2

							• Cable stayed bridges • Suspension bridges			
4	2, 6	3	Audio Visual Presentation on Tunnels: 1. Terminology 2. Advantages of tunnels 3. Size and shapes of tunnels- horse shoe, egg shape, segmental roof section 4. Transferring alignment inside the tunnel, mucking, concept of shafts 5. Objects of tunnel lining and Ventilation 6. Drainage in tunnels	2		2	Assignment 2 : To be conducted In class in the form of Discussion and presentation 1. Compare the Local Bus transport system with the Metro Rails and Sub urban Railway systems (Completed)available in different cities of India 2. Compare the following parameters with respect to Roadways, Railways and Airport system : • Population of the cities • Project Completion Cost • Annual returns (Income) • Ridership per annum Report which transportation system is most economical in different cities of India 3. Compare between road pavement and runway pavement of airports Assignment 3 : To be conducted in class in the form of Discussion and presentation Report the following 1. Cities/ Places in India where Harbours and Airports are situated			3

							2. Study salient features in the airports situated in different cities of India. 3. Project Completion Cost of those Harbours and Airports situated in different cities of India 4. Types of Airports and Harbours situated in India			
4	6	4	Case study : Students shall be selecting different topics of interest on latest technology in transportation engineering, Conduct a case prepare a report and present Example: 1.https://bengaluru.citizenmatters.in/no-potholes-in-electronics-city-roads-80916 2.https://auto.hindustantimes.com/auto/news/indias-first-ever-steel-road-opens-for-traffic-showcases-sustainable-model-41648449391277.html 3.https://www.icevirtuallibrary.com/doi/10.1680/jcien.19.00046 4. https://www.iosrjournals.org/iosr-jmce/papers/AETM'15_CE/2/18-CE-128.pdf 5. https://pdfcoffee.com/whitetopping-pdf-free.html			4	CASE STUDY 1 : Conduct a case study on the construction procedure of the following and prepare a report 1. Grade separators • Underpass • Flyover – Overpass • Interchange 2. Retaining wall in highway construction			3

			5	CIE 5- Written and practice test				Assessment Review and corrective action			3
	4	7	6	<i>Industry Class on</i> Audio Visual Presentation on Construction stages/ phases of following 1.Bridges and Tunnels system 2.Grade Separators, Interchanges and Retaining wall in highways	1		4	<i>Industry weekly assignment</i>			
12	5	2	1	1.Peer review on industry class 2.Review of Assignment 2 and 3 and Case study 1		4		Audio Visual Presentation on Introduction to Multi Modal Transportation system - Public Transport- Bus Rapid Transit System (BRT) and Light Rail Transit system (LRT) - Services and Freight - Intermediate Para Transit - Multi Occupancy Cars (Car Pool) - Marine transit system (Maritime) - Air transportation	1		2
	5	5	2	Audio- Visual Presentation on Road Safety - Pedestrian Safety and Security - Risk factors for Pedestrian Traffic Injury - Road Crashes/ Accidents - Factors influencing crashes	1		3	Road Safety Auditing - IRC SP 88 - Different Types of auditing - Introduction to road safety auditing - Need of road safety auditing - Objectives of road safety auditing - Benefits of road safety auditing - Code of good practice and checklists	1		2

			5. Safety Precautions to be considered for Road safety							
3,4	5		Audio- Visual Presentation on Stages of Road safety auditing 1. Auditing of Roads before opening to traffic • Feasibility stage • Preliminary design stage • Detailed design Stage • Pre –opening stage 2. Auditing of Existing roads • Accidental data collection • Inspection at Road Construction at accident black spot • Inspection of Designs • Assessment and Reviews	2		2	Audio- Visual Presentation on 1. Step wise procedure followed in the Road safety auditing 2. General and Formal requirements of Road safety auditing 3. Importance of Monitoring and Evaluation of road safety by auditing			3
5	5, 6		Audio- Visual Presentation on 1.Environmental Impact Assessment of Transportation projects • Screening and Scoping • Establishing Baseline • Impact Assessment • Mitigating Impacts • Monitoring and Evaluation 2.Health Impact Assessment of Transportation projects • Current exposure to emissions (air and noise pollution)	2		2	CASE STUDY 2 :: Students shall be selecting different topics of interest on following topics , Conduct a case study, prepare a report and present • Road safety auditing Example : https://www.researchgate.net/publication/325116717_Road_safety_audit_a_case_study_on_NH-65			3

