

# **Techno India NJR Institute of Technology**



## **Course File**

**Concrete Technology (4CE4- 08)**

**(2022-23)**

Rakesh Yadav  
(Assistant Professor)  
**Department of CE**



# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

## SYLLABUS

II Year-IV Semester: B.Tech. (Civil Engineering)

### 4CE4-08: CONCRETE TECHNOLOGY

Credit: 3

Max. Marks: 150 (IA:30, ETE:120)

3L+0T+0P

End Term Exam: 3 Hours

SN	CONTENTS	Hrs.
1	<b>Introduction:</b> to objective, scope and outcome of the subject	1
2	<b>Ingredients of concrete:</b> Cement: hydration of cement and its basic compounds, structure of hydrated cement, C-S-H gel, heat of hydration, gel-space ratio etc.	2
3	<b>Aggregates:</b> types, physical properties and standard methods for their determination, including Grading of aggregates as per IS. Manufactured sand- properties and IS Specifications for use in concrete.	2
4	<b>Concrete:</b> Grade of concrete, proportioning of ingredients, water content and its quality, water/cement ratio and its role, Properties of fresh concrete including workability, air content, Flow ability, Segregation, Bleeding and Viscosity etc. Factors affecting, methods of determination.	4
5	Properties of hardened concrete such as strengths, permeability, creep, shrinkage, factors influencing, Standard tests on fresh and hardened concrete as per IS code. Aggregate- cement interface, its effect on properties of concrete.	4
6	<b>NDT:</b> Introduction and their importance. Application & use of Rebound Hammer, Ultra-sonic pulse velocity meter, Rebar & Cover meter, half-cell potential meter, corrosion resistivity meter, core sampling. Interpretation of their results,	4
7	<b>Concrete Handling in Field:</b> Batching, mixing, placing and transportation of concrete, equipment's for material handling, various methods their suitability and precautions. Compaction of concrete: methods & equipment. Curing of concrete: various methods their suitability.	4
8	Durability of concrete. Causes of deterioration, Carbonation, Tests for durability assessment	3
9	<b>Admixture in concrete:</b> Chemical and mineral admixtures, their types and uses: accelerator, retarders, water-proofing, plasticizers, super plasticizers- types, their suitability. Fly ash-properties for use in concrete, specifications of fly ash as per IS 3812, and effect on properties of concrete. GGBFS, Micro silica and metakaolin- properties, specifications and utility in concrete.	7

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Rajasthan Technical University, Kota



**RAJASTHAN TECHNICAL UNIVERSITY, KOTA**  
**SYLLABUS**  
**II Year-IV Semester: B.Tech. (Civil Engineering)**

<b>10</b>	Concrete mix design (IS method)- with and without water reducing admixtures	<b>2</b>
<b>11</b>	<b>Form work:</b> Requirements, their types. Typical formworks and shuttering/centering for Columns, beams, slabs, walls, etc. Slip and moving formwork.	<b>3</b>
<b>12</b>	<b>Special types of concrete:</b> Sulphate resisting concrete, under water concreting, pump able concrete: methods and issues in making, salient properties and applications.	<b>3</b>
<b>13</b>	Concretes with tailored properties- including high performance concrete, with specific properties in fresh and hardened states, self-compacting concrete-materials, mix proportioning, test methods, use and applications with case studies.	<b>3</b>
<b>TOTAL</b>		<b>42</b>

## Course Overview:

The course on “Concrete Technology” focuses on concrete making materials including supplementary cementations materials. Concrete production process also forms a part of the discussion. Going through the course one would develop first-hand knowledge on concrete production process and properties and uses of concrete as a modern material of construction. The courses will enable one to make appropriate decision regarding ingredient selection and use of concrete. This course broadly encompasses the study of properties of ingredients of concrete, design of concrete mix, production of concrete and various concreting operations. Cementing material is the vital component of the concrete, hence study of process of manufacturing of cement, types of cement and their properties are covered in this course. Study of properties of aggregates and water also finds their due coverage in the course. Process of concrete production and concreting operations also forms an essential component of the course. In addition to the study of special purpose concretes, the course also provides the due coverage of admixtures which are added to modify the properties of concrete. Properties of concrete in plastic as well as in hardened stage find its due coverage in this course. The course aims at imparting knowledge and skill to supervise concreting operations involving proportioning, mixing, transporting, placing, compacting, finishing and curing of

