

**BRIDGE ENGINEERING
(CIVL 4241)**

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) If the bridge span increases, the impact factor
 - (a) increases
 - (b) decreases
 - (c) remains constant
 - (d) none of these.
 - (ii) The stringer beams in a steel trussed bridge are
 - (a) T sections
 - (b) angle sections
 - (c) channel sections
 - (d) I sections.
 - (iii) Shear connectors are used in
 - (a) composite bridge
 - (b) box culvert
 - (c) rigid frame bridge
 - (d) arched bridge.
 - (iv) Bending Moment in simply supported deck slab bridge is maximum when IRC Class AA Tracked vehicle is placed
 - (a) adjacent to support
 - (b) at the quarter span
 - (c) at the centre of span
 - (d) at one third span.
 - (v) Two way bridge deck slab is designed by using
 - (a) Courbon's Method
 - (b) Pigeaud's Method
 - (c) Jaeger's Method
 - (d) Massonet Method.
 - (vi) Maximum axle load of IRC Class A vehicle is
 - (a) 68 kN
 - (b) 27 kN
 - (c) 114 kN
 - (d) none of these.
 - (vii) Minimum clearance between the road face of kerb and the outer edge of IRC class A wheel is
 - (a) 0.3 m
 - (b) 0.6 m
 - (c) 0.9 m
 - (d) 1.2 m.

- (viii) Minimum nose to tail distance between two consecutive IRC Class A Train of vehicles must be
 - (a) 14.8 m
 - (b) 11.7 m
 - (c) 13.6 m
 - (d) 18.4 m.
- (ix) Poisson's Ratio is used for bridge deck design in case of
 - (a) one way deck slab
 - (b) two way deck slab
 - (c) cantilever deck slab
 - (d) none of these.
- (x) In case of a RCC bridge deck, under flexure, the maximum strain in concrete at the outermost compression fibre is
 - (a) 0.0020
 - (b) 0.0015
 - (c) 0.0002
 - (d) 0.0035.

Group - B

2. Design an Elastomeric Pad Bearing to support a Tee Beam Girder of a bridge, if the effective span of the girder is 16m and if M20 Grade concrete is used for Tee beam and bed block. Maximum dead load reaction per bearing is 300kN. Maximum live load reaction per bearing is 700kN. Longitudinal force due to friction per bearing is 45kN. Estimated rotation at bearing of the girder, due to dead and live load, is 0.002 Radian. Total estimated shear strain, due to creep, shrinkage and temperature, is 6×10^{-4} . **12**
3. Design a Reinforced Concrete Rocker Bearing to transmit a support reaction of 600kN. Adopt M30 grade concrete and Fe 415 grade HYSD rebars. Permissible bearing stress in concrete is 8MPa. Sketch the details of reinforcements in the rocker bearing. **12**

Group - C

4. Determine the design shearing force and design bending moment for the deck slab of a Slab Bridge to be constructed on a Double Lane National Highway, by using Fe415 grade steel and M25 grade concrete, against IRC Class AA Wheeled Vehicle loading, if 8 metres of clear span is required. Bearing width is 400mm and wearing coat thickness is 80mm. Relevant IS and IRC specifications should be followed. **12**
5. Design a RCC box culvert conforming to the specifications of IRC:112-2011 if the box culvert has a clear vent way of 3.5m × 3.5m. The superimposed dead load on the culvert is 10 kN/m². The live load is estimated as 40 kN/m². Density of the site soil is 1800 kg/m³. Angle of Repose is 28°. Adopt M20

grade concrete and Fe415 Grade HYSD rebars. Sketch the details of reinforcements in the box culvert.

12

Group - D

6. Design the longitudinal main girders and the transverse cross girders of a RCC Tee beam girder bridge, against IRC class AA tracked vehicle loading, by using M25 concrete and Fe415 steel, if the clear width of the carriage way is 7.5m and the span measured centre to centre of bearings is 16m. Consider suitable thickness of deck slab, 600mm × 400mm kerbs on either side and 80mm thick wearing coat.

12

7. Design the shear connectors of a composite bridge deck with RCC slab and steel plate girders to cover a span of 15m, by considering 2.5m spacing of main girders. Clear width of roadway is 7.5m and the footpath is 1 m wide on either side. Rolled steel sections having yield stress of 236MPa, M25 grade concrete and Fe415 grade steel reinforcement bars are to be considered as the bridge materials.

12

Group - E

8. Design the stringer beams of a steel trussed bridge, having 30m effective span with 6 identical panels and 2-lane roadway of width 7.5m. Consider M25 concrete, Fe415 HYSD rebars and make use of rolled steel sections having yield stress of 236MPa. Consider 100mm thick wearing coat, 200mm thick deck slab and IRC class AA tracked vehicle.

12

9. Explain the various structural components of a cable stayed bridge with neat sketches by mentioning their structural functions in details and also discuss the procedure of finding out the optimum cable inclination and height of pylon.

6 + 6 = 12