

**REPAIR & REHABILITATION OF STRUCTURES
(CIVL 3221)**

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 type of shrinkage in concrete which occurs after setting is known as
 - (a) carbonation shrinkage
 - (b) dry shrinkage
 - (c) plastic shrinkage
 - (d) autogenous shrinkage.
 - (ii) Corrosion of reinforcing bars occurs by
 - (a) chloride induced and carbonation induced corrosion
 - (b) alkali aggregate reaction and alkali silicate reaction
 - (c) both (a) and (b)
 - (d) shrinkage induced corrosion.
 - (iii) Cracks with less than 2 mm width are known as
 - (a) thin cracks
 - (b) wide cracks
 - (c) medium cracks
 - (d) crazing.
 - (iv) The test used to check uniformity in concrete is
 - (a) Schmidt rebound hammer test
 - (b) windsor probe test
 - (c) carbonation depth test
 - (d) ultrasonic pulse velocity test.
 - (v) Conditional assessment of concrete structures can be classified into main levels of
 - (a) preliminary and detailed investigation
 - (b) preliminary investigation
 - (c) secondary investigation
 - (d) visual inspection.
 - (vi) Bonding coats are used for
 - (a) bonding new concrete
 - (b) bonding old concrete
 - (c) binding concrete
 - (d) bonding new concrete with old concrete.
 - (vii) Classification of grouting techniques include
 - (a) gravity grouting and pressure grouting
 - (b) injection grouting
 - (c) both (a) and (b)
 - (d) only gravity grouting.

- (viii) In fiber-reinforced concrete, steel content varies from
(a) 200 kg to 300 kg per cubic meter of concrete
(b) 100 kg to 150 kg per cubic meter of concrete
(c) 300 kg to 500 kg per cubic meter of concrete
(d) 10 kg to 50 kg per cubic meter of concrete.
- (ix) Steel jacketing of beams and columns comes under
(a) repair technique (b) rehabilitation technique
(c) retrofitting or strengthening technique (d) grouting technique.
- (x) Foundation can be strengthened by
(a) enlarging the area of footing (b) underpinning
(c) strengthening by micropiles (d) all of the above.

Group- B

2. (a) Define the following terms:
(i) Structural degradation
(ii) Rehabilitation of structure. [[CO1](Remember)/LOCQ]
- (b) Explain the following terms:
(i) Autogenous shrinkage
(ii) Drying shrinkage. [[CO1](Remember)/LOCQ]
- (2 × 2) + (4 × 2) = 12**
3. (a) Mention all the causes for damage or distress in concrete structures. [[CO2](Remember)/LOCQ]
- (b) Clearly explain corrosion mechanism of embedded reinforcement bars and explain the chemical reactions involved in the corrosion process of steel in RCC structures. [[CO2](Understand)/IOCQ]
- 6 + 6 = 12**

Group – C

4. (a) With the help of a flowchart, write down various steps involved in systematic approach of defect diagnosis in concrete. [[CO1,CO2](Understand/IOCQ)]
- (b) Explain how poor quality of construction materials and poor quality of supervision affects deterioration of concrete structures. [[CO1,CO2](Understand)/IOCQ]
- 8 + 4 = 12**
5. (a) Mention about the common types of non-destructive tests conducted to assess damage in concrete structures. [[CO3,CO5](Remember/LOCQ)]
- (b) Write short notes on:
(i) Rebound hammer test
(ii) Ultrasonic pulse velocity test
(iii) Carbonation test. [[CO3,CO5](Remember/LOCQ)]
- 6 + (3 × 2) = 12**

Group - D

6. (a) Vividly explain the advantages of using epoxy resin as repair materials in concrete structures. [(CO3, CO4)(Understand/IOCQ)]
(b) Elaborately explain the influence of fiber reinforced concrete on various mechanical strength properties of concrete. [(CO3, CO4)(Understand/IOCQ)]
6 + 6 = 12
7. Explain the functions and applications in details of polymer modified concrete and mortars as repair materials. [(CO3, CO4)(Understand/IOCQ)]
12

Group - E

8. What are the various techniques for strengthening shallow and deep foundations? Explain the same with neat sketches. [(CO5, CO6)(Understand)/IOCQ]
(6 + 6) = 12
9. Explain in details how FRP (Fiber Reinforced Polymer) composites are advantageous in repair and retrofitting of structures. Also mention about various types of FRP composites. [(CO5, CO6)(Understand)/IOCQ]
(6 + 6) = 12
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	31.25	68.75	0

Course Outcome (CO):

The course will assist the students to:

CO1: Identify various damages to concrete structures.

CO2: Predict damage assessment of any building showing signs of deterioration and thus should be able to detect the possible cause /source of deterioration.

CO3: Develop a detailed knowledge of the concrete repair industry equipped with variety of repair materials and techniques.

CO4: Utilize various types of newly developed repair materials in the process repair and rehabilitation of structures.

CO5: Summarize and apply the importance of quality control in concrete construction and significance of protection and maintenance of structures.

CO6: Assess damage to structures and various repair and retrofitting techniques.

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

