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CONCRETE TECHNOLOGY **Course Code : 313322**

Programme Name/s	**: Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/**
Programme Code	**: CE/ CR/ CS/ LE**
Semester	**: Third**
Course Title	**: CONCRETE TECHNOLOGY**
Course Code	**: 313322**

I. RATIONALE

Concrete is the most common construction material on earth and it directly determines the construction quality of the concrete structure and plays a very important role in the stability of the building structure. A diploma civil engineering students are required to develop the basic competency in dealing with concrete as a construction material ,so that they should have the basic knowledge of cement chemistry, concrete batching, placement, compaction and curing and testing of concrete. This course will be helpful for students to build their theoretical and practical knowledge in civil and structural engineering.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Design the concrete mix as per the given specifications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Suggest relevant types of cement to be used in the given site conditions.
- CO2 - Classify the given aggregates based on its shape and size with the importance of their properties.
- CO3 - Prepare concrete of required specifications in the given situation.
- CO4 - Undertake the necessary procedures to maintain the quality of given type of concrete.
- CO5 - Suggest relevant type of admixtures to be used in the given situation.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313322	CONCRETE TECHNOLOGY	CTE	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 1 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

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V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the chemical constituents of the given type of cement TLO 1.2 Describe the relevant physical properties of the given type of cement in the given situation. TLO 1.3 Carry out the relevant test on the given sample of cement for the given purpose. TLO 1.4 Propose the relevant type of cement to be used in the given situation.	**Unit - I Cement** 1.1 Chemical Constituents of OPC (Ordinary Portland Cement) and their effects on properties of OPC, Bogue's compounds and their properties, hydration of cement. Physical properties of OPC: fineness, specific gravity, standard consistency, setting time, soundness, compressive strength 1.2 Different grades of OPC 33, 43, and 53 with its uses and specifications of physical properties as per relevant IS codes for OPC. 1.3 Testing of OPC: Field tests and laboratory tests-fineness test, standard consistency test, setting time test, soundness test, and compressive strength test, Storage of cement and effect of storage on properties of cement. 1.4 Field applications of different types of cements: Rapid hardening cement, Low heat cement, Portland pozzolana cement, sulphate resisting cement, blast furnace slag cement, High alumina cement, White cement.	Lecture Using Chalk-Board Hands-on Site/Industry Visit Collaborative learning Video Demonstrations Case Study
2	TLO 2.1 Identify the type of given aggregate samples based on source, shape and size. TLO 2.2 Explain the methodology to suggest suitability of given fine aggregate. TLO 2.3 Explain the methodology to suggest suitability of given coarse aggregate.	**Unit - II Aggregates** 2.1 Aggregates: Requirement of good aggregates, Classification according to source, size and shape. 2.2 Fine aggregates: Properties, size, specific gravity, bulk density, water absorption and bulking, fineness modulus and grading zone of sand by sieve analysis, silt content in sand and their specification as per IS 383, bulking of sand. Concept of crushed Sand. 2.3 Coarse aggregates: Properties, size, shape, surface texture, water absorption, soundness, specific gravity, bulk density, fineness modulus of coarse aggregate by sieve analysis, grading of coarse aggregates, crushing value, impact value and abrasion value of coarse aggregates with specification.	Lecture Using Chalk-Board Hands-on Video Demonstrations Site/Industry Visit Collaborative learning Demonstration

