CBCS SCHEME

USN | | | | | | | | | |

15CV741

Seventh Semester B.E. Degree Examination, Aug./Sept.2020
Design of Bridges

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of IRC 6, IRC21, IS-456-2000 is permitted.
3. Sketch reinforcement details wherever necessary.

Module-1

1 a. Briefly discuss any three methods for computation of Peak Flood discharge. **(06 Marks)**

b. Write short notes on the following with respect to hydraulic design of Bridges.
Linear waterway, Economical span, Scour depth and Afflux. **(10 Marks)**

OR

2 a. Explain fixation of linear waterway in (i) streams with rigid boundaries (ii) Quasi – Alluvial soil (iii) Alluvial soil streams. **(06 Marks)**

b. The following levels are available from a bridge site. HFL of flow is 97.960 mtr. Calculate hydraulic mean radius using Area Velocity method.

Chainage (m)	Bed Level (m)
60	97.960
55	95.700
50	94.600
40	91.800
20	91.400
0	90.900
20	91.100
40	95.160
50	95.800
55	96.800
62	97.960

(10 Marks)

Module-2

3 A slab culvert is proposed across a stream in an Highway having following data:
Design the deck slab adopting M25 grade concrete and Fe 415 steel. [Shear Analysis and Footpath design not required]
Carriageway width = 7.50 m. ; Footpath width = 1.00m
Effective span of bridge deck = 6.40 mtr ; Wearing coat thickness = 80 mm
Loading = IRC Class A Two Lane loading. **(16 Marks)**

OR

4 Design the Deck slab for a culvert using below given data:
Road width = 7.50 m ; Width of kerb = 0.60 m
Effective span of deck slab = 4.40 m
Thickness of wearing coat = 80 mm
Grade of concrete = M25
Grade of steel = Fe 415
Loading = IRC Class AA Tracked. **(16 Marks)**

Module-3

5 In a State highway a T Beam Girder Bridge is to be constructed across a river. The details are as below:
Carriageway width = 7.50 mt ;
Kerb width = 0.60
Kerb thickness above slab level = 0.30 mtr
Wearing coat thickness = 0.08 mtr
Effective span of Bridge = 16 mtr
Live Load = IRC Class AA Tracked.
Adopting M25 grade concrete and Fe 415 steel, design outer girder of bridge [Shear Analysis not required]. **(16 Marks)**

OR

6 a. Three Longitudinal girders at a spacing of 2.50 m c/c are provided in a Slab Girder Bridge,
b. Spanning over a Nala with c/c distance of Bearings equal to 16 mtr. Spacing of cross girders is 4.00 mtr c/c. Width of carriageway is 7.50 mtr. Footpath width is 1.00 mtr. Average thickness of wearing coat is 60 mm. Design interior panel of slab adopting M25 concrete and Fe 415 steel. IRC Loading : Class AA Tracked. **(16 Marks)**

Module-4

7 a. Draw neat sketches of Beddings for concrete pipes in pipe culverts. **(03 Marks)**
b. A Single Cell Box culvert with inner dimensions of 3.50m × 3.50m is provided in a highway of 7.50 mtr wide. Thickness of earth fill over top slab is 65 cms. Live load on culvert is 45 kN/m^2. Angle of internal friction of soil (ϕ) is 30° and unit weight is 18.47 kN/m^3. Analyze the Box frame considering Dead load, Live load and Earth pressure for NO flow condition in nala. Calculate final moments and draw BM diagrams. **(13 Marks)**

OR

8 a. Explain steps involved in structural design of pipes in a pipe culvert. **(03 Marks)**
b. A single cell box culvert is to be designed for an culvert in a highway with following data:
Box inside dimensions : 3m × 3m ; Earth fill load above top slab : 14 kN/m^2
Width of carriageway = 7.50 mtr ; IRC Live load = Class AA Tracked
Unit weight of soil is 18 kN/m^3 and angle of internal friction is 30°. Find final moments in top and bottom slab, vertical walls considering Dead Load, Live load and earth pressure combination. **(13 Marks)**