## Course Outcomes:

CO. NO.	Cognitive Level	Course Outcome
1	Application	Understand chemistry, properties, and classification of cement, fly ash, aggregates and admixtures, and hydration of cement in concrete.
2	Application	Execute the test for fresh concrete.
3	Analysis	Execute the test for hardened concrete with destructive and non-destructive testing instruments.
4	Design	Implement India standard codes procedure for design concrete mix of desired grade.
5	Application	Learner can state the concrete handling equipment and different special concrete types.

## Prerequisites:

1. Student will be able to understand chemistry, properties, and classification of cement, fly ash, aggregates and admixtures, and hydration of cement in concrete.
2. Student will be able to Prepare and test the fresh concrete.
3. Students will be able to Test hardened concrete with destructive and non-destructive testing instruments.
4. Students will be able to Design concrete mix of desired grade.
5. Students will be able to get acquainted to concrete handling equipment and different special concrete types.

### Course Outcome Mapping with Program Outcome:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO247.1	3	1	2	1	1	2	2	1	1	1	1	1	2	1	1
CO247.2	3	2	2	1	1	1	1	1	1	1	1	2	2	1	1
CO247.3	3	1	2	1	1	2	2	1	1	1	1	1	2	1	1
CO247.4	3	3	3	3	2	2	2	1	1	1	1	2	2	1	1
CO247.5	3	1	2	1	1	2	1	1	1	1	1	1	2	1	1
CO247 (AVG)	3	1.6	2.2	1.4	1.2	1.8	1.6	1	1	1	1	1.4	2	1	1

### Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	1	<b>INTRODUCTION:</b> Objective, scope and outcome of the course.
2	2	Student should be able to understand hydration of cement and its Basic compounds
3	2	Student should be able to understand Structure of hydrated cement, C-S-Hgel
4	2	Student should be able to understand Heat of hydration, gel-space ratio etc.
5	3	Student should be able to understand Types, physical properties of aggregate.
6	3	Student should be able to understand Standard methods for their determination, including Grading of Aggregates as per IS
7	3	Student should be able to understand Manufactured sand- properties and IS Specifications for use in Concrete.
8	4	Student should be able to understand Grade of concrete, proportioning of ingredients, water Content and its quality
9	4	Student should be able to understand Water/cement ratio and its role, Properties of fresh concrete Including workability
10	4	Student should be able to understand Air content, Flow ability, Segregation, Bleeding and Viscosity etc.
11	4	Student should be able to understand Factors affecting, methods of determination
12	5	Student should be able to understand PROPERTIES OF HARDENED CONCRETE: Strengths and permeability
13	5	Student should be able to understand Creep, shrinkage, factors influencing

14	5	Student should be able to understand Standard tests on fresh and hardened concrete as per IS code
15	5	Student should be able to understand Aggregate- cement interface, its effect on properties of concrete
16	6	Student should be able to understand Application of NDT& use of Rebound Hammer
17	6	Student should be able to understand Ultra-sonic pulse velocity meter, Rebar & Cover meter
18	6	Student should be able to understand Half-cell potential meter, corrosion resistivity meter
19	6	Student should be able to understand Core sampling. Interpretation of their results
20	7	Student should be able to understand CONCRETE HANDLING IN FIELD: Batching, mixing
21	7	Student should be able to understand Placing and transportation of concrete
22	7	Student should be able to understand Equipment's for material handling, various methods their suitability and precautions
23	7	Student should be able to understand Compaction of concrete: methods & equipment's
24	7	Student should be able to understand Curing of concrete: various methods their suitability
25	8	Student should be able to understand DURABILITY OF CONCRETE: Causes of deterioration
26	8	Student should be able to understand Carbonation process.
27	8	Student should be able to understand Tests for durability assessment.
28	9	Student should be able to understand about Chemical and mineral admixtures, their Types and uses
29	9	Student should be able to understand about Accelerator, retarders
30	9	Student should be able to understand about Water-proofing, plasticizers
31	9	Student should be able to understand about Super plasticizers-types, their suitability
32	9	Student should be able to understand about Fly ash-properties for use in concrete
33	9	Student should be able to understand Specifications of fly ash as per IS 3812, and effect on properties of Concrete
34	9	Student should be able to understand about GGBFS: properties, specification and utility in concrete
35	9	Student should be able to understand about Micro silica: properties, specifications and utility in concrete

