AN INTRODUCTION TO CONCRETE TECHNOLOGY
(CIVL 4126)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The slump test of cement concrete determines it's
(a) strength (b) workability (c) durability (d) microstructure.

(ii) In terms of oxide composition, the minimum percentage of ingredient in the cement is that of
(a) lime (b) magnesium oxide (c) iron oxide (d) alumina.

(iii) The permissible limits for sodium and potassium carbonates and bicarbonates concentration in water required for concreting is:
(a) 500 ppm (b) 600 ppm (c) 200 ppm (d) 1000 ppm.

(iv) The pH level of water required for concreting should be
(a) less than 6 (b) more than 8
(c) more than 10 (d) between 6-8.

(v) Adding an accelerator to concrete increases all of the following except:
(a) resistance to alkali-aggregate reaction
(b) rate of hydration of cement
(c) shrinkage
(d) rate of evolution of heat.

(vi) Workability of fresh concrete is most appropriately defined by
(a) the composite property satisfying the requirements of mixability, stability, transportability, placeability, mobility, compatibility and finishability
(b) ease and homogeneity with which it can be mixed, placed, compacted and finished
(c) it's consistency and plasticity
(d) its slump and compaction factor values.

(vii) An admixture which slows down the process of hydration of concrete to keep it plastic for a long time
(a) retarder (b) accelerator
(c) water reducer (d) both option (a) and (b).

(viii) Shrinkage increases with
(a) increase in the water-cement ratio (b) increase in cement content
(c) decrease in humidity (d) all of the above.

(ix) The target mean strength of concrete mix is given by: (where, f_{ck}= characteristic compressive strength of concrete, k= factor, S= Standard deviation)
(a) $f_t = kf_{ck} + S$ (b) $f_t = k + S$
(c) $f_t = f_{ck} + S$ (d) $f_t = f_{ck} + kS$

(x) The lightweight concrete is prepared by _____
(a) mixing Portland cement with saw dust in specified proportion in concrete
(b) using coke-breeze, slag as aggregate in concrete
(c) mixing aluminium in concrete
(d) mixing Fe in concrete.

Group - B

2. (a) Explain in details the various qualities of water to be used for proper workable and good concreting. [(CO1)(Remember/LOCQ)]
(b) Mention the chemical composition of ordinary Portland cement. [(CO1)(Understand/LOCQ)]
(c) Identify the relationship between gel-space ratio and Abram's law of water-cement ratio. [(CO2)(Apply/IOCQ)]
4 + 4 + 4 = 12

3. (a) Summarize various factors on which the workability of concrete depends. Explain in details [(CO2)(Understand/LOCQ)]
(b) Explain any two tests to determine workability of concrete. Also provide diagrams. [(CO2)(Understand/LOCQ)]
6 + 6 = 12

Group - C

4. (a) Demonstrate the concept of maturity of concrete. Strength of a sample of fully matured concrete is found to be 40.0 MPa. Find the strength of identical concrete at the age of 7 days when cured at an average temperature during day time at 20^0C and at night time 10^0C. [(CO4)(Create/HOCQ)]
(b) The strength of sample of fully matured concrete is found to be 40.00 MPa. Similarly, measure the strength of an identical concrete at the age of 7 days when cured at an average temperature during day time at 20^0 C and at night 10^0C. Also, consult the following table given below required for the given question.

Strength at 28 days at 18^0C (maturity) MPa	Coefficient A	Coefficient B
Less than 17.5	10	68
17.5 – 35.0	21	61
35.0- 52.5	32	54
52.5- 70	42	46.5

[(CO2)(Understand/LOCQ)]

(c) Conclude the relation between maturity of concrete and strength gain in concrete. [(CO2)(Analyze/LOCQ)]

(3 + 3) + 4 + 2 = 12

5. (a) Illustrate the tensile strength test of concrete along with neat diagrams. [(CO2)(Understand/LOCQ)]

(b) Examine the stress-strain characteristics of concrete using curves for stress-strain relationship of concrete and deformation of hardened concrete under loading. [(CO2)(Analyze/IOCQ)]

7 + 5 = 12

Group - D

6. (a) Illustrate the principle of concrete mix design with a self-explanatory flow chart. [(CO3)(Understand/LOCQ)]

(b) Elaborate utilization of various supplementary cementitious materials,
(i) fly ash
(ii) ground granulated blast furnace slag. [(CO4)(Create/HOCQ)]

6 + 6 = 12

7. (a) Categorize various types of admixture as mentioned in ASTM C 494. [(CO5)(Remember/LOCQ)]

(b) For a particular concrete mix design, following data is obtained after conducting laboratory tests:

- Specific Gravity of cement (S_c) = 3.15
- Cement content = 355 kg/m^3
- Water-cement ratio (w/c) = 0.40
- Dosage of superplasticizer at 2% provides 30% water reduction
- Specific Gravity of chemical admixture (S_s) = 1.145
- Volume fraction of coarse aggregate for pumpable concrete = p = 0.558.

Determine the absolute volume ratio of coarse aggregates to total aggregates (V_{ca}) and absolute volume ratio of fine aggregates to total aggregates (V_{fa}). Air content = 2 %. [(CO4)(Create/HOCQ)]

(c) Distinguish between retardars and accelerators. Under what circumstances are they used? [(CO1)(Analyze/IOCQ)]

5 + 4 + 3 = 12

Group - E

8. (a) What is non-destructive test of concrete. Mention any three popular non-destructive tests of hardened concrete. [(CO6)(Remember/LOCQ)]

(b) Contrast light-weight concrete and high-volume fly ash concrete. [(CO5)(Evaluate/IOCQ)]

(2 + 3) + 7 = 12

9. (a) Enlist the approaches generally considered for improvement of mechanical properties of concrete. [(CO5)(Remember/LOCQ)]

(b) What is steel-fibre reinforced concrete and what are it's advantages? [(CO5)(Understand/LOCQ)]

(c) Mention the respective velocity values of ultrasonic waves encountered in various qualities of concrete grade. [(CO5)(Analyse/IOCQ)]

3 + 5 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	59.37	23.96	16.66

Course Outcome (CO):

After the completion of the course students will be able to:
CO1: Understand the properties of ingredients of concrete.
CO2: Study the behavior of concrete at its fresh and hardened state.
CO3: Study about the concrete design mix.
CO4: Know about the procedures in concreting.
CO5: Understand special concrete and their use.
CO6: Understand the various Non-Destructive tests

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