Module-5

9 a. List factors to be considered while selecting Bridge Bearings. **(05 Marks)**
b. Draw typical shapes of piers commonly used in concrete bridges. List loads and forces to be considered in pier design. **(11 Marks)**

OR

10 a. Discuss main functions of a Bridge Bearing. List four major forces considered in the design of Bearings. **(05 Marks)**
b. Explain any six forces considered in the design of Abuttments. With necessary sketch explain stability analysis of Abuttment. **(11 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

15CV741

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019
Design of Bridges

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of IS-456, IRC-5, IRC-6, IRC-21, IS1343, pigeaud's curves and relevant charts allowed.

Module-1

1 a. How are the bridges classified, briefly explain. **(10 Marks)**

b. List the various loads to be considered in the design of bridges. **(06 Marks)**

OR

2 Briefly explain the following terms:
i) Linear waterway
ii) Economic span
iii) Afflux
iv) Scour Depth. **(16 Marks)**

Module-2

3 Design a deck slab for the following details:
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 grade concrete and Fe415 grade HYSD bars
Loading : IRC class AA tracked vehicle. **(16 Marks)**

OR

4 Design a SKEW slab culvert to suit the following data:
Clear span = 6m
Width of bearing = 370mm
Width of carriage way = 7.5m
Overall depth of slab = 540mm
Wearing coat = 80mm
Skew angle = 30°
Loading : IRC class AA tracked vehicle
Materials : M20 grade concrete and Fe415 HYSD bars. **(16 Marks)**

Module-3

5 Design the 'Deck slab only' for the T-beam bridge for the following data:
Effective span = 16m; Live Load – IRC class AA tracked; Materials – M25 grade concrete and Fe415 steel; spacing of the cross girders 4m c/c ; width of carriage way = 7.5m ; thickness of wearing coat = 80mm ; Kerbs on either side = 600mm wide × 300mm deep ; width of main girder = 300mm ; width of cross girder = 300mm ; spacing of main girders = 2.5m c/c ; sketch reinforcement details. **(16 Marks)**

OR

6 Design T-beam bridge "cross girder" for the data given in Q5 and sketch the reinforcement details. **(16 Marks)**

Module-4

7 Design a Reinforced concrete box culvert having a clear vent way 3m by 3m. The super imposed dead load on the culvert is 12.8 kN/m^2. The Live Load is estimated as 50 kN/m^2. Density of soil at site is 18 kN/m^2. Angle of repose = 30°. Adopt M20 grade concrete and Fe415 steel. Sketch the details of reinforcement. **(16 Marks)**

OR

8 Design a suitable reinforced concrete pipe culvert to suit following data:

Discharge through pipe culvert	= 1.57m^3/s
Velocity of flow through pipe	= 2m/s
Width of road	= 7.5m
Top width of embankment	= 1.5:1
Bed level of stream	= 100.00 m
Top of embankment	= 103.00 m

Loading : IRC class AA Wheeled vehicle. **(16 Marks)**

Module-5

9 Verify the stability of the abutment shown in Fig.Q.9. The other salient details are given below:

Material	= Concrete
Density of soil	= 18 kN/m^3
Coefficient of friction	= 0.6
Angle of repose of soil	= ϕ = 30°
Live Load on bridge	= IRC class AA tracked
Span of bridge	= 15m
Angle of friction between the soil and concrete	= 18°

The bridge deck consists of three longitudinal girders of 1.4m depth with a deck slab of 200mm depth. **(16 Marks)**