36	<b>9</b>	Student should be able to understand about Metakaolin: properties, specifications and utility in concrete
37	<b>10</b>	Student should be able to understand CONCRETE MIX DESIGN (IS METHOD): with water reducing admixtures
38	<b>10</b>	Student should be able to understand Concrete mix design (IS method): without water reducing Admixtures
39	<b>10</b>	Student should be able to understand about Form work: Requirements, their types
40	<b>10</b>	Student should be able to understand about Typical formworks and shuttering/centering for Columns, beams
41	<b>11</b>	Student should be able to understand about TYPICAL FORMWORKS AND SHUTTERING/centering for slabs, walls, etc
42	<b>11</b>	Student should be able to understand about Slip and moving formwork

### **TEXT/REFERENCE BOOKS**

1. Concrete Technology by M. S. Shetty, S. Chand & Co.
2. Concrete Technology by Neville & Brooks, Pearson Education.
3. Concrete: Microstructure, Properties & Materials by Mehta P. K, Tata McGraw Hill.

**Course Level Problems (Test Items):**

<b>Co.NO.</b>	<b>Problem description</b>
<b>1</b>	A. Explain flakiness index and elongation index B. Describe field testing of cement. C. Distinguish between setting and hardening of cement.
<b>2</b>	A. State factors affecting durability of concrete and state prevention for anyone. B. State factors affecting durability of concrete and state prevention for any one C. State methods of application of repair materials for cracked concrete and explain any one method.
<b>3</b>	A. Explain procedure to determine soundness test of cement. B. Explain procedure to determine aggregate crushing value test. C. Explain procedure to determine aggregate impact value test.
<b>4</b>	A. State methods of mixing of concrete and explain anyone. B. State different methods of transportation of concrete. C. State different methods of compaction of concrete.
<b>5</b>	A. Explain procedure to determine compressive strength test of cement. B. Explain procedure to determine soundness test of cement. C. Explain procedure to determine aggregate crushing value test.

**Assessment Methodology:**

1. Practical exam in lab where they have to analyze problem statement. (Once in a week)
2. Assignments one from each unit.
3. Midterm subjective paper based on topics as mentioned in the modules. (Twice during the semester)
4. Final paper at the end of the semester subjective.



## Teaching and Learning resources unit-wise:

INTRODUCTION: Objective, scope and outcome of the course.

Video Tutorials: <https://youtu.be/cx5gPKp9QEc>

Theory concepts: [https://www.cement.org/learn/concrete-technology#:~:text=In%20its%20simplest%20form%2C%20concrete,and%20coarse%20\(larger\)%20aggregates.](https://www.cement.org/learn/concrete-technology#:~:text=In%20its%20simplest%20form%2C%20concrete,and%20coarse%20(larger)%20aggregates.)

Concrete.

Video Tutorials: <https://youtu.be/UU6PccuoleE>

Theory concepts: <https://en.wikipedia.org/wiki/Concrete>

A. flakiness and elongation test

Video Tutorials: <https://youtu.be/pZOBN-hIgiE>

Theory concepts: <https://helptheengineer.com/determination-of-indices-flakiness-and-elongation/#:~:text=The%20Flakiness%20Index%20of%20aggregates,1.8%20times%20their%20mean%20dimension.>

B. concrete preparation

Video Tutorials: <https://youtu.be/3UyqRqcdWLw>

Theory concepts: [http://www.madehow.com/Volume-1/Concrete.html#:~:text=First%2C%20the%20cement%20\(usually%20Portland,placed%2C%20compacted%2C%20and%20cured.](http://www.madehow.com/Volume-1/Concrete.html#:~:text=First%2C%20the%20cement%20(usually%20Portland,placed%2C%20compacted%2C%20and%20cured.)