			- Traffic Injury and Fatalities - Current level of Physical activities			- Environmental and Health Impact assessments of transportation systems Example : https://www.researchgate.net/publication/335365145_Impact_Assessment_of_Road_Construction_on_Rural_Accessibility_A_Case_Study_in_India - Sustainability – Reclaimed Asphalt Pavement - Usage of alternative materials in road construction Example: 1.https://www.researchgate.net/publication/346892421_Case_Studies_of_Sustainable_Road_Transport_Practices_in_Different_Industry_Sectors_in_India 2.https://www.fhwa.dot.gov/pavement/sustainability/case_studies/			
		5	Developmental assessment			1. Assessment Review and corrective action			3
						2. Review of Case study 1 and 2			
5	7	6	<i>Industry Class –</i> <i>1.Intelligent Transportation System</i> <i>2. Sustainable Transportation system</i> <i>3. Application of Drone, GIS and Radar Survey in Transportation Engineering</i>	1		4	<i>Industry weekly assignment</i>		

13		6		Internship 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.			Project 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.			
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Note: Saturday session from 9 AM -2 PM

1. Students shall be encouraged by conducting more number of field visits / site visits at the construction stage as and when course content demands to gain more exposure
Ex: Airport, Harbour, Road, Railway, Tunnel, Bridge, Metro, Flyover, Underpass, Retaining wall
2. Industry classes for content mentioned shall be conducted from Industry experts in that area of interest
3. Students shall be encouraged to give presentation on Important IRC codal provisions and MORTH Specifications every week whose knowledge is important in Construction field

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
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* 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

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

Programme		Civil Engineering	Semester		V																																																					
Course		Transportation Engineering	Max Marks		30																																																					
Course Code		20CE53I	Duration		4 hours																																																					
Name of the course coordinator																																																										
Note: Answer one full question from each section.																																																										
Qn.No	Question		CL	CO	PO	Marks																																																				
Section-1 (Theory) – 10 marks																																																										
1.a)	The speeds of overtaking and overtaken vehicles are 70 kmph and 40 kmph, respectively on a two-way traffic road. If the acceleration of the overtaking vehicle is 0.99 m/sec ² , a) Calculate safe overtaking sight distance (3) b) Compute the sight distance that can be provided at zones where OSD is not providable (1) c) Show the positions of the sign posts on a neatly drawn sketch of overtaking zone (2) .		4	1	1,2,3	5																																																				
b)	The following table is the volume count data collected by an enumerator in an urban mid-block section. Find the Peak hour Volume (3) and Peak hour factor (PHF) (1) . Give your inference on the results (1) <table><tr><td>TIME INTERVAL</td><td>LCV</td><td>CAR</td><td>2 wheelers</td></tr><tr><td>2:30 – 2:40</td><td>10</td><td>16</td><td>24</td></tr><tr><td>2:40 – 2:50</td><td>12</td><td>9</td><td>33</td></tr><tr><td>2:50 – 2:60</td><td>13</td><td>8</td><td>27</td></tr><tr><td>3:00 – 3:10</td><td>13</td><td>15</td><td>32</td></tr><tr><td>3:10 – 3:20</td><td>14</td><td>10</td><td>28</td></tr><tr><td>3:20 – 3:30</td><td>10</td><td>9</td><td>41</td></tr><tr><td>3:30 – 3:40</td><td>11</td><td>8</td><td>38</td></tr><tr><td>3:40 – 3:50</td><td>6</td><td>15</td><td>21</td></tr><tr><td>3:50 – 3:60</td><td>7</td><td>9</td><td>26</td></tr><tr><td>4:00 – 4:10</td><td>9</td><td>11</td><td>35</td></tr><tr><td>4:10 – 4:20</td><td>11</td><td>12</td><td>39</td></tr><tr><td>4:20 – 4:30</td><td>8</td><td>10</td><td>42</td></tr></table>		TIME INTERVAL	LCV	CAR	2 wheelers	2:30 – 2:40	10	16	24	2:40 – 2:50	12	9	33	2:50 – 2:60	13	8	27	3:00 – 3:10	13	15	32	3:10 – 3:20	14	10	28	3:20 – 3:30	10	9	41	3:30 – 3:40	11	8	38	3:40 – 3:50	6	15	21	3:50 – 3:60	7	9	26	4:00 – 4:10	9	11	35	4:10 – 4:20	11	12	39	4:20 – 4:30	8	10	42	3	1	1,2,3	5
TIME INTERVAL	LCV	CAR	2 wheelers																																																							
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4:20 – 4:30	8	10	42																																																							

