# AN INTRODUCTION TO CONCRETE TECHNOLOGY
## (CIVL 4126)

**Time Allotted : 2½ hrs** **Full Marks : 60**

***Figures out of the right margin indicate full marks.***

***Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.***

***Candidates are required to give answer in their own words as far as practicable.***

## Group – A

1. Answer any twelve: **12 × 1 = 12**

*Choose the correct alternative for the following*

(i) The approximate ratio between the strengths of cement concrete at 7 days and 28 days is
(a) 3/4 (b) 2/3 (c) 1/2 (d) 1/3

(ii) The maximum heat of hydration per gram of individual cement compound is
(a) $C_3S$ (b) $C_2S$ (c) $C_3A$ (d) $C_4AF$

(iii) Use of accelerators in concrete
(a) shortens the setting time
(b) increases the early strength of concrete
(c) increases the time of setting
(d) all of these

(iv) If the slump of concrete mix is 75 mm, it's workability is considered to be
(a) very high (b) high
(c) medium (d) low

(v) Vicat's apparatus is used to determine which of the following properties of cement?
(a) Normal consistency (b) Initial setting time
(c) Final setting time (d) Fineness.

(vi) The pH value of water for concrete construction is
(a) 3-4 (b) 5-6 (c) 8-9 (d) 6-8.

(vii) Creep of concrete influenced by
(a) strength of concrete (b) age of concrete
(c) water-cement ratio (d) all of these.

(viii) The nominal mix proportion of M20 grade concrete is
(a) 1:2:4 (b) 1:3:6 (c) 1:1:2 (d) 1:2:6.

(ix) The property of fresh concrete in which the water in the mix tends to rise to surface while placing and compacting, is called
(a) segregation (b) bleeding
(c) bulking (d) creep.

(x) Air entrainment in concrete increases
(a) workability (b) strength
(c) effect of temperature variation (d) unit weight.

*Fill in the blanks with the correct word*

(xi) Air permeability method is used to determine _____.

(xii) The relationship between strength of concrete and cement-water ratio is _____.

(xiii) In order to obtain the best workability of concrete, the preferred shape of aggregate is _____.

(xiv) Ratio of compressive strength to tensile strength of concrete _____ (increases / decreases) with age.

(xv) Lighweight concrete exhibits _____ shrinkage than normal weight concrete.

## Group - B

2. (a) Explain how presence of minerals in water influence the properties of fresh concrete. Also mention the tolerance concentration of various impurities in mixing water. *[(CO1)(Understand/LOCQ)]*

(b) Define "workability" of fresh concrete. Also explain the different factors which affect workability of concrete. *[(CO2)(Understand/LOCQ)]*

**(3 + 4) + (2 + 3) = 12**

3. (a) What are segregation and bleeding? Explain. *[(CO2)(Remember/LOCQ)]*

(b) Write short note on "alkali aggregate reaction"? *[(CO2)(Remember/LOCQ)]*

(c) What is the difference of fine and coarse aggregate? How will you define elongation and flakiness index of coarse aggregate? *[(CO2)(Understand/LOCQ)]*

**(2 + 2) + 4 + 4 = 12**

## Group - C

4. (a) With neat sketches, describe briefly the following,
(i) Slump Cone test
(ii) Compacting factor Test
Also, mention various values of slump and compacting factor for concrete mixes. *[(CO2)(Analyse/HOCQ)]*

(b) What gel-space or hydrate space ratio and how does it validates Abram's law of water-cement ratio? *[(CO2)(Apply/IOCQ)]*

**(6 + 2) + 4 = 12**

5. (a) Following is the result of a sieve analysis of 500 gm aggregate.

| IS sieve size | Weight retained (gm.) |
|---|---|
| 10 mm | 0 |
| 4.75 mm | 10 |
| 2.36 mm | 50 |
| 1.18 mm | 50 |
| 600 μ | 95 |
| 300 μ | 175 |
| 150 μ | 85 |
| Lower than 150 μ | 35 |

Determine the Fineness Modulus (F.M.) of the aggregate sample. *[(CO3)(Analyse/HOCQ)]*

(b) Explain various methods of curing of concrete. *[(CO3)(Remember/LOCQ)]*

(c) Define creep. What are it's advantages and disadvantages? *[(CO2)(Understand/LOCQ)]*

**4 + 4 + 4 = 12**

## Group - D

6. (a) What are admixture? Describe the effects of flowing admixtures on cement concrete with three examples of each:
(i) Retardars
(ii) Accelerators
(iii) Water reducers. *[(CO4)(Remember/LOCQ)]*

(b) Provide the steps involved in mix proportioning. *[(CO4)(Understand/IOCQ)]*

**(2 + 6) + 4 = 12**

7. Design a concrete mix of M45 grade pumpable concrete mix having a slump of the order of 100-125 mm using grade OPC 43 conforming to IS: 8112 for a reinforced concrete high rise building subjected to very severe exposure conditions during it's service life with the following data as per IS:10262:2009.
Fine aggregate is natural river and conforming to grading zone- I (fineness modulus of 2.4), specific gravity of 2.62, moisture content of 2.0%, absorption of 1.0%, coarse aggregate crushed (angular) stone chips of 10 mm and 20 mm maximum size conforming to IS 383 code requirements with specific gravity of 2.67, moisture content of 1.0% and absorption of 0.5%, specific gravity of cement is 3.15. Degree of quality control at site is good and super-plasticizer conforming to IS: 9103 may be used. Assume, also the following values of other data as may be required for your design: Standard Deviation= 5.0 MPa; air content= 2.0%; Maximum allowable w/c ratio= 0.4; minimum and maximum cement content = 375 kg/$m^3$ and 475 kg/$m^3$, respectively. *[(CO3)(Construct/HOCQ)]*

**12**

## Group - E

8. (a) What is "Polymer concrete"? Discuss the advantages and disadvantages of polymer concrete. *[(CO5)(Remember/LOCQ)]*

(b) What are the advantages of PPC over OPC? Explain briefly about light-weight concrete. *[(CO5)(Understand/IOCQ)]*

**(2 + 4) + 6 = 12**

9. (a) Introduce the following tests:
   (i) Rebound hammer test in concrete
   (ii) Ultrasonic pulse velocity test in concrete. *[(CO6)(Understand/IOCQ)]*

   (b) Explain the factors affecting the properties of fiber-reinforced concrete. *[(CO5)(Understand/IOCQ)]*

   (c) Explain the following:
   (i) GGBFS
   (ii) Fly ash. *[(CO5)(Remember/LOCQ)]*

**(3 + 3) + 2 + 4 = 12**

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| Cognition Level | LOCQ | IOCQ | HOCQ |
|---|---|---|---|
| Percentage distribution | 52.08 | 22.92 | 25 |

**Course Outcome (CO):**

After going through this course, the students will be able to:
1. Understand the properties of ingredients of concrete.
2. Study the behavior of concrete at its fresh and hardened state.
3. Study about the concrete design mix.
4. Know about the procedures in concreting.
5. Understand special concrete and their use.
6. Understand the various Non-Destructive tests.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*