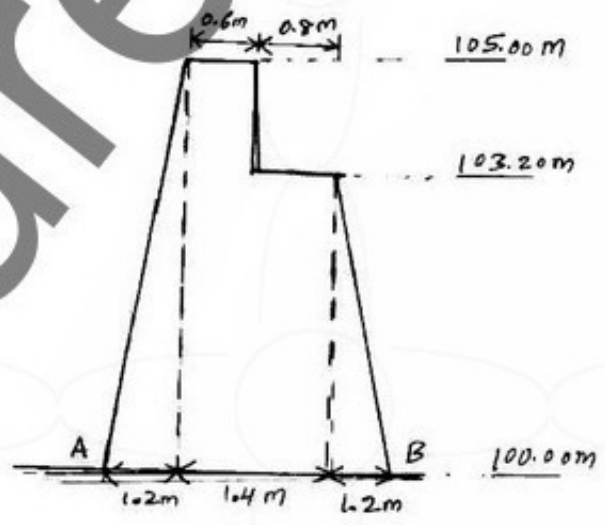

Fig.Q.9

OR

10 Write short notes on:
a. Bridge bearings
b. Hinges
c. Expansion Joints **(16 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

15CV741

Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020
Design of Bridges

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of codes IRC-6, IRC-21, IRC-112, IS-456, SP-16 and Pigeaud's curves are permitted.

Module-1

1 a. Classify bridges based on various parameters. **(10 Marks)**
b. What are the different types of loads acting on a bridge? **(06 Marks)**

OR

2 a. What is meant by economic span? Derive the expression for economic span. **(08 Marks)**
b. Determine the linear waterway for a bridge across a stream with a flood discharge of 200 m^3/s, velocity 1.4 m/s and width of flow at high flood level 52.0m. if the allowable velocity under the bridge is 1.75 m/s. **(08 Marks)**

Module-2

3 A reinforced concrete slab bridge has a clear span of 5.5m and has the following data:
Width of bearing on either side = 500 mm
Clear width of carriage way = 7.5 m
Width of footpath on either side = 1.0 m
Wearing coat thickness = 80 mm
Live load expected – Class AA tracked vehicle
Grade of concrete = M30
Grade of Steel = Fe 415
Design and detail the slab bridge. **(16 Marks)**

OR

4 a. What is meant by a skew slab bridge? **(02 Marks)**
b. What are the differences between a straight slab bridge and a skew slab bridge? **(06 Marks)**
c. Sketch typical reinforcement detailing of skew slab bridges. **(08 Marks)**

Module-3

5 Design and detail the interior slab of a T-beam bridge with the following data:
Spacing of longitudinal main girders = 3.0 m
Spacing of cross girders = 3.75 m
Thickness of deck slab = 200 mm
Thickness of wearing coat = 80 mm
Live load = Class AA, tracked vehicle
Grade of concrete = M30
Grade of steel = Fe415 **(16 Marks)**

OR

6 A T-beam bridge has the following data:
Effective span = 16.0 m
Clear carriage way = 7.5 m
Longitudinal main girders = 3 Nos@2.5m c/c
Cross girders = 5 Nos@4.0 m c/c
Kerbs at both the ends = 600 mm wide
300 mm deep.
Thickness of deck slab = 200 mm
Thickness of wearing coat = 80 mm
Live load – class AA tracked vehicle
Grade of concrete – M30
Grade of steel – Fe415
Design and detail the outer main girder of the T-beam bridge. **(16 Marks)**

Module-4

7 A single vent box culvert has internal dimensions 3.0m × 3.0m with the following data:
Superimposed dead load = 16.0 kN/m^2
Live load including impact = 52.0 kN/m^2
Insitu intensity of soil = 18.0 kN/m^3
Angle of internal friction = 30 degrees
Considering empty condition, Design and detail the box culvert using M30 Grade concrete and Fe 415 grade steel. **(16 Marks)**

OR

8 Design and detail a pipe culvert for the following data:
Catchment area = 12.0 sq. km
Maximum daily rainfall = 25 mm
Runoff coefficient = 0.8
Clear road width = 7.5 m
Footpath on either side = 600 mm
Bed level of stream = 50.0 m
Road formation level = 53.0 m
Weight of earthfill = 74 kN/m
Influence coefficient C_s = 0.036
Impact factor = 1.5
Loading – Class A vehicle with 114 kN use NP_3 pipes with longitudinal reinforcement 3.55 kg/m, spiral reinforcement 46.21 kg/m and a 3 Edge bearing strength of 100.6 kN/m. **(16 Marks)**