2.a)	The NH-75 segment passing through Yeshwanthpur to Hebbala flyover has a horizontal curve at Kuvempu Circle bus stop near Lottegollahalli railway station (after BEL circle) with absolute minimum radii. Design the following geometric features of this curve assuming suitable data for a design speed of 80 kmph. a. Super elevation (1) b. Extra widening (1) c. Length of the transition curve (2) d. Stopping sight distance (1)	4	1	1,2,3	5																						
b)	The following Spot speed data was collected from a mid-block section <table><thead><tr><th>Speed Range (KMPH)</th><th>Frequency</th></tr></thead><tbody><tr><td>0-10</td><td>5</td></tr><tr><td>10-20</td><td>10</td></tr><tr><td>20-30</td><td>15</td></tr><tr><td>30-40</td><td>20</td></tr><tr><td>40-50</td><td>25</td></tr><tr><td>50-60</td><td>30</td></tr><tr><td>60-70</td><td>25</td></tr><tr><td>70-80</td><td>20</td></tr><tr><td>80-90</td><td>15</td></tr><tr><td>90-100</td><td>15</td></tr></tbody></table> a) Plot the frequency distribution and cumulative frequency distribution curves from this data (3) b) Compute the design speed (1) c) Compute Speed limits (1)	Speed Range (KMPH)	Frequency	0-10	5	10-20	10	20-30	15	30-40	20	40-50	25	50-60	30	60-70	25	70-80	20	80-90	15	90-100	15	3	1	1,2,3	5
Speed Range (KMPH)	Frequency																										
0-10	5																										
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30-40	20																										
40-50	25																										
50-60	30																										
60-70	25																										
70-80	20																										
80-90	15																										
90-100	15																										
Section-2 (Practical) - 20 marks																											
3)	In a highway project, based on the field survey data, Civil Draftsman has prepared key plan and alignment is fixed. In this plan, it is observed that in one point there is a change of direction and it is to be provided with as Compound Curve based on design criteria at office. - You as a Site engineer assume the field as that point where compound curve has to be set out using Total station along with your team - What are the instruments you need to carry along with you before going into field	3	1		10																						

	Explain and execute how you set out compound curve in that field for the design data given				
4)	You have a team of site engineers working in road project of Shiradi Ghat - You have received the geometric designs showing many number of reverse curves - Assume the field as your project site , What are the instruments you need to carry along with you before going into field - Explain and Execute one reverse curve as per the design data given	3	1		10

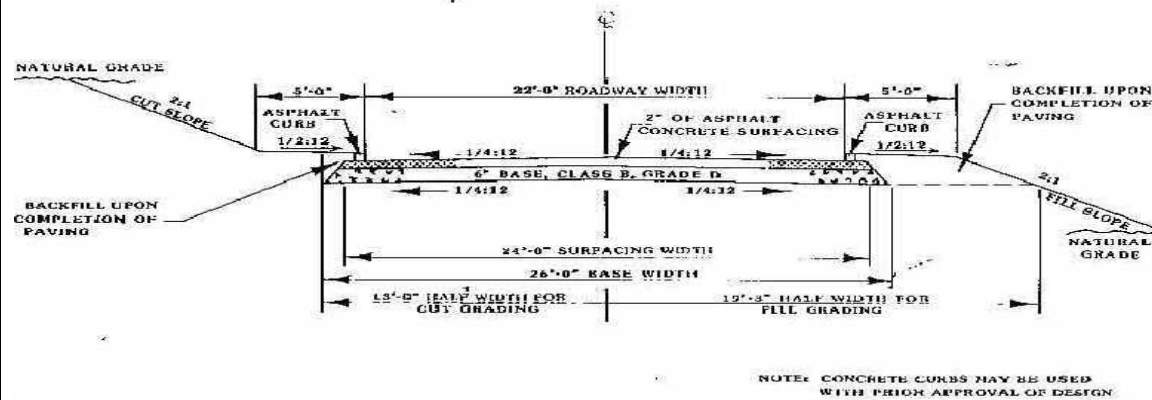
Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory) – 100 Marks / 3 hours (Reduced to 60 marks)

Programme : Civil Engineering			Semester: V																		
Course : Transportation Engineering			Max Marks: 100																		
Course Code :20CE53I			Duration : 3 Hrs																		
Instruction to the Candidate: Answer one full question from each section.																					
Q.No	Question	CL	CO	Marks																	
Section-1																					
1.a)	A Valley curve is formed by a descending gradient of 1 in 40 which meets an ascending gradient of 1 in 30. - Design the total length of valley curve if the design speed is 100 kmph so as to fulfill both comfort condition and head light sight distance for night driving after calculating the SSD required. (8) - Determine the position of the lowest point of the valley curve to locate the culvert(2)	3	1	10																	
b)	An Engineering student in 6 th semester is doing Internship under Directorate of Urban Transport (DULT) in Bangalore. He has been asked to Conduct Origin and Destination study of an area in Malleswaram. Explain the stepwise procedure he should follow to conduct the following surveys - Home Interview Survey - Road side Interview survey (with neat sketch)	3		10																	
2.a)	A highway engineer wants his team to conduct engineering survey for a new highway project. Elaborate the stages of engineering surveys his team need to conduct for a new highway alignment	3		10																	
b)	A Probe car / Moving car was used to estimate Flow, Density and Speed. Use the following data to Estimate q, k, v and plot the q-v graph in the graph sheet <table><tr><th>Vehicles moving against the stream</th><th>Vehicles that had overtaken the test vehicle</th><th>Vehicle overtaken by the test vehicle</th></tr><tr><td>120</td><td>15</td><td>75</td></tr><tr><td>135</td><td>25</td><td>50</td></tr><tr><td>40</td><td>20</td><td>10</td></tr><tr><td>90</td><td>20</td><td>10</td></tr><tr><td colspan="3">Length of the road : 0.5 Km, Speed of the car : 20 Kmph</td></tr></table>	Vehicles moving against the stream		Vehicles that had overtaken the test vehicle	Vehicle overtaken by the test vehicle	120	15	75	135	25	50	40	20	10	90	20	10	Length of the road : 0.5 Km, Speed of the car : 20 Kmph			3
Vehicles moving against the stream	Vehicles that had overtaken the test vehicle	Vehicle overtaken by the test vehicle																			
120	15	75																			
135	25	50																			
40	20	10																			
90	20	10																			
Length of the road : 0.5 Km, Speed of the car : 20 Kmph																					
Section-2																					