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Justify use of different grades of concrete and their properties for given applications, TLO 3.2 Select w/c ratio for a given grade of concrete, with justification TLO 3.3 Interpret the given data obtained from test on given type of concrete sample. TLO 3.4 Describe the factors affecting overall durability of given type of concrete. TLO 3.5 Explain the given method of concrete mix design for the given situation. TLO 3.6 Describe the need of NDT for the given field situation	**Unit - III Concrete and its testing.** 3.1 Concrete: Necessity of supervision for concreting operation, different grades of concrete (ordinary Concrete, standard concrete and high strength concrete) as per provisions of IS 456. 3.2 Water cement ratio, Duff Abraham w/c law, significance of w/c ratio, selection of w/c ratio for different grades of concrete and different exposure conditions. 3.3 Properties of fresh concrete: Workability, Factors affecting workability of Concrete. Determination of workability of concrete by slump cone test and compaction factor test. Range values of workability requirement for different types of concrete works. Segregation, bleeding and preventive measures. 3.4 Properties of Hardened concrete: compressive strength, durability, impermeability and dimensional changes of concrete, creep and shrinkage. 3.5 Concrete Mix Design objectives, methods of mix design, study of mix design procedure by I.S. method as per I.S. 10262-(Only procedural steps) 3.6 Testing of concrete: Significance of testing, determination of compressive strength of concrete cubes at different ages, interpretation and co-relation of test results. Non- destructive testing of concrete: Importance of NDT, methods of NDT(only List of methods)	Lecture Using Chalk-Board Video Demonstrations Hands-on Site/Industry Visit Collaborative learning Case Study
4	TLO 4.1 Explain the sequential operations of concreting in given situation. TLO 4.2 Explain the given type of form works and stripping time. TLO 4.3 Identify the type of construction joint to be used in given situations of concreting works, with justification.	**Unit - IV Quality Control of Concrete** 4.1 Concrete operations: Batching – Definition and types of Batching, Mixing – Types of Mixing and Mixers, Transportation- Modes of Transportation of concrete, precautions to be taken during transportation, Placing- placing of concrete in form work, precautions to be taken while placing of concrete, Compaction of concrete-methods of compaction, care to be taken during compaction, Finishing of concrete-purpose of finishing, types of Finishing, Curing of concrete-definition of curing, necessity of curing, different methods of curing and their application 4.2 Formwork for concreting: Different types of formworks for beams, slabs, columns. Materials used for form work. Requirement of good form work. Stripping time for removal of formworks per IS 456-2000 provision for different structural members. 4.3 Joints in concrete construction: Types of joints, joining old and new concrete, methods of joining, materials used for filling joints.	Lecture Using Chalk-Board Video Demonstrations Hands-on Site/Industry Visit Collaborative learning Cooperative Learning

