Name : ……………………………………………………………

Roll No. : …………………………………………………………

Invigilator's Signature : ………………………………………

CS/B.Tech/CE/SEM-8/CE-802/2/2013

2013
BRIDGE ENGINEERING

Time Allotted : 3 Hours   *Full Marks :* 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

IRC-6, IRC-21, IRC-24 And Pigeaud's chart are
permitted for use by the examinees.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :   10 × 1 = 10

    i)   A simply supported deck slab bridge is subjected to dead load bending moment M_D and live load bending moment M_L. Then the bending moment M for distribution steel would be

         a) $M = 0 \cdot 2\, M_D + 0 \cdot 3\, M_L$

         b) $M = 0 \cdot 3\, M_D + 0 \cdot 2\, M_L$

         c) $M = 0 \cdot 2\, M_D + 0 \cdot 4\, M_L$

         d) $M = 0 \cdot 4\, M_D + 0 \cdot 3\, M_L.$

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   ii)   Pigeaud's method is used in designing of

      a)   one-way deck slab

      b)   R.C.C. Tee beam

      c)   welded plate girder

      d)   two-way deck slab.

   iii)   The junction of cantilever and simply supported span of balanced cantilever bridge is referred to as

      a)   articulation   b)   pylon

      c)   superstructure   d)   shear connector.

   iv)   Total load of IRC class AA wheeled vehicle is

      a)   700 kN   b)   350 kN

      c)   400 kN   d)   114 kN.

   v)   The effective span of a deck slab bridge is 9·0 m. It is subjected to IRC Class AA tracked vehicle. The impact factor to be considered for this bridge is equal to

      a)   10%   b)   20%

      c)   25%   d)   12%.

   vi)   Maximum axle load of IRC Class A load is

      a)   114 kN   b)   68 kN

      c)   41 kN   d)   27 kN.

vii) In using Courbon's method

    a) total no. of equally spaced cross girders required is five

    b) total no. of longitudinal girders required is five

    c) total no. of cross girders required is four

    d) total no. of cross girders and longitudinal girders should be the same.

viii) The maximum scour depth from HFL for a moderate bend is

    a) 1·27 dm   b) 2 dm

    c) 1·75 dm   d) 1·5 dm.

ix) The clear distance of wheel from wheel guard for IRC Class AA tracked vehicle of carriageway width 5·5 m and above is

    a) 1·2 m maximum   b) 1·2 m minimum

    c) 0·6 m minimum   d) 0·15 m minimum.

x) For beam, using grade of steel Fe 415, the minimum tension reinforcement is

    a) 0·25% of bd   b) 0·2% of bd

    c) 0·12% of bd   d) 0·15% of bd.

xi) Co-efficient of thermal expansion per degree Centrigrade for steel bridge is

    a) $11·7 \times 10^{-6}$ b) $10·8 \times 10^{-6}$

    c) $11·0 \times 10^{-5}$ d) $10·0 \times 10^{-5}$.

xii) Nose to tail length of IRC tracked vehicle is

    a) 4 m   b) 3·6 m

    c) 5·6 m   d) 7·2 m.
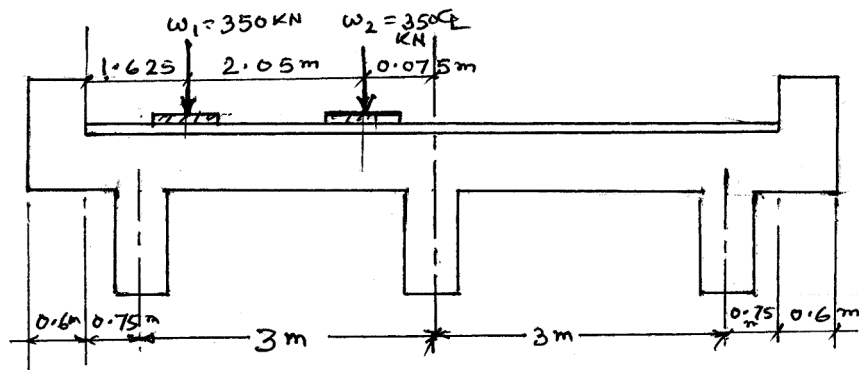
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GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.   3 × 5 = 15

2. The cross-section of a tee beam bridge is shown in the following figure. Calculate the reaction factors of the longitudinal girders by Courbon's method.

3. What hydraulic factors are to be considered in bridge design ?

4. Write notes on bridge subjected to seismic effect.

5. If the catchment area is 200 sq. km and the site situated from coast is 150 km, what will be the maximum flood discharge according to Dickens' and Ryve's formula ?

6. Write notes on shear connectors.

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GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7.   A two-way deck slab panel of R.C.C. Tee beam bridge has the following data :

Dimension of the slab panel = 3.5 m $\times$ 2.5 m

Thickness of the slab panel = 220 mm

Thickness of wearing course = 80 mm

Type of loading : IRC Class AA tracked vehicle

Materials M30 grade concrete and Fe 415 grade HYSD bars

Design the slab panel using Pigeaud's method.

8.   The design data of an R.C.C. Tee beam bridge girder are as follows :

Width of carriageway = 10 m

Span of the bridge (c/c of bearings) = 16 m

No. of main girders = 4

Spacing of main girders = 2.5 m c/c

Spacing of cross girders = 4.0 m c/c

Thickness of deck slab = 220 mm

Thickness of wearing course = 80 mm

Dimension of the kerb = 600 mm wide $\times$ 225 mm thick

Calculate design bending moment of the bridge girder.

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9. A box culvert has the following specifications :

   Inside dimension = 4·0 m × 4·0 m

   Width of carriageway = 7·5 m

   Superimposed dead load = 18 kN/m^2

   Live load = 60 kN/m^2

   Unit of soil = 18 kN/m^3

   Angle of repose of soil = 30°

   Thickness of slab = 400 mm and thickness of wall = 400 mm

   Calculate the joint moments of the culvert for the following load condition.

   Box culvert subjected to superimposed dead load, self weight, live load, lateral pressure due to superimposed dead load, live load and soil pressure.

10. Design deck type welded plate girder bridge for a broad gauge railway line across a stream from the following data :

   Span of bridge = 25 m

   D.L. intensity = 12·5 kN/m

   Live load for B.M. per track = 2300 kN

   Live load for S.F. per track = 2500 kN

   Critical stress feb = 1500 N/mm^2, σ_{bc} = 158 N/mm^2.

   Design only for plate girder, connection between flange and web.

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11. Calculate the live load moment for a two-lane bridge for the internal longitudal girder, for IRC class loading. The effective span of the bridge is 24 m. The details of the RCC girder bridges are shown in the following figure :

No. of longitudal girders = 4

No. of cross girders = 5

Size of bottom flange of longitudal girder = 600 mm × 300 mm

Thickness of web of longitudal girder = 300 mm

Thickness of cross girder = 200 mm

Size of fillets = 150 mm × 150 mm

Centre to centre distance of longitudal girder = 2250 mm

Size of cantilever slab (thickness) = 150 mm to 350 mm

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