3.a)	As a part of certain highway consultancy project, the subgrade soil sample was characterized for assessing its plasticity properties as well as the classification of soil. • Liquid limit of the soil = 55% • Plastic limit of the soil= 30% Grain size distribution was done on the same soil sample and test results are given below <table><tr><td>Particle size in mm</td><td>2.0</td><td>0.6</td><td>0.3</td><td>0.15</td><td>0.075</td><td>0.032</td><td>0.009</td><td>0.0015</td></tr><tr><td>Percentage Finer</td><td>100</td><td>85</td><td>71</td><td>61</td><td>50</td><td>38</td><td>28</td><td>10</td></tr></table> • Plot the grain size distribution plot and give the proportion of various fractions in the soil • Classify the soil as per Indian Standard (IS) Classification System	Particle size in mm	2.0	0.6	0.3	0.15	0.075	0.032	0.009	0.0015	Percentage Finer	100	85	71	61	50	38	28	10	4	2	10					
Particle size in mm	2.0	0.6	0.3	0.15	0.075	0.032	0.009	0.0015																			
Percentage Finer	100	85	71	61	50	38	28	10																			
b)	Enumerate the differences between the following • Design parameters of Flexible and Rigid Pavements • Pavement design aspects of Highways and Runways	3	10																								
4.a)	Analyse the results of an asphalt concrete mix having weighed 1228 grams in air and 706 grams in water during the course of Marshal Stability test. Determine the following for the given data below • Bulk Density and Theoretical Density • Air Voids in total mix • Voids in mineral aggregate • Voids filled with bitumen <table><tr><td>Sl.NO.</td><td>MATERIAL</td><td>PERCENTAGE OF MATERIAL</td><td>SPECIFIC GRAVITY</td></tr><tr><td>1</td><td>Coarse aggregate</td><td>25</td><td>2.67</td></tr><tr><td>2</td><td>Fine aggregate</td><td>35</td><td>2.68</td></tr><tr><td>3</td><td>Stone dust</td><td>40</td><td>2.72</td></tr><tr><td>4</td><td>Filler</td><td>2</td><td>3.02</td></tr><tr><td>5</td><td>Bitumen</td><td>5</td><td>1.02</td></tr></table>	Sl.NO.	MATERIAL	PERCENTAGE OF MATERIAL	SPECIFIC GRAVITY	1	Coarse aggregate	25	2.67	2	Fine aggregate	35	2.68	3	Stone dust	40	2.72	4	Filler	2	3.02	5	Bitumen	5	1.02	4	10
Sl.NO.	MATERIAL	PERCENTAGE OF MATERIAL	SPECIFIC GRAVITY																								
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3	Stone dust	40	2.72																								
4	Filler	2	3.02																								
5	Bitumen	5	1.02																								
b)	Outline in detail the material specification, Construction process and quality control tests of Wet Mix Macadam layer in road construction as per MORTH Specifications and IRC code of practice	3	10																								

Section- 3																																		
5.a)	In a highway project a volumetrically unstable soil is encountered as a subgrade material. As a consequence of this problematic soil, the pavement is undergoing lot of distress quite frequently after laying it. - What suggestions would you give to your client who approaches with this problem? - What are the probable Mechanism involved in the suggested Stabilization method that could overcome the problem									3	3																							
b)	Estimate the quantity of earthwork for the portion of a road between chainages 0 to 10 from the following data, lengths being measured with a standard 20m chain. <table border="1"><tr><td>Chains</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr><tr><td>G.L.</td><td>131.1</td><td>131.2</td><td>130.9</td><td>130.8</td><td>130.7</td><td>130.6</td><td>130.4</td><td>129.1</td><td>129.5</td><td>129</td></tr></table> The formation level at 0 chainages is 130.0 and the road is in a rising gradient of 1 in 200. The width of formation 9 m. and the side slopes 1.5: 1 in banking and 1:1 in cutting. The lateral slope of the ground may be assumed as level									Chains		0	1	2	3	4	5	6	7	8	9	G.L.	131.1	131.2	130.9	130.8	130.7	130.6	130.4	129.1	129.5	129	4	10
Chains	0	1	2	3	4	5	6	7	8	9																								
G.L.	131.1	131.2	130.9	130.8	130.7	130.6	130.4	129.1	129.5	129																								
6.a)	1) As a Technical head of a forthcoming highway project, How would you emphasize the requirements of highway drainage system (5) 2)With a neat sketch explain the method of lowering of ground water table in a previous soil by providing subsurface drains (5)									3	10																							
b)	Estimate the quantities of the following items of works for the cross section of a 1km long road shown in fig									4	10																							