Module-5

9 a. What are the forces acting on piers? **(04 Marks)**
b. Sketch typical types of piers used in bridges. **(06 Marks)**
c. Write short notes on stability of abutments. **(06 Marks)**

OR

10 a. With neat sketches, explain different types of bearings used in bridges. **(10 Marks)**
b. Explain why expansion joints are required on bridge deck slabs. **(04 Marks)**
c. Detail a typical expansion joint in the deck slab of a concrete bridge. **(02 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | |

15CV741

Seventh Semester B.E. Degree Examination, June/July 2019
Design of Bridges

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of IRC:21-2000 allowed.*
3. *Assume any missing data suitably.*

Module-1

1 a. Explain linear waterway, afflux and scour. **(06 Marks)**

b. Determine the water way for a bridge across a stream with a flood discharge of 225 m^3/s, velocity 1.5 m/s and width of flow at high flood level 60 m, if allowable velocity under the bridge is 1.8 m/s. Use Molesworth formula. **(10 Marks)**

OR

2 a. Derive an expression for economic span of a bridge. **(08 Marks)**

b. Briefly explain class AA wheeled vehicle with a neat sketch. **(08 Marks)**

Module-2

3 Design a slab bridge for the following details.
Loading = class AA tracked vehicle
Clear span = 4.5 m
Road width = 7.5 m
Foot path on either side = 600 mm
Thickness of wearing course = 80 mm
For M25 concrete and Fe415 steel
$k_d = 0.318$ d, $j_d = 0.89d$
Constant $\alpha = 2.85$
Density of concrete = 24 kN/m^3
Density of wearing course = 22 kN/m^3
Check for shear not required and no need to design the footpath. Show reinforcement details in a cross section. **(16 Marks)**

OR

4 Design a slab bridge for the following details:
Carriage way width = 12 m
Kerb width = 550 mm
Exposure condition = moderate
M25 concrete and Fe 415 steel
Loading = class AA wheeled vehicle
Clear span = 5.0m; $\alpha = 3.0$
Wearing course = 60 mm
Check for shear not required. No need to design Kerb. Show reinforcement details.
(16 Marks)

Module-3

5 A T-Beam bridge has to be provided across a channel having following data. Design the slab deck and show reinforcement details.
Food discharge = 30 m^3/s
Bed width = 12 m
Side slope = 1:1
Depth of flow = 1.25 m
Maximum allowable afflux= 1.50 cm
Number of longitudinal girders = 3
Load = IRC class AA tracked vehicle on a two lane highway of 7.5 m
M25 concrete and Fe415 steel, $k_d = 0.318$ d, $j_d = 0.89$ d.
Thickness of wearing course = 80 mm
Take $m_1 = 0.043$ and $m_2 = 0.028$ for self weight of slab and surface finish. Take $m_1 = 0.077$ and $m_2 = 0.058$ for live load. No need to check for shear. **(16 Marks)**

OR

6 A T-beam bridge has to be provided across a channel having following data. Design the T-beam and show reinforcement details.
Clear span = 14 m
Number of longitudinal girders = 3
Spacing of girders = 3 m
Width of main girder = 0.30 m
Spacing of cross girders = 3.5 m
Width of cross girder = 0.25 m
M25 concrete and Fe415 steel = $k_d = 0.318$ d, $j_d = 0.89$ d
Load = IRC class AA tracked vehicle on a two lane highway of 7.5 m
Footpath = 1 m wide footpath on either side
Thickness of wearing course = 80 mm
Take impact = 10%
Overall depth = 1450 mm
Reaction coefficient for the critical girder due to live load = 0.517 **(16 Marks)**

Module-4

7 An RCC pipe culvert is proposed for a drain carrying a design discharge of 1.40 m^3/s. Permissible velocity of flow is 1.50 m/s. Bed level of drain 100.00 m, road formation level 103.00 m, road width is 7.50 m. Embankment slope is 1.5:1. Table below gives the details of NP3 pipe and its strength.

