Programme	Civil Engineering	**Semester**	Fourth Semester
Course Code	20CE41P	**Type of Course**	Programme Core
Course Name	Concrete Technology	**Contact Hours**	8 hours/week 104 hours/semester
Teaching Scheme	L: T:P :: 3:1:4	**Credits**	6
CIE Marks	60	**SEE Marks**	40

1. Rationale: Diploma holders in Civil Engineering are supposed to supervise concreting operations involving proportioning, mixing, transporting, placing, compacting, finishing and curing of concrete. To perform above functions, it is essential to impart knowledge and skills regarding ingredients of concrete and their properties; properties of concrete in fresh and hardened stage, water cement ratio and workability; proportioning for ordinary concrete; concreting operations and joints in concrete.

2. Course Outcomes/Skill Sets: At the end of this course students will be able to

CO-01	Identify the ingredients of concrete, test the properties and study the behaviour of concrete ingredients to ensure it can be used for the given construction activity
CO-02	Design concrete mix proportions for required compressive strength and perform appropriate concrete operation procedures under a given exposure condition.
CO-03	Identify the types of admixtures based on its properties, behaviour and determine the type of admixtures to be used in concrete for a given construction activity.
CO-04	Differentiate between special concrete and conventional concrete with regards to composition, its applications and sustainability along with advantages and disadvantages of both.

3. Course Content

Week	**CO**	**PO**		**Lecture (Knowledge Criteria)**	**Tutorial (Activity Criteria)**	**Practice (Performance Criteria)**

				3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1	1,4	1	Cement – Chemical composition, grades of cement, Tests on cement- fineness, normal consistency, specific gravity on cement.	1.Conduct field test on cement. 2. Conduct market analysis on price, grades and brand of cement.	1. a. Fineness test on Cement- sieve analysis by Blaine's air permeability test. 1.b. Normal Consistency test on cement.
			2	Setting time, Soundness and compressive strength of cement cube.		2. a. Initial setting time & final setting time test. 2.b. Specific gravity test on cement.
			3	Storing Cement: - (a) Storing of cement in the warehouse. (b) Storing of cement at site. (c) Effect of storage on strength of cement. Water -Quality of mixing water, Limits on the impurities as per ISI.		
2	1	1, 4	1	Fine aggregate – specific gravity, density, moisture content.	1.Conduct water absorption test on silt. 2.Compare properties of Manufactured sand with Natural River Sand	1. Test on Compressive strength of cement cube
			2	Bulking, sieve analysis, grading of fine aggregate, deleterious materials.		2. Fineness modulus, Specific gravity of fine aggregate
			3	Emerging trends in fine aggregate manufactured sand, P-sand, Filtered sand		
3	1	4	1	Coarse aggregate - Importance of size, shape and texture, grading of coarse aggregates.	1. Study on Recycled coarse aggregate and prepare a report.	1. Bulking of Fine Aggregate-River sand, M-Sand, P-Sand.
			2	Sieve analysis, specific gravity, flakiness and elongation index of coarse aggregate.		2. Fineness modulus, Specific gravity of coarse aggregate.
			3	Moisture test, Impact test and abrasion test of coarse aggregate Storing of coarse aggregate at site.		

4	2	1	1	Concrete, Behaviour of concrete- Hydration of cement, Bogue's compounds.	1.Study the advantages and uses of concrete in comparison to other building materials 2.Video demonstration on Hydration of cement and hydration process, Physical structure of hydrated cement	1. Flakiness Index, Elongation Index of coarse aggregate.
			2	Gel/space ratio, Water requirement for hydration, Water Cement Ratio.		2. Absorption test and surface moisture test on fine aggregate and coarse aggregates.
			3	Effect of various W/C ratios on the physical structure of hydrated cement.		
5	2	1,4	1	Internal moisture, temperature, age, and size of specimen, cube strength.	1. Prepare Comparison report on different grades of concrete based on workability.	1. Slump Test on concrete for the nominal mix.
			2	Workability – Factors affecting workability, measurement of workability, Segregation and bleeding.		2. Compaction factor test for the nominal mix.
			3	Strength-a) Characteristic strength, (b) Durability, (c) Permeability Factors affecting strength, w/c ratio, maturity, effect of aggregate properties.		
6	2	1, 4	1	Compressive strength, split tensile strength, bond strength, modulus of rupture.	1. Study and demonstrate Pull out test on concrete.	1. Compressive strength test on concrete - cube strength.
			2	Modulus of elasticity, Poisson ratio, the relationship between these parameters. Aggregate-cement bond strength.		
			3	Shrinkage – plastic shrinkage and drying shrinkage, factors affecting shrinkage.		2. Non-destructive test on concrete. a) Ultrasonic Pulse Velocity test. b) Rebound Hammer test.
7	2	1, 4	1	Creep –Factors affecting creep, effects due to the creep of concrete,		1. Site Visit/Demonstration-