1. Earthwork excavation for the pavement shown in figure
2. 6" Base concrete for the road.
3. Top concrete surface.
4. 2" Asphalt layer above top layer.
5. Asphalt curbing on both sides 20m

Section-4

7.a)	You are proposing a railway track to proposed alignment What are the various components and requirements of a good track to be considered for proposing a railway track	3	4	10
b)	You are working in bridge construction project, - What are the factors you consider for selection of site for bridge Construction? - Draw a typical cross-section of bridge and show its components	3		10
8.a)	As a site engineer while surveying and fixing alignment of railway track, you will encounter some place where tunnel needs to be constructed based on the conditions. - Justify your decision of constructing tunnel with the advantages of tunneling - Justify why tunnel lining and ventilation should be given	3		10
b)	You are working in Airport construction project - What are the factors you consider for selection of site for airport Construction? - What is the importance of Airport lighting in the project?	3		10

Section-5				
9.a)	Road safety auditing has been conducted by auditors to check road safety aspect. • Explain Step wise procedure followed in road safety auditing	3	5	10
b)	Explain the procedure of environmental Impact assessment process for a highway project	3		10
10.a)	What are the risk factors and safety precautions to be taken for road safety	3		10
b)	Explain the procedure of Health Impact assessment process for a highway project	3		10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks: 100
Problem statement	Condition: A consultancy company has been requested to design paving mix and conduct Marshal stability test for Dense Bituminous Macadam (DBM) layer in the construction field. You as an employee of the consultancy company is assigned with the following works .	
1	Preparation of Mix design of the Bituminous paving mix from the data given from pavement material tests	10
2	Gradation and Proportioning of aggregates for DBM construction work by Rothfutch's Graphical method	10
3	Preparation of Test Specimen for different proportions of bitumen content	25
4	Determination of weight and dimensions or volume of test specimens	05
5	Conduction of Marshal Stability test to determine Marshal Stability values and Flow Values	20
6	Tabulation and calculations of the test results	10
7	Plotting of graphs, Interpretation of test data and Calculations to determine Optimum Bitumen Content (OBC)	20
Total		100

References:

Sl. No.	Description
1	“ Highway Engineering “ by Khanna S.K. and Justo C.E.G, , Nemchand and Bros, Roorkee
2	“ Highway Material Testing Laboratory Manual” by Khanna SK and Justo CEG, Nemchand and Bros. Roorkee
3	“ Highway Engineering “ by Kadiyali L.R, , Khanna Publishers, New Delhi
4	“ Traffic Engineering and Transport Planning “ by Kadiyali L R
5	“Railway Engineering “by Satish Chandra and Agarwal M M, Oxford university press.
6	IRC Codal Provisions
7	Transportation Engineering and related courses in NPTEL , Swayam
8	Industry Consultation
9	Web searches

1. List of equipments

SI.NO.	PARTICULARS	QUANTITY
1	Mechanical Sieve Shaker	2
2	Set of IS sieves for coarse aggregates	2 sets
3	Set of IS sieves for fine aggregates	2 sets
4	Casagrande's apparatus	2
5	Hot air Oven	1
6	Standard Proctor test apparatus	1
7	Modified Proctor test apparatus	1
8	Impact testing machine	2
9	Los Angeles abrasion testing Machine	1
10	Compression Testing Machine	1
11	Water Bath	1
12	Electric Heater for bitumen	1
13	Length gauge and Thickness gauge	2
14	Set of Pycnometers and Beaker- Different sizes	2 sets
15	Crushing test apparatus- Moulds	2 sets
16	Penetrometer and mould	1
17	Briquette Moulds and Ductility Machine	1 set
18	Ring and Ball Apparatus	2 sets
19	Cannon Fenske Opaque Viscometer /	2
20	Penskey Martens Closed cup apparatus	2
21	Total Station with Target	2 sets
22	Auto Level with Levelling Staff	2
23	Tapes	2
24	Ranging rods	6
25	Arrows	20



