Reg. No. : | | | | | | | | | | | | |

Question Paper Code: U3904

M.E. DEGREE EXAMINATION, MAY 2024

Elective

Structural Engineering

21PSE504 – DESIGN OF BRIDGES

(Regulation 2021)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 20 = 100 Marks)

Use following IS codes

IS 800:2007, SP 6-1:1964, IS:456-2000, IRC: 6-2010, IRC: 18-2000, IRC: 22-2008, IRC: 24-2010, IRC: 83-1999

1.	(a)	The reinforced concrete slab panel of a RC Tee beam and slab deck is 2m wide between Tee beams and 4m 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 80m. Sketch the details of reinforcements in the slab.	CO2-App	(20)
		Or		
	(b)	Determine the design live load for the reinforced concrete slab culvert using IRC class A loading. Show that the live moments are significantly lower when compared with those resulting from IRC class AA tracked vehicle loading on the slab culvert. Carriage way – Two Lane (7.5m wide), Foot paths – 1m on either side, Clear span – 6m, Wearing coat – 80mm, Width of bearing – 400mm, Materials – M25 & Fe415 Grades(HYSD Bars)	CO2-App	(20)
2.	(a)	Design a reinforced concrete box culvert having a clear vent way of 3m by 3m. The superimposed dead load on the culvert is 12.6kN/m^2. The live load is estimated as 50.5kN/m^2. Density of soil at site is 18kN/m^3. Angle of repose is 30^o. Adopt M25 & Fe415 HYSD grades. Sketch the reinforcements in the box culvert. Assume design data.	CO3-Ana	(20)

(b) A reinforced concrete tee beam and slab bridge deck is to be designed for a major national highway crossing of a river. Design the typical structural elements of the bridge deck to suit the following data, CO3-Ana (20)

Clear span of the bridges – 16m
Width of carriage way – 3 standard lanes of 3.5m each with foot paths 1.5m wide
Thickness of the wearing coat – 80mm
Number of main girders – 4
Cross girders at every 4m intervals
Live load – IRC class AA tracked vehicle
Materials – M25 & Fe500 HYSD bars

3. (a) Design a post tensioned prestressed concrete slab bridge deck for a national highway crossing to suit the following data, CO4-Ana (20)

Clear span – 10m
Width of bearing – 400m
Clear width of roadway – 7.5m
Foot paths – 1m on either side
Kerbs – 600mm wide by 300mm deep
Thickness of wearing coat – 80mm
Live load – IRC class AA tracked vehicle
Types of structure – Class 1 type
Materials – M40 grade concrete and 7mm diameter high tensile wires with an ultimate tensile strength of 1500N/mm^2 housed in cables with 12 wires and anchored by Freyssinet anchorages of 150mm diameter.
Assume compressive strength of concrete at transfer as 35N/mm^2.

Or

(b) A prestressed concrete slab 400 mm thick with parallel post tensioned cables is prided for a road bridge of effective span 8 m. The live load analysis indicates equivalent live load of 40 KN m². The force at transfer in each of the cables is 400 KN. If the compressive stress permissible in concrete at transfer is 16 N/mm². Design the slab as Class-1 type member and determine the spacing of the cables and their eccentricity at mid span. Assume a loss ratio of 0.8. CO4-Ana (20)

4. (a) Determine the loads and bending moments of steel truss bridges to suit the following data, effective span – 30m, roadway – 7.5m (two lane), kerbs – 600mm, 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^2. CO2-App (20)

Or

(b) A through type steel trussed bridge of N-type is required for a highway crow The span of the bridge is 48 m. The spacing of the cross girders is 6 m and the spacing of the stringer beams is 2.25 m. Road width 7.5 m Footpaths-1.25 m on either side Loading: L.R.C. class AA, Materials: M-20 grade concrete and Fe-415 grade to steel. Adopt rolled steel sections for the truss members. Calculate the loads and critical moments of the bridge. Design the R.C.C. deck slab, stringer beams, cross girder and the typical members of the N-truss. CO2-App (20)

5. (a) A concrete pier of a major bridge is rectangular in section with dimensions of 3 m wide by 10 m in length and a height of 10 m above ground with hemispherical cut and ease waters the top section is 2m by 10 m. The dead load from the super structure is 1800 kN from each span acting at a distance of 0.5 m from the centre line of the pier. The live load reaction from one span is 1000 KN. Wind pressure on pier is 2 kN/m^2. The maximum permissible compressive stress on concrete per is 2000 kN/m^2. Calculate the stresses developed at the base of the pier due to a) dead load and self weight b) Effect of buoyancy c) Eccentricity of live load d) wind pressure. CO2- App (20)

Or

(b) The concrete abutment of a major bridge has the following dimensions:
Width at top 1.5 m
Width at foundation level - 3 m
Height of abutment - 4 m
The water face of the abutment is vertical and the earth side is sloping Live loads acting at the centre of top are 25 kN
Safe bearing capacity of the soil-200 kN/m^2
Density of soil at site = 16 kN/m Angle of internal friction - 30°
Compute the stresses developed at the base and check for the stability of the abutment CO2- App (20)