Name:
Reg. No

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

07 THRISSUR CLUSTER

FIRST SEMESTER M. TECH. DEGREE EXAMINATION, MARCH 2021

Civil Engineering

Structural Engineering

07CE 6311 DESIGN OF BRIDGES

Time: 3 hours **Max. Marks: 60**

Answer all six questions. Part 'a' of each question is compulsory.
Answer either part 'b' or part 'c' of each question. Assume missing data, if any, suitably.

Codes permitted: IS: 456-2000, IS: 800-2007, IS:1343-2012, IS - SP: 16, IS - SP: 6 (1), IRC: 6-2017, IRC: 18-2000, IRC: 24-2010, IRC: 40-2002, IRC: 78-2014, IRC: 83-1999 (Part 1), IRC: 83-2015 (Part 2), IRC: 83-2002 (Part 3), IRC83-2014 (Part 4), IRC: 112-2011. Pigeaud's curves will be supplied on request.

	Module 1	**Marks**
1a	Explain the significance of scour in bridge engineering. How are bridges safeguarded against scour?	**4**
	Answer b or c	
b	What is meant by ground contact area of the wheels of various vehicles in design of bridges? Explain the significance of ground contact area in inducing moments and shears in various elements of a bridge.	**5**
c	List the various forces which cause transverse (normal to span) load on a bridge. Explain the procedure for estimating any one of them	**5**

	Module 2	**Marks**
2a	What is a box culvert? Describe the various load cases for the analysis of a box culvert.	**4**
	Answer b or c	
b	An RCC skew slab bridge with skew angle of 14º and carriageway width 7.5m is to be designed for a site with the following details. Clear span between abutments = 6m, width of bearing= 0.6m, thickness of wearing course = 75mm. Type of traffic load is IRC Class AA Tracked Vehicle. Grade ofconcrete is M30 and that of steel Fe 415. Design the bridge for moment and shear, and sketch the structural details. Serviceability checks are not expected.	**5**
c	Explain Hendry-Jaegar method for distribution of loads among girders in a slab-girder bridge.	**5**

	Module 3	Marks
3a	Explain the advantages and disadvantages of continuous bridges over simply supported ones.	**4**
	Answer b or c	
b	A T- beam bridge has the following details. Clear span = 16m, live load: IRC Class AA tracked vehicles, roadway: 2-lane National Highway of 7.5m carriageway width, footpaths: 1.2m wide raised at 20cm on both sides, deck slab thickness = 200mm, thickness at edge of cantilever slab = 150mm, longitudinal girders: 4 Nos. at c/c spacing of 2.7m, girder end bearing width = 0.8m, cross girders: 5 Nos. at equal spacing. Calculate the design moment and shear in each of the girders. Use Courbon's method for distribution of live load.	**5**
c	In the above problem, calculate the loads on an intermediate cross girder, and evaluate the design moment and shear in each of the cross girders. Use IS code coefficients for moments and shears. Design is not necessary.	**5**

	Module 4	Marks
4a	Explain how the design loads in a group of piles in a pile foundation for a bridge abutment subjected to loads in vertical and 2 horizontal directions, and moments about longitudinal and transverse axes.	**4**
	Answer b or c	
b	List the various loads acting on a bridge abutment, and explain the step by step procedure for its design.	**5**
c	A girder of a T-beam bridge has an effective span of 15m, DL reaction = 250kN, LL reaction = 200kN, longitudinal force at support = 20kN, rotation at support = 0.25º. Design a suitable Neoprene pad bearing for the girder.	**5**

	Module 5	Marks
5a	What are pre-tensioning and post-tensioning? Discuss the advantages and disadvantages of each.	**5**
	Answer b or c	
b	A post-tensioned pre-stressed simply supported slab bridge has the following details. Effective span = 15m, overall slab thickness = 700mm, live load is IRC Class AA tracked vehicle, maximum live load moment = 300kNm/m, maximum live load shear = 165kN/m, clear carriageway width = 7.5m, width of footpath on either side = 1.0m, thickness of wearing course = 80mm, concrete grade is M40, minimum ultimate strength of pre-stressing steel is 2100MPa and supplementary reinforcement Fe 415. The losses in pre-stress may be taken as 18%. The transfer of pre-stress is done when the compressive strength of concrete	**7**

is 36MPa. Calculate the required pre-stressing force, the area of pre-stressing steel and the trajectory of the cable. Also, check for the extreme stresses at transfer and service. Calculation of ultimate strength of the section is not expected.

c In the above problem, one designer prescribes 12 numbers of 7mm diameter bundled wires as parabolic cables at a spacing of 250mm c/c with a central eccentricity of 200mm and zero eccentricity at supports. An initial pre-stressing force of 3450kN is also suggested in each cable. Design the end block for anchorage of the cables. **7**

Module 6 **Marks**

6a Discuss with neat sketches the various steel trusses commonly used for construction of trussed bridge. **5**

Answer b or c

b A welded plate girder with equal flanges and single web plate has the following details. Flange plates: 560mm×50mm, web plate: 12mm×1800mm. It is laterally restrained. Calculate the shear capacity of the section. The steel grade is Fe410. **7**

c Explain the components of a steel trussed bridge, and explain the step-by-step design considerations for the members of the bridge floor. **7**