Government of Karnataka
DEPARTMENT OF COLLEGIATE and TECHNICAL EDUCATION

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

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,

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

Week	CO	PO	Day	1 st Session (9am to 1pm)	L	T	P	2 nd Session (1.30pm to 4.30pm)	L	T	P
1	1,3	1,2	1	Built Environment: Introduction, need, types, public health and sustainable built environment. Sustainable Development Goal's (SDG's). Audio - Video Presentation on Built Environment. Case Exercise: 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) References: SDG's: THE 17 GOALS Sustainable Development (un.org)	1	1	2	Water Supply system: 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. Case Exercise: 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) 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 & Environmental Engineering Organization (CPHEEO), Govt of India	1		2
	1,3	1,2	2	Sources of Water: World water distribution, Natural and artificial Sources of water and their availability, characteristics and Selection of sources, Uses of Water, Water supply key issues. THE RAINWATER (HARVESTING AND STORAGE) BILL, 2016 Case Exercise:	2		2	Sizing-the challenge: Water demand. • Components. • Per capita water demand. • Factors affecting water demand. • Commercial and Industrial water demand. • Firefighting demand. • Fluctuations in water demand. • Types of variations.	1		2

			4. Conduct a Survey of nearby locality to identify sources of fresh water. 5. Prepare a report on Rain water harvesting and Desalination. 6. Estimate the quantity of rain water can be harvested from building roof top. (Note: Conclusions and recommendations are must) References: 1. Desalination: IVRCL 2. Rainwater Harvesting: RWH starting page.pmd (iricen.gov.in)			Peak demand for maximum demand Estimations. Peak factor, Design period and design population, population forecasting methods, Demand forecasting and Design Capacities. Accurate population forecasting. Case Exercise: 7. Collect water demand and supply data of your district for a period of 10 years and analyze. 8. Identify the factors affecting the variation between the actual population and forecasted population. (Note: Conclusions and recommendations are must) References: 1. An Analysis of Demand and Supply of Water in India Bhat Journal of Environment and Earth Science (iiste.org)			
2	2	3	Practice problems on population forecasting and demand calculation, Design flow of water treatment plant. Case Exercise: 9. Using population data of nearby locality find. (Specify the nature of locality) (A) Forecasted population. (B) Forecasted total demand. (C) Allocation of water for various demands as per codal provisions. (Note: Conclusions and recommendations are must)	1	3	Conveyance from the source: 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. Case Exercise: 10. Suggest a suitable intake structures for various types of surface water sources.	2		1
3	1,3	4	Water Conveyance: Pipes and conduits for water supply	1	3	Design of pipe lines, Losses in pipes and factors affecting losses. Laying, jointing and			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	PEER REVIEW: Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)		4		Pumps: Types and capacity of pumps, Energy efficient pumps, Selection of pumps, pumping stations, Booster pumping stations. Practice problems on pumps. Case Exercise: 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	Water Storage: Raw water storage, Treated water storage, Location, Geometrical design and Construction of storage Reservoirs. Practice problems on Reservoir capacity Estimation. Case Exercise:	1		3	Water Sampling and Analysis: 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. Physical Parameters: 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	Chemical Parameters: 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	PEER REVIEW: Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)		4	Water Treatment units: Screening and aeration: Introduction, Selection, Application, Operation, design and Process control. Practice problems on screens and aeration. Demonstrate relevant videos. Sedimentation: Introduction, Selection, Application, Design of sedimentation tank, Operation and Process control. Practice Problems on Sedimentation. Demonstrate relevant videos.	2		1
	1,2	2	2	Coagulation and Flocculation: 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	Filtration process: Introduction, Filtration theory, principle, Selection criteria. Construction, operation, Filter media, components and cleaning of • Slow sand filters. • Rapid sand filter. • Pressure filters. • Ultra and micro filtration. Design of slow and rapid sand filters. Demonstrate relevant videos.	2		1
	1,2,3	2,4	3	Disinfection. • Chlorination • Ozone and UV disinfection. • Advanced and alternate treatment systems. • Advanced oxidation processes and Membrane process. • Water softeners. • Sludge management. Practice problems on chlorine demand and sludge deposition. Case Exercise:	2	2	Design of Water Distribution network: • Systems of Water distribution networks. • Methods of water supply. • Analysis and design of Water Distribution Networks. • Types of layouts and their suitability. Practice Problems on Pipe flow. Case Exercise:			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	- Water Losses in the Water Distribution System. - Water balance for water loss Assessment and performance Indicators. - Water loss Detection and control. - Continuous (24/7) water supply systems. 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) - Necessity of Hydraulic Simulation - Challenges of Hydraulic simulation 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	PEER REVIEW: 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) - Project Set up. - Drawing the network. - Setting the properties of the object in the model. - Save the project.			3
	4	4,7	2	Smart water Supply and monitoring system: Need, Concept, Objectives. Introduction to Automation in Water supply systems and case study.	2		2	- Modern smart water systems: IoT and Sensing devices. - Smart water metering and monitoring systems.	1		2