				measurement of creep, Permeability in concrete.	1. List the remedies for cracks in concrete.	Evaluation of Compressive strength by core cutter test.
			2	Factors contributing to cracks in concrete – Settlement cracks, Thermal expansion, and structural design deficiencies.		
			3	Concrete in Aggressive Environment: Alkali – Aggregate Reaction, Sulphate Attack, Chloride Attack, Acid Attack, Effect of Sea Water, Carbonation, special coating for Waterproofing, Freezing and thawing.		2. Demonstration- Permeability test on concrete.
8	2	1,4	1	CONCRETE OPERATIONS: - Batching (a) Batching of cement (b) Batching of aggregate: Batching by volume, using gauge box, selection of proper gauge box, Batching by weight-spring balances and by batching machines. (c) Measurement of water.	1.IS Codal provisions for mix design of concrete. 2. Importance of bulking of sand in Volume batching	1. Concrete Mix Design as per IS Codes.
			2	Mixing (a) Hand mixing (b)Machine mixing-types of mixers, capacities of mixers, choosing appropriate size of mixers, operation of mixers, mixing of water. (c)Maintenance and care of machines.		
			3	Transportation Transportation with the use of the following- pans, wheelbarrows, transit mixers, chutes, belt conveyors, pumps, tower cranes.		2. Preparation of gauge box Demonstration on Hand mixing and machine mixing.
9	2	1, 4	1	Ready Mix concrete Manufacturing of ready-mix concrete, Quality inspection of Ready-Mix Concrete in site. Precautions and care before, during and after concreting Using RMC	1. Visit the construction site and study the concrete operations	1. Demonstration on volume batching in site and Weigh batching in

			2	Compaction: (a) Hand compaction (b) Machine compaction-types of vibrators-internal and external vibrators Method of handling machine vibrators and its suitability for various situations.	like batching, mixing, transportation, compaction, finishing and curing of concrete and prepare a report.	RMC(semi-automated and fully automated)
			3	Finishing-screeding, floating, and towelling Curing: - Object of curing, Method of curing - conventional and advanced methods. Recommended duration for curing		2. Prepare the trail mix for the mix design and conduct test in fresh state (slump and compaction factor test) and hardened state (Succeeding week)
10	3	1, 4,5	1	Mineral admixture- Fly Ash, its Composition, properties, uses and advantages	1. Study on Natural fibres and artificial fibres and prepare a report	1. Prepare mix design and Conduct Slump test and compaction factor test on fresh concrete with mineral admixtures
			2	GGBS-its Composition, properties, uses and advantages		
			3	Silica fume- its Composition, properties, uses and advantages		2. Compressive strength test on hardened concrete with mineral admixture
11	3	1,4 ,5	1	Chemical Admixture-Plasticizers, Super plasticizers- its Composition, properties, uses and advantages.	1. Conduct market analysis on chemical admixtures and compare.	1 & 2 Site visit to study the methodology of concrete Pumping to upper floors in construction site.
			2	Accelerators and Retarders- its Composition, properties, uses and advantages.		
			3	Air Entraining and Integral Waterproofing compounds- its Composition, properties, uses and advantages.		
12	3,4	1,4 ,5	1	High strength concrete, High performance Concrete-Ingredients and preparation, advantages and application.	1. Compare the special concrete with conventional	1 & 2: Prepare mix design and conduct Slump flow test, V Funnel Test, L Box

					concrete and prepare report	Test, U Box Test to determine workability of Self Compacted concrete.
			2	Pervious concrete, high density concrete. -Ingredients and preparation, advantages and application		
			3	Self-compacting concrete-Ingredients and preparation, advantages and application		
13	3,4	4, 5	1	Fibre reinforced concrete. - Ingredients and preparation, advantages and application	Study on Reactive powder Concrete, Roller Concrete, Epoxy concrete	1 & 2 Compressive strength test on special concrete
			2	Geopolymer concrete - Ingredients and preparation, advantages and application		
			3	Lightweight concrete-Ingredients and preparation, advantages and application		
Total in hours				**39**	**13**	**52**

NOTE 1: The course content shall be delivered through lectures, PowerPoint presentations, video demonstrations and field visits

NOTE 2: The TUTORIAL (Activity criteria) shall be conducted / executed by the student (Minimum ONE suggested activity from each week) and to be submitted in portfolio evaluation of activities through rubrics to the faculty.

NOTE 3: The PRACTICE (Performance criteria) shall be conducted by the student and observations and report to be submitted at the end of each session to the faculty

4. CIE and SEE Assessment Methodologies

Sl. No	**Assessment**	**Test Week**	**Duration** In minutes	**Max marks**	**Conversion**
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	

5	CIE-5 Skill Test-Practice	12	180	100	Average of two skill test reduced to 20
6	CIE-6 Portfolio continuous evaluation of Tutorial sessions through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
Total Marks					**100**

5. Format for CIE written Test

Course Name	**Concrete Technology**	Test	I/II/III	Sem	III/IV
Course Code	**20CE41P**	Duration	80 Min	Marks	30

Note: Answer any one full question from each section. Each full question carries 10 marks.

Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks
I	1			
	2			
II	3			
	4			
III	5			
	6			

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2

4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
	Average Marks= (8+6+2+2)/4=4.5						**5**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference:

Sl. No.	Description
1	Concrete technology- MS Shetty , Chand S and Co.
2	Concrete Technology, Tata McGraw Hill, New Delhi
3	Concrete Technology - Theory & Practice - R.S. Varshney
4	Relevant BIS codes

8. a. CIE Skill Test 1 - Scheme of Evaluation

SL. No.	Particulars/Dimension	Marks
1	Portfolio evaluation for practice sessions -Performance criteria (Observations and report)	10
2	a. Fineness test on Cement- sieve analysis by Blaine's air permeability test / Normal Consistency test / Initial setting time test on cement **OR** b. Fineness modulus / Specific gravity/ Bulking of Fine aggregate (River sand / M-Sand / P-Sand)/ Absorption test and surface moisture test on fine aggregates **OR** c. Fineness modulus / Specific gravity/ Flakiness Index, Elongation Index test/ Absorption test and surface moisture test on coarse aggregate Procedure-10 marks Tabular column/observation-10 marks Conduction of Experiment-10 marks calculation and Results-10 marks	40
3	a. Slump test on conventional concrete for nominal mix **OR**	

	b. Compaction factor test on conventional concrete for nominal mix Procedure-10 marks Tabular column/observation-10 marks Conduction of Experiment-10 marks calculation and Results-10 marks	40
4	Viva	10
	Total Marks	**100**

Note for the Examiner:

1. The choice among the questions 2a,2b and 2c shall be done by the examiner.
2. The choice between the questions 3a and 3b shall be done by the examiner.

8. b. CIE Skill Test 2 - Scheme of Evaluation

SL. No.	Particulars/Dimension	Marks
1	Portfolio evaluation for practice sessions -Performance criteria (Observations and report)	10
2	Concrete Mix Design as per IS Codes for the given data	30
3	a. Slump test / Compaction factor test on concrete with mineral admixtures for trail mix **OR** b. Prepare Concrete Mix design for self-compacting concrete as per IS Codes for the given data Conduct test to determine workability of Self Compacting concrete: Slump test/ V Funnel Test / L Box Test / U Box Test for trail mix Procedure-10 marks Tabular column/observation-10 marks Conduction of Experiment-20 marks calculation and Results-10 marks	50
4	Viva- voce	10
	Total Marks	**100**

Note for the Examiner:

1. The choice between the questions 3a and 3b shall be done by the examiner.

8. c. SEE - Scheme of Evaluation

SL. No.	Particulars/Dimension	Marks
1	a. Fineness test on Cement- sieve analysis by Blaine's air permeability test / Normal Consistency test / Initial setting time test on cement **OR** b. Fineness modulus / Specific gravity/ Bulking of Fine aggregate (River sand / M-Sand / P-Sand)/ Absorption test and surface moisture test on fine aggregates **OR** c. Fineness modulus / Specific gravity/ Flakiness Index, Elongation Index test/ Absorption test and surface moisture test on coarse aggregate Procedure-10 marks Tabular column/observation-10 marks Conduction of Experiment-10 marks Calculation and Results-10 marks	40
2	a. Prepare Concrete Mix design and conduct Slump test / Compaction factor test on concrete with mineral admixtures for trail mix **OR** b. Prepare Concrete Mix design for self-compacting concrete as per IS Codes for the given data Conduct test to determine workability of Self Compacting concrete: Slump test/ V Funnel Test / L Box Test / U Box Test for trail mix Mix design -20 marks Conduction of Experiment-10 marks Calculation and Results-10 marks	40
5	Viva- voce	20
	Total Marks	**100**

Note for the External Examiner:

1. The choice among the questions 1a,1b and 1c shall be done by the external examiner.
1. The choice between the questions 2a and 2b shall be done by the external examiner.

9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Blaine's air permeability test apparatus		10
2	Sieve analysis apparatus for Cement		10
3	Vicat Apparatus		10
4	Pycnometer		10
5	Density bottle		10
6	UTM		1
7	CTM		1
8	Slump test apparatus		5
9	Flakiness index apparatus		10
10	Elongation index apparatus		10
11	Sieve analysis for fine aggregate		10
12	Sieve analysis for Coarse aggregate		10
13	UPV apparatus		1
14	Digital Rebound Hammer		2
15	Core cutter apparatus		1
16	Compaction factor test apparatus		4