A. concrete crack

Video Tutorials: <https://youtu.be/lwKFJTYgMjk>

Theory concepts: <https://concretesupplyco.com/6-concrete-cracks/#:~:text=When%20the%20top%20of%20a,or%20pattern%20to%20concrete%20surfaces>

B. admixtures

Video Tutorials: <https://youtu.be/bl4g38BuvlA>

Theory concepts: [https://www.cement.org/learn/concrete-technology#:~:text=In%20its%20simplest%20form%2C%20concrete,and%20coarse%20\(larger\)%20aggregates.](https://www.cement.org/learn/concrete-technology#:~:text=In%20its%20simplest%20form%2C%20concrete,and%20coarse%20(larger)%20aggregates.)

## **ASSIGNMENT NO. 1**

**B TECH (Civil) 2<sup>nd</sup> YEAR (IV SEM.)**

### **CONCRETE TECHNOLOGY**

#### Part - 1

- A. What are admixture write types of admixture?
- B. Define Self Compacting Concrete?
- C. Define actions of plasticizer?
- D. What do you mean by durability of concrete?
- E. What do you mean by carbonation of concrete?

#### Part - 2

1. Write process of manufacture of concrete?
2. Explain Slump cone test for self-compacting concrete?
3. Explain use of silica fume as admixture in concrete?
4. Discuss factors affecting compressive strength of concrete?

## **ASSIGNMENT NO. 2**

**B TECH (Civil) 2<sup>nd</sup> YEAR (IV SEM.)**

### **CONCRETE TECHNOLOGY**

Part- A

- A. What is retarder?
- B. Differentiate between Nominal mix and Design mix
- C. Write the principle of ultrasonic-pulse velocity meter?
- D. Write two examples of plasticizer?
- E. Define high performance concrete?

Part- B

- 1. Please explain underwater concreting?
- 2. Explain J ring test?
- 3. Explain Rebound hammer test
- 4. Describe the requirement of a good formwork?
- 5. Explain fly ash?

### Objective Questions

1. What is Concrete Technology?
  - a) Concrete Technology deals with the study of bricks
  - b) Concrete Technology is the study of building materials
  - c) Concrete Technology deals with the study of properties of concrete
  - d) None of the mentioned(c)
  
2. What is concrete?
  - a) A mixture of homogenous materials
  - b) A mixture of material and hydrogen
  - c) A mixture of cement and hydrogen sulphide
  - d) A mixture of cement, water, and aggregates(d)
  
3. Why concrete technology is needed?
  - a) Concrete technology is needed to build a building
  - b) Concrete technology is needed to address properties of concrete
  - c) Concrete technology is needed to produce building materials
  - d) None of the mentioned(b)
  
4. What are the ingredients of concrete?
  - a) Binding material
  - b) Fine aggregate
  - c) Admixtures
  - d) All of the above(d)
  
5. Which of the following cement is used for interior and exterior decorative works?
  - a) Low Heat Cement
  - b) High Alumina Cement
  - c) Rapid Hardening Cement
  - d) Colored Cement(d)
  
6. Which of the following ratio is also known as water-cement ratio?
  - a) Weight of water to the weight of aggregates
  - b) Density of cement to the Density of cement
  - c) Weight of water to the weight of cement
  - d) Volume of cement to the volume of cement(c)
  
7. What is the total percentage of aggregates in concrete in terms of volume?
  - a) 65-80%
  - b) 90%
  - c) 60-75%
  - d) 40%(c)