	1,4	4,7	3	• Video demonstration of SCADA. • Discuss Basics of SCADA. • System components- Supervisory computers, Remote terminal units, Programmable logic controllers, Communication infrastructure, Human-machine interface • SCADA in water supply network monitoring: Concept and application. Case study on SCADA: Study tour_Navi Mumbai Nagpur for 24x7 _ SCADA_16 Aug 2013.pdf (pas.org.in) Case Exercise: 16. Comparative analysis of conventional and smart water management.	2		2	Economics of water supply systems. Capital and Operational cost of water supply system, Water Pricing. Case study and Practice problems on water pricing. Water reuse for multipurpose usages (3R concept) with different modes and strategies.				3
	2,3	2	4	Field Visit to Water Treatment Plant and distribution network system.			4	Field Visit to Water Treatment Plant and distribution network system.				3
	2		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-4 case exercises.				Assessment Review and corrective action				3
	4	4,7	6	Industry class: Software's for water distribution network design. Smart water supply and monitoring system.	3		2	Weekly Assignment				
5	1	1,5	1	PEER REVIEW: Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)			4	Waste Water Management System: Need, Waste water impact on environment and ecosystem, SDG's and Waste water. Wastewater treatment new directions and concerns. Job opportunity, Role of Engineer.	1			2

							Audio Video presentation on • Need of waste water management system. • Waste water treatment process. 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	Introduction: Technical Terms used, Sources of waste water generation, Types of waste water. Case Exercise: 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	Sewer appurtenances: • Types • Suitability • Location. • Materials. • Construction. Case Exercise: 18. For a residential building Suggest suitable type of sewer appurtenances required and specify suitable location.	2		1
	1,3	3	3	Design and construction of sewers: Estimation of quantity of sewage, Population forecast, Design period, Per capita sewage generation, Appropriate peak factor. Case Exercise: 19. Estimate quantity of sewage generated for a selected locality.	2	2	Hydraulics of sewers: 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. Case Exercise: 20. Design a sewer for a selected nearest ongoing project.	2		1
	1,3	2	4	Surface and storm water drainage: Determination of Storm Water Flow, Run-Off Co-Efficient, Time of Concentration, Empirical Formulae for Run-Off.	1	3	Collection, Conveyance, Treatment and Disposal of waste water. Sewerage system: • Types: Separate, Combined and Partially Separate Systems.			3

				Problems on Design of Storm Water Sewers Systems. Case Exercise: 21. Estimate quantity of storm water run-off flow for a selected locality and design storm water sewer.			- Working principle. - Suitability - Types of sewers. Method of Conveyance: Gravity, Low Pressure and Vacuum. Case Exercise: 22. Suggest suitable type of sewerage system and sewers for a selected locality. Reference: (1007) Wastewater Collection Method of conveyance - YouTube			
	1,3		5	CIE 2- Written and practice test Submission of week-5 case exercise reports.			Assessment Review and corrective action			3
	1,3	2	6	Industry class-Repairs and maintenance of sewerage systems.	3	2	Industry weekly assignment			
6	2,5	4	1	PEER REVIEW: Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)		4	Waste water characteristics: Physical, Chemical and Biological characteristics. Source specific wastewater characteristics. - Sampling technique. - Sample preservation - Analytical methods and Instrumental techniques - Data handling and reporting. 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. Analysis of physical Parameters: 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	Analysis of Chemical Parameters: 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	Wastewater treatment: 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	PEER REVIEW: Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics)		4	Primary treatment of Sewage: Principles, functions and design of sewage treatment units-screens, grit chamber, Skimming tank, Sedimentation tanks. Construction, Operation and Maintenance aspects.	2		1

	3	2	2	Secondary treatment of sewage: Objectives, Selection of Treatment Methods, Principles, Functions. (ii) 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	Tertiary treatment: Sand and activated carbon filter and chlorination. Explore reuse of tertiary treated waste water. Case Exercise: 23. Estimate quantity of fresh water consumption can be reduced by reusing treated waste water.	2	2	Effluent Disposal: Dilution, Self-purification of streams, factors affecting self-purification. Disposal in Sea water, Disposal on Lands. Recycle of wastewater. Case exercise: 24. Identify the disposal method/system of treated wastewater in your locality.	2	1
	3	5	4	Rural Sanitation: 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		
8	4	4,7	1	PEER REVIEW: 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 Project 1 works to be conducted for the next 4 days.	2	1
	4	3	2	Project 1 Water supply and waste water Management Project. 1. Village traversing.					7
	3,4	3	3						7
	3,4	3	4						7