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Justify the need of given admixtures in concrete mix. TLO 5.2 Describe the characteristics and uses of given type of Mineral admixtures in concrete. . TLO 5.3 Select the type of Special Concrete in the given situation with justification.	**Unit - V Admixture in concrete and Special Concrete** 5.1 Admixture in concrete: Purpose, properties and application for different types of admixture such as accelerating admixtures, retarding admixtures, water reducing admixture, air entraining admixture, plasticizers and super plasticizers, (IKS*: Paste of Vegetable Extract and Jaggery used as a admixture in the construction of Vadakumnathan temple, Tirussur, Kerala, India .) 5.2 Cementitious (Mineral) Admixtures: Fly ash, Silica Flume, Blast furnace slag, its use, properties and effects 5.3 Special Concrete: Properties, advantages and limitation of the following types of Special concrete: Ready mix Concrete, Fiber Reinforced Concrete, High performance Concrete and self-compacting concrete, light weight concrete.	Lecture Using Chalk-Board Video Demonstrations Case Study Site/Industry Visit Collaborative learning Presentations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Check suitability of cement based on its fineness.	1	Determine fineness of cement by Blaine's air permeability apparatus or by sieving.	2	CO1
LLO 2.1 Propose the water cement ratio for the given type of cement.	2	*Determine standard consistency, initial and final setting times of OPC.	2	CO1
LLO 3.1 Undertake the testing on the given type of cement to determine its compressive strength.	3	*Determine compressive strength of ordinary Portland cement.	2	CO1
LLO 4.1 Measure the volumetric changes in the given sample of cement.	4	Determine the soundness of ordinary Portland cement (OPC)	2	CO1
LLO 5.1 verify the suitability of given sample of sand to prepare concrete	5	Determine silt content of given sample of sand by volume.	2	CO2
LLO 6.1 Undertake the required test to estimate the quantity of sand for preparing concrete	6	Determine bulking of the given sample of sand.	2	CO2
LLO 7.1 Use relevant aggregate for concrete mix design.	7	Determine bulk density of fine and coarse aggregates.	2	CO2
LLO 8.1 Decide percentage of absorbed water in aggregate and able to decide Water cement ratio.	8	Determine water absorption of fine and coarse aggregates.	2	CO2
LLO 9.1 Decide Grading of fine aggregates for quality of concrete Mix.	9	*Determine Fineness modulus of fine aggregate by sieve analysis.	2	CO2
LLO 10.1 Decide Grading of coarse aggregates for quality of concrete Mix.	10	*Determine Fineness modulus of coarse aggregate by sieve analysis.	2	CO2
LLO 11.1 Decide the suitability of coarse aggregate for wearing or non-wearing surfaces.	11	*Determine aggregate impact value or Crushing Value or Abrasion value	2	CO2
LLO 12.1 Decide the suitability of coarse aggregate for concrete work based on its size and shape.	12	*Determine aggregate elongation index and flakiness index.	2	CO2
LLO 13.1 Decide suitability of concrete according its workability in different situations.	13	*Determine workability of concrete by slump cone test or Compaction factor test.	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Measure the ability of concrete to resist the compressive loads.	14	*Determine compressive strength of concrete for 7 days	2	CO3
LLO 15.1 know the components parts of RMC and its functioning.	15	*Field Visit/video demonstration on RMC plant to understand the components and its functioning.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

specific learning / Skills Development (Self Learning)

- Prepare a list of IS codes with their Specifications required for Cement, Aggregate and concrete (Any three codes for each).
- Study of Sieve Analysis for WMM (Wet Mix Macadam) and GSB(Granular sub base) courses.
- Study of water quality parameters used in concrete as per IS 456.
- Study of various methods of NDT such as Rebound Hammer method and Ultrasonic pulse velocity test.
- Prepare a study report on hot & cold weather concrete.

Micro project

- Market survey to select type of cement for various types of construction works.
- Visit to site under construction to observe concreting operations.
- Visit to site under construction to observe the quality of fresh concrete.
- Visit to site under construction to observe form work, scaffolding used and joints in concrete.
- Search the software/freeware for the course content and prepare report stating their applications.
- Visit to site under construction to collect detail information about the ingredients of concrete mix.
- Market survey to select types of admixture for relevant construction work.
- Prepare mix design for the grade given by course teacher.
- Visit to stone crusher to observe its manufacturing.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Blaine's air permeability apparatus as per IS: 4031 (part 1)-1999, and sieve no. IS 90 micron - IS Brass Sieve (200 mm dia), 90 Micron size.	1

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
2	I S sieve set (sizes- 80 mm, 40 mm, 20 mm, 10 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 µ, 300 µ. 150 µ,90 µ and pan) , sieve shaker with adaptors	1,9,10,11
3	Aggregate impact testing apparatus with mould,	11
4	Aggregate crushing mould	11
5	Los Angeles abrasion testing machine	11
6	Elongation gauge and thickness gauge.	12
7	Slump cone(top dia.100mm, bottom dia.200mm, Height 300mm)	13
8	Compaction factor test apparatus	13
9	Table vibrator, moulds(150mm x150mmx 150mm)	14
10	Vicats apparatus- VICAT mould of dia. 80 mm & 40 mm high glass base plate, initial needle, final needle. Consistency plunger M.S. base plate (non porous) of weight 300 gm. Vicat mould split type with camping ring.	2
11	Measuring Cylinder 1000 ml capacity	2,3,5,6
12	Measuring Cylinder of 100 ml capacity	2,3,5,6
13	Compression testing machine-2000 kN capacity, Cement mortar cube vibrator-, moulds size 50 cm2 (7.07 cm x 7.07 cm)	3,14
14	Curing Tank	3,14
15	Le chatelier apparatus	4
16	Hot Air Oven	5,6,7,8,9,10,11,12
17	Density basket as per IS specification	7
18	Weighing Balance	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Cement	CO1	6	2	4	4	10
2	II	Aggregates	CO2	8	2	4	6	12
3	III	Concrete and its testing.	CO3	16	4	8	12	24
4	IV	Quality Control of Concrete	CO4	8	2	4	6	12
5	V	Admixture in concrete and Special Concrete	CO5	7	4	8	0	12
Grand Total				**45**	**14**	**28**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term work, Assignment, Micro project, SLH (60% Weightage to process and 40% weightage to product), Question and Answer

