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**Question Paper Code: U5604**

M.E, DEGREE EXAMINATION, APRIL / MAY 2025

Professional Elective

Structural Engineering

21PSE504 – DESIGN OF BRIDGES

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 20 = 100 Marks)

1. (a) A road bridge deck consists of a concrete slab continuous over tee beams spaced at 2 m apart and cross girders spaced at 5m centers. Thickness of wearing coat is 100 mm, Type of loading is IRC class AA tracked vehicle. Materials – M30 & Fe415 Grades (HYSD Bars). Design the RC slab and draw the cross section and longitudinal section of the slab. CO2-App (20)

Or

(b) The reinforced concrete slab panel of a RC Tee beam and slab deck is 2 m wide between Tee beams and 4 m long between cross girders. Design the RC slab panel for IRC class A loading using M30 grade concrete and Fe500 grade HYSD bars. Assume the thickness of the wearing coat as 80 m. Sketch the details of reinforcements in the slab. CO2-App (20)
2. (a) Design a reinforced concrete box culvert having a clear vent way of 3 m by 3 m. The superimposed dead load on the culvert is  $12.8 \text{ kN/m}^2$ . The live load is estimated as  $50 \text{ kN/m}^2$ . Density of soil at site is  $18 \text{ kN/m}^3$ . Angle of repose is  $30^\circ$ . Adopt M30 & Fe415 HYSD grades. Sketch the reinforcements in the box culvert. Assume material properties. CO3-Ana (20)

Or

- (b) Design the cantilever slab of a Tee beam and slab bridge deck **CO3-Ana (20)**  
using the following data,  
Width of roadway – 7.5 m  
Width of kerb – 600 mm  
Depth of kerb – 300 mm  
Number of longitudinal girders – 3  
Width of girder – 300 mm  
Spacing of longitudinal girders – 2.5m  
Thickness of wearing coat – 80 mm  
Materials – M20 & Fe415 Grades(HYSD Bars)  
Loading – IRC Class A wheel loads  
Assume material properties
3. (a) Explain the design concept of prestressed concrete bridges in comparison with the steel, reinforced concrete and composite bridges construction. **CO1-App (20)**
- Or
- (b) Determine the spacing of the cables and their eccentricity at mid span for a prestressed concrete slab 410 mm thick with parallel post tensioned cables is provided for a road bridge of effective span 7 m. The live load analysis indicates equivalent live load of 30 kN/m<sup>2</sup>. The force at transfer in each of the cables is 300 kN. If the compressive stress permissible in concrete at transfer is 15 N/mm<sup>2</sup>. Assume a loss ratio of 0.8. **CO1-App (20)**
4. (a) Analyse the bending moments and shear forces for a steel truss bridges to suit the following data, **CO5-Ana (20)**  
Effective span – 30 m  
Roadway – 7.5 m (two lane)  
Kerbs – 600 mm  
IRC class AA traced vehicle  
Use M25 grade concrete and Fe415 grade HYSD bars for deck slab.  
Rolled steel sections with an yield stress of 236 N/mm<sup>2</sup>.

Or

- (b) Analyze the bending moments and shear forces for the steel truss as per codal provisions. Effective span – 30 m, Roadway – 7.5 m (two lane), Kerbs – 600 mm, IRC class AA traced vehicle, Use M25 grade concrete and Fe415 grade HYSD bars for deck slab and Rolled steel sections with an yield stress of  $236 \text{ N/mm}^2$ . Assume relevant design data CO5-Ana (20)
5. (a) Design the pier of a major bridge using the following data: Dimensions of pier; Height of pier-9 m, Width at top-2.0 m, Width at bottom-3.0 m, Length of pier-8.5 m, Maximum water level-8 m above base of pier. Girder bearings located at 500 mm from centre of pier on either side Dead load from each span 2300 kN, Reaction due to live load on one span = 1000 kN Maximum mean velocity of current - 3 m/sec, Material for pier, M-20 Grade concrete, Live load: IRC Class AA or Class A whichever produces the worst effect, Check the adequacy of the dimensions provided by computing the stresses in the pier. CO5-Ana (20)
- Or
- (b) Design a reinforced concrete rocker bearing to transmit a support reaction of 600kN. Adopt M30 grade concrete and Fe415 grade HYSD bars. Permissible bearing stress in steel plate –  $185 \text{ N/mm}^2$ . Sketch the details of reinforcements in the rocker bearing. CO5-Ana (20)