				2.Examination of sources of water and water quality analysis. 3.Examination of sources of waste water and waste water analysis. 4.Calculation of quantity of water required based on existing and future projected population for a village. 5. Estimation of waste water generated. 6.Selection of sites for ground level reservoir, overhead tank and treatment plants. 7.Block levelling for water treatment and waste treatment plant. 8.Longitudinal section from source to the treatment plant and from treatment plant to the overhead tank (OHT) or reservoir. 9.Longitudinal section along the left and right side of the roads in the entire village. 10.Underground drainage system surveys for laying the sewers. Drawings to be prepared 1.Preparation of village map 1.Plan of water supply line, sewer lines in village map 2.L/S of water supply and sewer lines 3.Block levelling placing overhead tanks 4.Block levelling Placing WTP Instructions: 1. It is suggested to use total station for surveying works. 2. The Project-1 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.							
	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-8 case exercise reports.				Assessment Review and corrective action			3
	1,3	2	6	Wastewater Treatment Plant Visit			5	Industry weekly assignment			
9	1	5	1	PEER REVIEW: Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics) Review of Project-1 progress.		4		Solid Waste Management System: Introduction, Need, Impact, early waste disposal. Solid waste Management Hierarchy. Video demonstration on 1.Impact of solid waste. 2.Solid waste management system.	1		2

							Reference: Solid Waste Management Rules 2016 — Vikaspedia			
	3	5	2	Sources, Classification, Characteristics and composition of solid waste. Case Exercise: 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) Case Exercise: 24. Estimate the quantity of solid waste generated at your institution based on their characteristics and composition separately.	1		2
	4	3	3	- Separation and reduction of solid waste at source. - Storage: Selection and function of containers. - Collection: Frequency of collection, Factors affecting collection, Segregated collection, collection methods. Case Exercise: 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	- Collection routes. - Tools and equipment's. - Designing collection system: - Determining type and number of vehicles - Determining vehicles time on the route - Routing Case Exercise: 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. Case Exercise:	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		5	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	PEER REVIEW: Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics) Review of Project-1 progress.		4	Processing of municipal solid waste: Purpose, Methods and waste minimization, recovery, recycle and reuse (3R) of materials from solid waste, volume and size reduction, biological processing. Case Exercise: 28. Prepare a report on the common types of materials recovered from MSW.	1		2
	3	2	2	Treatment methodologies: 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. Case Exercise: 29. Analyze and select suitable composting technique for treating solid waste generated at your institution (Project-2).	1	3	Case Exercise: 30. Visit to nearby composting unit and prepare a report on. • Estimation of degradable solid waste. • Design of composting pit • Processing of degradable solid waste. • Operation and maintenance of the unit.			3
	3,4	3	3	Project-2 At the end of 13th week there shall be a waste to wealth/waste to energy system executed.						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	PEER REVIEW: Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics) Review progress of Project-1 and Project-2		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. Case Exercise: 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. Case Exercise: 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	Biomedical waste management: Introduction, sources and generation, classification, Issues, Management technologies.	1		3	Industrial waste management: 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	E-Waste Management: 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	Construction and demolition waste: 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	PEER REVIEW: Focused group discussion on industry class. (Faculty shall evaluate student's performance using rubrics) Review of Project-1 and Project-2 progress.		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 system.		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				Internship 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.				Project 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 (swachhamevajayate.org)
- Karnataka Urban Water Supply and Drainage Board: ವ್ಯಾಪ್ತಿ – Karnataka Urban Water Supply and Drainage Board (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
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* 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

CIE-1 Model Question Paper

Programme	Civil Engineering	Semester	V		
Course	Built Environment	Max Marks	30		
Course Code	20CE54I	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)	Estimate water demand for your Institution. Assume relevant data required. • Identify suitable source of water. • Estimate firefighting demand. • Estimate average daily demand. • Peak demand. • Design period. Design suitable storage reservoir.																														
4)	Estimate quantity of rainwater can be harvested from your institution. Use the data given below: Runoff co-efficient(K) for impervious surface=0.8 Runoff co-efficient(K) for pervious surface=0.2 Annual rainfall data <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> 1.Roof top of your institution building. (Minimum area to consider 500 m²) 2.Surface run off of your institution premises.	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				
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																														

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory) – 100

Programme : Civil Engineering Course : Built Environment Course Code : 20CE54I			Semester : V Max Marks : 100 Duration : 3 Hrs								
Instruction to the Candidate: Answer one full question from each section.											
Q.No	Question	CL	CO	Marks							
Section-1											
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							
Section-2											
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
Section-4				
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
Section-5				
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 ³ /s in summer (Mar-Jun), 25m ³ /s in monsoon (Jul-Oct) and 15m ³ /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 ³ /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
Problem statement	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. (For design of a water supply system)	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

Total	100
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Scheme of Evaluation (2) for SEE 2

Sl. No	Description	Marks: 100
Problem statement	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. (For design of waste water management system)	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
Total		100

Scheme of Evaluation (3) for SEE 2

Sl. No	Description	Marks: 100
Problem statement	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. (For design of solid waste management System)	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
Total		100