

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM COURSE TITLE: CONCRETE TECHNOLOGY (COURSE CODE: 3350602)

Diploma Programme in which this course is offered	Semester in which offered
Civil Engineering/ Transportation Engineering	5 th Semester

1. RATIONALE:

Cement mortar and concrete are the most widely used and versatile construction materials. It is the material of choice where strength, impermeability, durability, performance, fire resistance and abrasion resistance are required.

Concrete is generally a site-made material unlike other materials of construction and as such can vary to a great extent in its quality, properties and performance owing to use of natural materials except cement. The knowledge of concrete and its properties in the plastic condition and in hardened condition are highly important in order to make Civil Engineering Structure safe and serviceable. This course focuses on students' acquisition of knowledge, skills & practices in concrete works. The knowledge and application of such aspects is essential in developing a good technician who should be conversant with the tests of various components of concrete and site practices to maintain quality of concrete works.

2. LIST OF COMPETENCIES

The course content should be taught and implemented with the aim to develop required skills so that students are able to acquire following competencies:

- Determine various properties/ characteristics & parameters of concrete with respect to Construction and Engineering Applications
- Evaluate Engineering Properties / characteristics of concrete for their suitability for Engineering Structures

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- i. Evaluate physical properties of cement, sand and aggregates.
- ii. Describe proper method for making and curing of concrete.
- iii. Measure important properties of fresh and hardened cement concrete including NDT.
- iv. Explain properties of various types of Admixtures and their utility
- v. Design Concrete Mix as per IS method
- vi. Explain various types of special concrete and their use.
- vii. Explain methods to prevent and repair different types of the crack
- viii. Prepare summary of at least one research paper on concrete from any journal of civil engineering

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			C	ESE	PA	ESE	PA	150
03	00	02	05	70	30	20	30	

Legends: L- Lecture; T- Tutorial/Teacher Guided Student Activity; P - Practical; C –Credit; ESE-End Semester Examination; PA- Progressive Assessment

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (Outcomes in Cognitive Domain)	Topics and Sub-topics
Unit-I Materials for Concrete	1a. Evaluate physical properties of cement 1b. Evaluate Physical Properties of sand and aggregates used in concrete 1c. Test quality of water used in Concrete	1.1 Importance of cement in preparation of concrete, Chemical compound of ordinary Portland cement, Bougue's compounds and its functions 1.2 Types and Grades of cement and its uses 1.3 Physical properties- Fineness, consistency of Cement, IST & FST, Soundness & Compressive Strength of cement and its I.S. Requirements, Its Importance & their related Test as per Indian Standards 2.1 Role of Coarse & Fine Aggregates in Concrete, Classifications of aggregate on the basis of its size, shape, texture and weight Sieve Analysis, Water Absorption Specific Gravity of Fine Aggregate & Coarse Aggregate, Coarse Aggregate Impact Value, Crushing Value & Abrasion Value, Flakiness & Elongation Index, its importance & their related Test as per Indian Standards 1.1 Requirements of quality for water in concrete.