8. What happens if mineral oil is present in mixing for concrete?
- a) Gives more slump
  - b) Improves strength
  - c) Gives a smooth surface
  - d) Reduces strength
- (b)
9. . What is wet process?
- a) Grinding and mixing of the raw materials in their overheated state
  - b) Grinding and mixing of the raw materials in their wet state
  - c) Grinding and mixing of the raw materials in their dry state
  - d) Grinding and mixing of the raw materials in their medium state
- (b)
10. . Which of the following increases the workability of concrete?
- a) Decreasing size of aggregates
  - b) Increasing flaky aggregates
  - c) Increasing size of aggregates
  - d) Increasing fine aggregates
- (c)

# TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

CE/ME B. TECH 2<sup>nd</sup> - YEAR (IVSEM.) - MT-I

Subject Name:-Concrete Technology (4CE4-08)

Time: 3 Hr

Max. Marks:70

**Note:**

- 1) The paper is divided into 2 parts: Part-A and, Part-B.
- 2) Part-A contains 10 questions and carries 2 mark each.
- 3) Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

**Part- A (20 Marks)**

A	Write the name of basic compound of cement and their role in hydration of cement.	CO1
B	Discuss the significance of C-S-H Gel	CO1
C	What do you mean by Heat of Hydration?	CO1
D	Brief the term of grading of aggregates	CO1
E	How do you mean by the aggregates-silica reaction.	CO2
F	Discuss the role of Water Cement ratio in concrete.	CO2
G	Describe in brief the phenomenon of bleeding and segregation of concrete.	CO2
H	What is aggregate-cement interface? How its effect on properties of concrete.	CO2
I	Write the principle of ultrasonic-pulse velocity meter.	CO3
J	Write the principle of half cell potential meter.	CO3

**Part- B (50 Marks)**

1. Discuss and compare in detail the role of C <sub>3</sub> S, C <sub>2</sub> S and C <sub>3</sub> A in governing the various properties of cement.	CO1
OR	
1. Explain the gradation of aggregates for fresh concrete.	CO1
OR	
2. How is workability of fresh concrete determined? Also discuss factors affecting it	CO1
OR	
2. Write a note on Process of Manufacture of Concrete	CO1
OR	
3. Differentiate between: a) Elongated and flaky aggregates    b) Segregation and bleeding	CO2
OR	
3. Differentiate between weigh batching and volume batching	CO2

4. List the types of shrinkage of concrete. Describe plastic shrinkage and its preventive measures to reduce plastic shrinkage.	CO2
OR	
4. Explain in detail Properties of Hardened Concrete	CO2

5. What are the types of NDT for hardened concrete? Explain rebound hammer test and its limitations.	CO3
OR	
5. Explain application and use of ultrasonic-pulse velocity meter.	CO3

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# TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

B. TECH (Civil) 2<sup>nd</sup> YEAR (IV SEM.) – MT II

CONCRETE TECHNOLOGY (4CE4-08)

Time: 2 Hr.

Max. Marks: 70

**Note:**

- 1) The paper is divided into 2 parts: Part-A and, Part-B.
- 2) Part-A contains 10 questions and carries 2 mark each.
- 3) Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

Part- A (20 Marks)

A.	What are admixture write types of admixture?	CO3
B.	What is retarder?	CO3
C.	Define Self Compacting Concrete?	CO4
D.	Differentiate between Nominal mix and Design mix	CO4
E.	Define actions of plasticizer?	CO4
F.	What do you mean by durability of concrete?	CO4
G.	What do you mean by carbonation of concrete?	CO5
H.	Define aggregate silica reactions?	CO5
I.	Write the principle of ultrasonic-pulse velocity meter?	CO5
J.	Write two differences between bleeding and segregation of concrete?	CO5

Part- B (50 Marks)

1.	Write process of manufacture of concrete?	CO3
OR		
1.	A. What is pumping able concrete? Explain design consideration for pump able concrete? B. Please explain underwater concreting?	CO3
OR		
2.	A. Explain Slump cone test for self-compacting concrete? B. Explain J ring test?	CO4
OR		
2.	A. Explain v funnel test? B. Explain fill box test?	CO4
OR		
3.	A. Difference between Retarder and accelerator admixture B. Difference between Chemical and mineral admixture	CO4
OR		
3.	A. Explain use of silica fumes as admixture in concrete? B. Explain use of fly Ash as admixture in concrete?	CO4