Pipe diameter		Reinforcement		Three edge bearing strength
Internal	External	Longitudinal	Spiral	
800 mm	990 mm	26.60 N/m	130.40 N/m	57.48 kN/m

Embankment load is 60 kN/m. Value of $C_c = 0.025$ for IRC class AA wheel load of 62.50 kN. Impact factor is 1.50. Coefficient of head loss at entry is 0.51. Coefficient of head loss due to friction is $0.0033\ L/(R)^{1.3}$. Design the pipe culvert. Draw the cross section of pipe showing reinforcement and bedding details. **(16 Marks)**

OR

8 Design a box culvert having inside dimensions of 3.5m × 3.5 m. The culvert is subjected to a super imposed dead load of 12 kN/m^2 and a live load of 35.7 kN/m^2 including impact. Unit weight of soil = 18 kN/m^3. The coefficient of active earth pressure, $k_a = 1/3$. k = 0.318 and j = 0.89 for M25 concrete and Fe415 steel. The design condition is the top of the slab carries the dead and live loads and the culvert is empty. Take road width equal to 7.5 m. **(16 Marks)**

Module-5

9

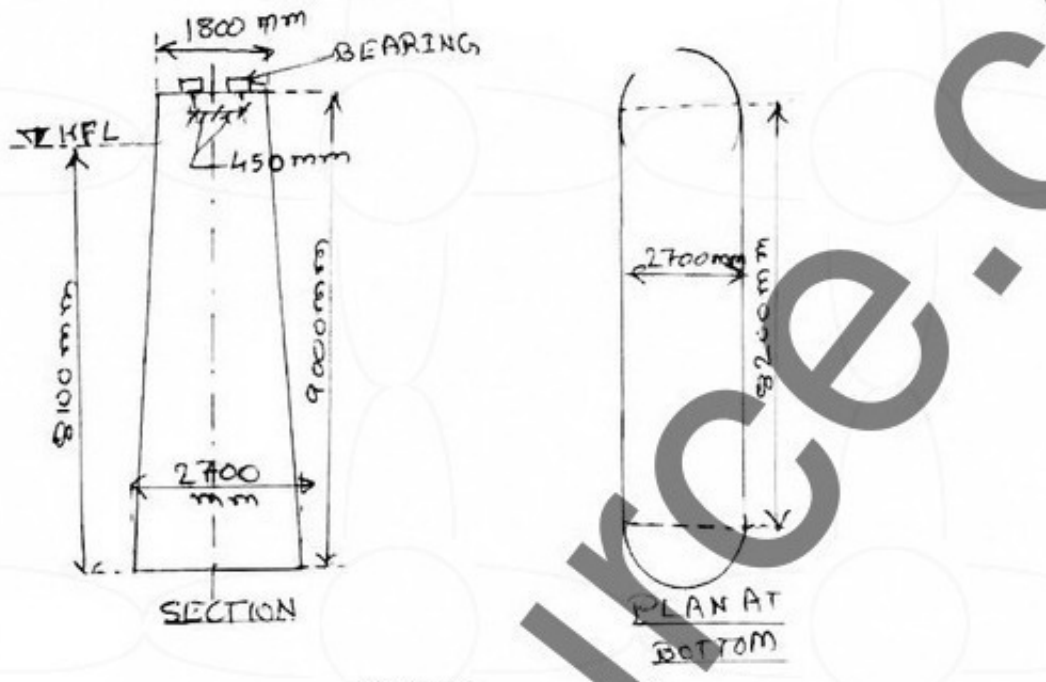

Fig.Q9

Check the adequacy of dimensions of the pier shown in Fig.Q9 for the following details.
Super structure = simply supported T-beam of 21.30 m span
Foundation = well foundation
Dead load from each span = 2250 kN
Reaction due to live load on one span = 900 kN
Maximum mean velocity of current = 3.6 m/s
Materials for pier : M20 grade concrete
Live load = IRC class AA tracked vehicle **(16 Marks)**

OR

10 a. Explain with a neat sketch the following two types of bearings:
i) Fixed bearing
ii) Expansion bearing **(08 Marks)**

b. What are the functions of an expansion joint? Explain it briefly with any two neat sketches. **(08 Marks)**

* * * * *