Unit	Major Learning Outcomes (Outcomes in Cognitive Domain)	Topics and Sub-topics
Unit-II Fresh Concrete	2a. Evaluate workability , harshness, segregation and bleeding properties of fresh concrete 2b. List the factors affecting workability 2c. Describe methods of measurement of workability , slump test & compaction factor test 2d. Describe methods of mixing of concrete 2e. Describe methods of compaction of concrete 2f. Describe methods of Curing 2g. List Effect of curing on development of strength of concrete	2.1 Fresh concrete and its properties - Workability, harshness, Segregation and bleeding 2.2 Factors affecting workability 2.3 Methods of measurement of workability Slump Test & Compaction Factor Test 2.4 Relation between workability and strength of concrete 2.5 Methods of mixing of concrete – Hand & Machine Mixing and its Transportation and Placing 2.6 Methods of compaction of concrete and its suitability 2.7 Factors affecting compaction 2.8 Curing and its importance , its methods and suitability 2.9 Effect of curing on development of strength of concrete
Unit-III Admixtures	3a Explain properties of various types of Admixtures and their utility	3 . 1 Admixtures and its benefits , Types of Admixtures - Accelerator and Retarder Plasticizer and Super Plasticizer Water roofing and Air entraining admixture 3.2 Utility of Admixtures
Unit-IV Hardened Concrete	4a Evaluate Properties of Hardened Concrete 4b Describe the steps to conduct Non Destructive Test of Concrete	4.1 Hardened Concrete and its Properties 4.2 Compressive Strength ,Tensile Strength, Bond Strength, Flexure Strength Durability, impermeability 4.3 Factors affecting Compressive Strength 4.4 Creep of Concrete & its effect , factors affecting Creep 4.5 IS Test Procedure to find Compressive & Tensile Strength of Concrete, Acceptance Criteria , Mean Strength & Standard Deviation 4.6 Durability of Concrete & factors affecting it 4.7 Economy of Concrete & factors affecting it 4.8 Methods of Non Destructive Test of Concrete Rebound Hammer Test, Ultrasonic Pulse Velocity Test 4.9 Importance of NDT

Unit	Major Learning Outcomes (Outcomes in Cognitive Domain)	Topics and Sub-topics
Unit-V Concrete Mix Design	5a Design Concrete Mix as per IS method	5.1 Factors affecting quality of concrete, Advantages of Quality control. 5.2 Concrete Mix Design and its importance. 5.3 Nominal Mix and Design Mix. 5.4 Factors affecting concrete mix design. 5.5 Different methods of Mix Design and its suitability. 5.6 I.S. method to design a Concrete Mix As per IS 10262-2009. 5.7 Example of Mix design as per I.S. method
Unit - VI Special Concrete & Concreting Techniques	6a Explain various types of special concrete and their use.	6.1 Light weight concrete 6.2 Plum concrete 6.3 Fibre reinforced concrete 6.4 Polymer concrete 6.5 High density concrete 6.6 No fines concrete 6.7 Ferro cement 6.8 Fly ash concrete 6.9 Pumped Concrete 6.10 Ready mix concrete
Unit -VII Prevention & Repair Techniques For Cracks	7a Explain various types of cracks in concrete structures and their causes. 7b Explain methods to prevent and repair the cracks.	7.1 Deterioration of concrete and 7.2 Corrosion of reinforcement 7.3 Types of deteriorations and its effects 7.4 Prevention of concrete deterioration 7.5 Effect of corrosion of reinforcement in concrete and remedial 7.6 Types ,causes and remedies of concrete cracks before hardening 7.7 Types ,causes and remedies of concrete cracks after hardening 7.8 Prevention of cracks 7.9 Materials for repair of cracks 7.10 Methods used for repair of cracked Concrete
Unit-VIII Modern Trend And Research Development In Concrete Technology	8a Explain about latest Developments in the field of concrete works. 8b Prepare summary of at least one research paper on concrete during the course from any journal of civil engineering	8.1 latest research and development in the field of concrete technology 8.2 Journals available in the library, its publishers, Editors and place of publications. 8.3 The various authorities in the field of concrete technology and their field of specialization.

6. SUGGESTED SPECIFICATION TABLE WITH HOURS& MARKS (Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Materials for Concrete	08	3	8	3	14
II	Fresh Concrete	08	2	2	8	12
III	Admixures	03	2	1	2	05
IV	Hardened Concrete	08	2	2	8	12
V	Concrete Mix Design	05	1	2	6	09
VI	Special Concrete & Concreting Techniques	04	1	2	4	07
VII	Prevention & Repair Techniques For Cracks	04	1	2	4	07
VIII	Modern Trend And Research Development in Concrete Technology	02	1	1	2	04
Total		42	13	20	37	70

Legends: R = Remember, U = Understand, A= Apply and above Level (Bloom's revised taxonomy)

Note: This specification table shall be treated as general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

7. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured. Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.*