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test), Practical Exam,

XI. SUGGESTED COS - POS MATRIX FORM

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Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	2	2		2			
CO2	3	2	2	2	2		1			
CO3	2	2	3	2	2	1	2			
CO4	2	2	2	2	2	2	2			
CO5	2	2	2	1	2	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Gambhir, M.L.	Concrete Technology	Tata McGraw Hill Publishing Co. Ltd., New Delhi, ISBN-13: 978-1-259-06255-1
2	Shetty, M.S	Concrete Technology	S. Chand and Co. Pvt. Ltd., Ram Nagar, New Delhi-110055 ISBN, : 978-8-121-90003-4
3	Santhakumar ,A. R	Concrete Technology	Oxford University Press, New Delhi ISBN-13: 978-0-195-67153-7
4	Neville, A. M. and Brooks, J.J.	Concrete Technology	Pearson Education Pvt. Ltd., New Delhi ISBN 978-0-273-73219–8
5	Job Thomas	Concrete Technology	CENAGE Publication ISBN-13:978-81-315-2668-2

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://archive.nptel.ac.in/courses/105/102/105102012/	NPTEL Concrete Technology course by Dr. B. Bhattacharjee, Department of Civil Engineering, IIT Delhi
2	https://youtu.be/sl0smPfvVAo?list=PLkyVnO47pDX9YJglk1o2iYzWgABo5I_xA	Testing of Cement by NITTTR Chandigarh
3	https://www.nitttrchd.ac.in/sitenew1/nctel/civil.php	Practical's on Cement/Concrete/Aggregate by NITTTR Chandigarh
4	https://www.youtube.com/watch?v=yzpWGrh9j6Y	Workability of Concrete – Slump Cone Test. By Ultra tech cement.
5	https://www.youtube.com/watch?v=M9hkvS_OLmk	Ultrasonic Pulse Velocity Test on Concrete.
6	https://youtu.be/6iThtydES5c?si=OAOv5EW3lukFiFBD	Fineness of Cement as per IS 4031-Part1 by Sieving method
7	https://cs-iitd.vlabs.ac.in/List%20of%20experiments.html	Virtual laboratory practical on concrete technology

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Sr.No	Link / Portal	Description
8	https://www.researchgate.net/publication/283109018	Research Article on Knowing from the past – Ingredients and technology of ancient mortar used in Vadakumnathan temple, Tirussur, Kerala, India (for IKS) in Journal of Building Engineering, ELSEVIER Publication
9	https://youtu.be/83AcFYK-Eno?si=5HUfRSWIQOLftjvc	Rebound Hammer Test
10	https://youtu.be/KHDdhYVP_GI?si=p3ADC6IkclMTKnai	Visit to Ready mix concrete (RMC) batching plant | How RMC plant works?
11	https://youtu.be/SR_Eq9Z7tbM?si=FQlrkUkEBx5zidt8	Visit to RMC Concrete Batching Plant Animation video
12	https://youtu.be/rdtDV-bE0wo	The Overview of the Stages involved in Manufacture of Concrete

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 02/07/2024 **Semester - 3, K Scheme**