4. A. Discuss formwork of walls & column with appropriate figures? B. Discuss formwork of beam slab and arches?	CO5
OR	
4. A. Describe the requirement of a good formwork? B. discuss about slip moving formwork	CO5

5. A. Discuss factors affecting compressive strength of concrete? B. Discuss durability of concrete and factor affecting durability?	CO5
OR	
5. Explain following type of concrete 1) Sulphate resisting concrete 2) self-compacted concrete B. Explain following NDT test in detail 1) Rebound hammer test 2) half-cell potential meter	CO5

4E1318

Roll No. \_\_\_\_\_

Total No. of Pages: 2

**4E1318**

**B. Tech. IV - Sem. (Main) Exam., - 2022**

**Civil Engineering**

**4CE4 – 08 Concrete Technology**

**Time: 3 Hours**

**Maximum Marks: 70**

*Instructions to Candidates:*

*Attempt all ten questions from Part A. Five questions out of seven questions from Part B and three questions out of five from Part C.*

*Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

*Use of following supporting material is permitted during examination. (Mentioned in form No. 205)*

1. NIL

2. NIL

**PART – A**

**(Answer should be given up to 25 words only)**

**[10×2=20]**

**All questions are compulsory**

- ~~Q.1~~ List the Bogue's compounds present in cement with its composition.
- ~~Q.2~~ Write about heat of hydration.
- ~~Q.3~~ What is the purpose of adding an air entraining admixture to concrete?
- ~~Q.4~~ Differentiate between Nominal Mix and Design Mix.
- ~~Q.5~~ What is Batching in concrete?
- ~~Q.6~~ Define Laitance.
- ~~Q.7~~ Name any four properties of hardened concrete.
- ~~Q.8~~ On what circumstances high grade concretes are utilize effectively?
- ~~Q.9~~ What is the use of IS 383?
- ~~Q.10~~ Name the admixture used for quick setting of concrete.

## PART - B

(Analytical/Problem solving questions)

[5×4=20]

Attempt any five questions (Word limit 100)

- ~~Q.1~~ Explain initial and final setting time of cement.
- ~~Q.2~~ What is curing of concrete and its significance?
- ~~Q.3~~ Differentiate between accelerators and retarders.
- ~~Q.4~~ Classify the aggregate and its important role in concrete.
- Q.5 Discuss the tests for workability of concrete.
- ~~Q.6~~ Describe the durability of concrete.
- Q.7 Explain the effect of GGBFS on concrete properties.

## PART - C

(Descriptive/Analytical/Problem Solving/Design Questions)

[3×10=30]

Attempt any three questions

- ~~Q.1~~ Explain the hardening and strength gaining of cement.
- Q.2 Find the quantity of Cement, Coarse Aggregate and Fine Aggregate in  $\text{Kg/m}^3$  by IS method for the following requirements: <https://www.rtuonline.com>
- (a) Characteristics compressive strength at 28 days: 25  $\text{N/mm}^2$
  - (b) Maximum nominal size of aggregate: 20 mm
  - (c) Shape of aggregate: angular
  - (d) Slump requirement: 50 mm
  - (e) Sand Zone -II
  - (f) Free Water Cement Ratio: 0.55(for mild exposure, Reinforced Concrete)
  - (g) Specific Gravity of cement = 3.15, Coarse aggregate = 2.7, and Fine aggregate = 2.6
  - (h) Water absorption of Coarse aggregate = 0.5%, Fine aggregate = 1%
- ~~Q.3~~ How will you determine the compressive strength of cement? Explain briefly the procedure.
- Q.4 Write short note of any two NDT method.
- ~~Q.5~~ What are Super Plasticizers? How are these helpful in modifying the properties of concrete?