S. No.	Unit No.	Practical/Exercise (Outcomes' in Psychomotor Domain)	Approx. Hrs. Required
1.	I	Test the cement for soundness	02
2.	I	Grade Aggregate into Fine and Coarse	02
3.	I	Determine Flakiness and Elongation Index	02
4.	I	Test Crushing Value for Aggregate	02
5.	I	Test Impact Value for Aggregate	02
6.	I	Determine Aggregate Abrasion Value	02

7.	II	Measure Workability (Slump, Compaction Factor Test)	02
8.	IV	Plot the effect of W/C ratio on Compressive Strength of Concrete	04
9.	IV	Conduct Split Cylinder Test	02
10.	IV	Conduct Pull Out Test to determine Bond Strength	02
11.	IV	Demonstrate Non-destructive Tests of Concrete	02
12.	IV	Project :- Concrete Mix Design as per I. S. Method	04
TOTAL HOURS			28

FIELD VISIT: Arrange field visit to cement factory and Ready Mix concrete plant and prepare a report which should be a part of term work

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Collect few Samples from nearby site & find out different Properties of concrete
- ii. Undertake visit to construction site and prepare the report
- iii. Visit to concrete Testing Laboratory for awareness related to other concrete Testing Equipment, concrete Testing Report

9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Show Video Clips of Concrete Testing, interact with students by asking questions
- ii. Show Picture Clips through Power Point regarding Testing of Concrete and its Commercial report
- iii. Video program on concrete tests – NPTEL & NITTTR - Bhopal

10. SUGGESTED LEARNING RESOURCES

A. List of Books:

No.	Title	Author	Publisher
1	Concrete Technology	M.S. Shetty	S.Chand& co.Ltd
2	Concrete Technology	M.L.Gambhir	Tata McGraw Hill Ltd.
3	Properties of Concrete	A.M.Neville	Pitman
4	Concrete Technology	Dr. K.T. Krishna swami	Dhanpatrai & sons
5	Concrete Technology	R.S. Vashney	Oxford & IBH Publishing co, Bombay

LIST OF RECOMMENDED I.S. PUBLICATIONS:

I.S. 269	Specifications for O.P.C.
IS.12269	Specifications for O.P.C.53 Grade
I.S. 383	Specifications for coarse and fine aggregates
I.S. 516	Methods of tests for strength of concrete
I.S. 2386 Part I to VIII	Methods of tests for aggregate for concrete
I.S.456	Code of practice for plain and R.C.C.
I.S. 2340	Methods for sampling of aggregates for concrete
Sp 23	Handbook for concrete Mix Design
I.S.4031	Methods of physical tests on Hydraulic cement

I.S. 13311	Methods of non destructive testing of concrete
I.S. 1199	Methods of sampling and analysis of concrete
I.S. 10262- 2009	Recommended guidelines for concrete mix design

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B. List of Major Equipment/Materials

- (i) Ennore sand of 3 grades (ii) Cube Moulds of size 7.07cm (iii) Mortar Mixer
 (iv) Compression Testing m/c (v) Le-chatlier mould (vi) Water bath (vii) I.S sieve sets
 (viii) Moulds for Aggregate Crushing and Impact Test (ix) Impact test Apparatus
 (x) Thickness and Length gauge (xi) Cube Moulds of size 15cms (xii) Slump cone
 (xiii) Compaction factor Apparatus (xiv) Schmidt Rebound Hammer (xv) Table Vibrator.

C List of Software/Learning Websites

- i. www.issnge.org
- ii. www.springer.com
- iii. www.britannica.com
- iv. www.trb.org
- v. www.nptel.ac.in

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. BG Rajgor**, H.O.D, App. Mech. , BBIT, V Vnagar
- **Prof. B G Bhankhar**, H.O.D, App. Mech., GP , Ahmedabad
- **Prof. K K Patel**, H.O.D, App. Mech. , GP, Rajkot
- **Prof. C H Bhatt**, Lam, Dr. S & S S Gandhi Engg. College, Surat
- **Prof. Bhruguli H Gandhi**, LAM, GGP, Ahmedabad

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. M C Paliwal**, Associated Professor, Department of Civil and Environmental Engineering.