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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Civil Engineering

Semester End Examination; February - 2022

Design of Bridges

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Identify site locations for the bridges.

CO2: Understand the IRC loadings.

CO3: Analyse and design of slab culvert.

CO4: Analyse and design of box culvert and T Beam Bridge.

Note: ***I) PART - A*** *is compulsory.* ***Two*** *marks for each question.*

II) PART - B*: Answer any* ***One*** *sub questions (from a, b) for Maximum of* ***18 marks*** *from each unit.*

III) *IS456, SP-16 and IRC 21 codes are permitted.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	List the components of bridges.	2	L1	CO1	PO1
b.	Explain equation used for calculating effective width for a single concentrated load.	2	L1	CO3	PO1
c.	Write schematic diagram showing the dimensions of vertical and horizontal clearance required for highway traffic.	2	L1	CO2	PO1
d.	List the three load conditions to develop maximum moments in box culvert.	2	L1	CO3	PO1
e.	List the conditions when Courbon's method is applicable in designing of Tee-beam bridges.	2	L1	CO4	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	i) The following are the costs of one pier and one superstructure span of multiple span bridge for various span lengths. The cost of super structure span excludes the costs of railing, and flooring system. Calculate the economic span.	8	L2	CO1	PO1,2

Span in metres	4	8	12	15
Super structure cost in Rs.	1700	7000	16000	2450
Substructure cost in Rs.	22200	23200	23000	23600

	ii) List the assumptions made in derivation for the economic spam.	10	L2	CO1	PO1,2
b.	Determine the design discharge at a bridge site alter computing the maximum discharge by, i) Empirical method ii) Rational method iii) Area-velocity method for the following data:	18	L2	CO2	PO1,2

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Catchment = 160 km^2
Distance of site from coast = 12 km
Distance of critical point to bridge site = 16 km
Difference in elevation between the critical point and the bridge site = 96 m
Peak intensity of rainfall = 60 mm/h
Surface of catchment is loam, largely cultivated C/s area of stream of MFL at bridge site = 120 m^2
Wetted pelimeter of stream at MFL at bridge site = 90 m
Stream condition-clear straight banks, fails condition
Slope of stream = 1/500

UNIT - II **18**

2 a.	Explain with neat sketch, IRC loading classification for road bridges and culverts. Write ground constant dimensions for class A loading.	18	L3	CO3	PO1,2
b.	Explain the impact loads to be considered in road bridges and culvert design. Write the live load combinations of loading arrangements to be adopted for single, double and triple lane design.	18	L3	CO3	PO1,2

UNIT - III **18**

3 a.	Design a deck slab for the following particulars: Clear span: 5.5 m ; width of carriage = 7.5 m Width of the foot path : 1 m on either side Wearing coat : 100 mm Loading : IRC class AA (Tracked) Materials: M35 Concrete and Fe415 steel.	18	L4	CO3	PO3, 9
b.	Design a R.C. slab culvert for the following data: Clear span = 5m Carriage way width : 7.5 m Width of bearing = 0.4 m Kerbs on either side = 600 × 300 mm Wearing coat = 56 mm thick Exposure condition : moderate Live load = IRC class AA (wheeled) Grade of steel = 415, M_{25} concrete	18	L4	CO3	PO3,9

UNIT - IV **18**

4 a.	Design a box culvert having inside dimensions 4m x 4m for the following data: Live load = class AA tracked vehicle Density of soil = 18 kN/m^3; $\phi = 30°$ Width of bridge deck = 8.7 m SBC = 120 kN/m^2 M_{30} concrete ; Fe_{415} steel	18	L4	CO3	PO3,9

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b.	Design a box culvert having inside dimensions of 3 m × 3 m. This culvert in subjected to a dead load of 14000 N/m^2 and a live load of IRC class AA tracked vehicle. Assume the unit weight of soil to be 18000 N/m^3. The angle of repose of soil is 30°. Use M35 concrete and Fe415 steel. Road width is 7.5 m. Span is 3.3 m.	18	L4	CO3	PO3,9
	UNIT - 5	**18**			
5 a.	A T-beam bridge has to be provided across a channel having the following data. Design the bridge deck. (i) Design Interior longitudinal girders. Span = 14 m Road = NH (2 dams) Footpath = 1m width on either side Loading = 1 RC class AA (tracked) Material = M40 Concrete, Fe415 Steel No. of longitudinal girders : 3	18	L4	CO4	PO3,9
b.	A RCC T-beam and slab deck has the following data: Effective span of girder = 16 m Clear width of Road way = 7.5 m Width of kerbs = 600 mm Thickness of wearing coat = 80 mm No. of main girders = 4 Spacing of main girders = 2.5 m Spacing of Cross girders = 4 m Type of loading : IRC class (Tracked vehicle) Materials: M20 grade concrete and Fe415 grade HYSD bars. Design only interior deck slab for flexure and check for shear.	18	L4	CO4	PO3, 9

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