Q.1  Attempt any 4 parts, each part is of 5 marks
a) What are the factors that affect the development of bridges?
b) Sketch an elastomeric bearing and mark its parts.
c) List the factors to be considered while deciding the suitability of the site for a permanent bridge over a hill stream.
d) Why it is necessary to calculate afflux while designing the waterway of a bridge?
e) Explain the class A and B loading as per IRC.

Q.2  Attempt any 4 parts, each part is of 5 marks
a) Explain the Courbon’s theory for proportioning the live loads on the cross girders in detail.
b) How will you design by a method given by M. Pigeaud?
c) Design intermediate post tensioned prestressed concrete Tee Beam bridge girder for the following data:
   - Effective span = 15 m
   - Width of carriageway = 7.5m
   - No. of beams 4, equally spaced along the carriageway width
   - Spacing of cross girders = 3m c/c
   - No footpath on either side loading class = IRC Class AA
   - Kerb size = 150 mm x 600 mm
   Use concrete of grade m 45 and steel of grade Fe 500
Design should include detail load, bending moment calculation.
d) Explain Class AA loading as per IRC.
e) Discuss the calculations involved in Courbon’s theory. On which conditions this theory is applicable?

Q.3  Attempt any 2 parts, each part is of 10 marks
a) Discuss about the various forces acting on the steel bridges. Also define the “Economical Span”
b) Discuss the general steps for designing of an Arch bridge.
c) Explain the various types of bridges with their neat sketches: Deck Type Bridge, Through Type Bridge, Arch Bridges, Suspension Bridges and Truss Bridges.

Q.4  Attempt any 2 parts, each part is of 10 marks
a) Design an elastomeric unreinforced neoprene pad bearing to suit the following data:
   - Vertical load (sustained) : 200 kN
   - Vertical load (dynamic) : 40 kN
   - Horizontal force : 60 kN
   - Modulus of rigidity of elastomer : 1 N/mm²
   - Friction coefficient : 0.3

a) What is the function of bearings in bridges? Design an elastomeric bearing at the sliding end of a bridge for the following data: Maximum Normal load 1000 kN, minimum Normal Load 200 kN, Transverse lateral Load 40 kN, Longitudinal Load 60 kN, Total Longitudinal Translation 15 mm, Rotation at support 0.0025 radians. Shear
modulus of elastomeric bearing = 1.2 N/mm². Allowable compressive stress for concrete = 7N/mm². Allowable compressive stress for elastomer = 10N/mm².

b) Design a reinforced elastomeric bearing at a pinned end of a plate girder of a bridge with following data:
   - Maximum vertical load = 1000kN
   - Dynamic vertical load = 80 kN
   - Transverse lateral load = 40 kN
   - Longitudinal load = 50 kN
   - Longitudinal total translation 12mm
   - Rotation at support 0.003°
   - Shear modulus of elastomeric bearing = 1.2N/mm²
   - Allowable compressive stress for concrete = 8 N/mm²
   - Allowable compressive stress for elastomer = 10N/mm²

Q.5 Attempt any 2 parts, each part is of 10 marks

a) Design wall type RCC pier for the following data:
   - Top width of pier = 1m with semi circulate ends
   - Length of pier = 7m excluding the semicircular part
   - Height of above footing = 10m
   - HFL above the top of footing = 8m
   - Total DL Reaction = 2000kN
   - Total LL Reaction = 1100 kN
   - Tractive force = 130kN
   - c/c Distance of bearing on either side of centre line of pier = 1m
   - BM in traffic direction due to unequal DL and LL = 600 kN-m
   - Material of Pier and footing = M 40 and Fe 500
   - Safe bearing capacity = 200 kN/m
   - Velocity of water current = 4 m/s
   - Consider the cross current, also design the RCC footing and reinforcement in pier, check the stresses at the bottom of pier.

b) i) Enlist the forces acting on Abutments.
   ii) Enlist the forces acting on piers.

c) Write the short notes on: (i) Piers (ii) Abutments

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