SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

III SEMESTER

1917307 - DESIGN OF BRIDGES

Regulation – 2019

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Prepared by

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DEPARTMENT OF CIVIL ENGINEERING

QUESTION BANK

SUBJECT : 1917307 Design of Bridges

SEM / YEAR: III/II Year

UNIT – I: GENERAL INTRODUCTION AND SHORT SPAN RC BRIDGES			
Types of bridges and IRC loading standards - Choice of type - I.R.C. specifications for road bridges – Design of RCC solid slab bridges - analysis and design of slab culverts.			
PART-A			
Sl.No	**Questions**	**BT Level**	**Competence**
1.	Give some IRC specifications for road bridges.	BT-1	Remember
2.	State the various type's loads to be considered in the design of bridges.	BT-1	Remember
3.	Define impact factor and its importance in the design of bridges?	BT-1	Remember
4.	State the function of cross girder in a RCC bridge deck system?	BT-1	Remember
5.	Define economical span.	BT-1	Remember
6.	List the three types of culverts.	BT-1	Remember
7.	Discuss the advantages of T-beam bridge.	BT-2	Understand
8.	What are the types of bridges recommended if the span is (a) less than 20m and between 1000m to 2000m?	BT-2	Understand
9.	Classify the types of bridges.	BT-2	Understand
10.	Select the position of loads for getting maximum bending moment in solid slab bridges?	BT-2	Understand
11.	Draw a simple sketch of kerb in slab bridge	BT-3	Application
12.	Write the specification of class 70 R tracked vehicle loading?	BT-3	Application
13.	Draw a neat sketch of component of a T-beam bridge.	BT-3	Application
14.	Criticize the aspects which influence the type of bridge.	BT-3	Application
15.	Distinguish between class 'A' loading and class 'B' loading as per IRC.	BT-3	Application
16.	Examine the factors influencing the selection of type of bridges?	BT-3	Application
17.	Evaluate the effective width of slab for a single concentrated load?	BT-3	Application
18.	Evaluate the causes for longitudinal forces on bridges?	BT-3	Application
19.	Write the two ways in which bridges may be classified.	BT-2	Understand
20.	Write note on IRC class AA loading	BT-2	Understand

21.	Define Water Current Forces	BT-1	Remember
22.	Write note on Effective Width Method	BT-2	Understand
23.	Advantages of Box Culvert	BT-2	Understand
24.	Define Centrifugal Force	BT-1	Remember
25.	Advantages Of Westergaards Method	BT-2	Understand

PART –B

1.	A RCC "T" beam and slab girder deck is required for the crossing of National high way for the following data. Clear width of road way : 25m Effective span : 30m Live load class AA thickness of wearing coat:100m Use M_{30} grade concrete and Fe 415 HYSD steel bars spacing of cross girders : 5m Design one of the interior panel of deck slab and sketch the details of reinforcement.	BT-3	Application
2.	List the various classification of bridge according to it materials used in construction.	BT-3	Application
3.	Describe the various investigations of major bridges.	BT-3	Application
4.	Design a box Culvert having inside dimensions of 3m x 3m. This culvert is subjected to a dead load of 14,000 N/m^2 and a Live load of IRC Class AA tracked Vehicle. Assume Unit Weight of soil to be 18,000 N/m^3 The angle of repose of soil is 30 degree .Use M25 Concrete and F415 steel Road width is 7.5 span is 3.3m	BT-3	Application
5.	Design and report a Tee beam for a bridge deck required for the crossing of highway using the following data. Clear width of roadway = 15m Effective span of the bridge = 22m Loading = IRC Class AA Number of main girders = 8 Spacing of the main girders = 2m Spacing of cross girders = 4m Materials = M30 grade concrete and Fe415 steel	BT-3	Application
6.	Design and report a Tee beam for a bridge deck required for the crossing of highway using the following data. Clear width of roadway = 12m Effective span of the bridge = 21m Loading = IRC Class AA Number of main girders = 7 Spacing of the main girders = 2m Spacing of cross girders = 3m Materials = M30 grade concrete and Fe415 steel	BT-3	Application
7.	Solve a solid slab bridge for class A loading for the following data: Clear span= 5m, clear width of roadways = 7m, average thickness of wearing coat =80mm. Use M20 concrete take unit weight of concrete as 24000 N/m^3.	BT-3	Application
8.	Write a detail note on the investigation procedure for the selection of the site and the type of bridge.	BT-3	Application
9.	Solve a solid slab bridge for class A loading for the following	BT-3	Application

	data: Clear span= 5m, clear width of roadways = 7m, average thickness of wearing coat =80mm. Use M20 concrete take unit weight of concrete as 24000 N/m^3.		
10.	Examine the super structure for one span of a T-beam bridge to be built on a rural section of a state highway. The bridge consists of 6 spans of 115m. Assume moderate exposure and cement wearing course.	BT-4	Analyze
11.	Examine the super structure for one span of a T-beam bridge to be built on a rural section of a state highway. The bridge consists of 7 spans of 140m. Assume moderate exposure and cement wearing course.	BT-4	Analyze
12.	Design a "T" beam bridge and Evaluate the courbon's reaction factor and the maximum bending moment. Span of the bridge = 18m Number of main girders = 3 with c/c spacing 2.6 m Loading Type = IRC A Roadway = 2 Lanes Kerb width = 600 mm on either side.	BT-4	Analyze
13.	Design a RC slab bridge of span 4.5m for IRC class AA (tracked vehicle) with M35 concrete and Fe415 steel. Assume width of roadway as 7.5m with footpath of 600mm on either side. Draw the cross sectional details of the slab.	BT-4	Analyze
14.	Design a RC slab bridge of span 6 m for IRC class AA (tracked vehicle) with M35 concrete and Fe415 steel. Assume width of roadway as 8.5m with footpath of 500mm on either side. Draw the cross sectional details of the slab.	BT-4	Analyze
15.	Explain in detail about the various types of bridges.	BT-4	Analyze
16.	Illustrate the factors influencing the choice of bridge type.	BT-4	Analyze
17.	Find out the live load moment for the RCC Slab culvert under IRC Class A loading with following details. Effective span=6.4m, width of the road way = 9.5m, wearing coat = 80cm, depth of slab =500mm, M25 grade concrete and Fe415 steel.	BT-4	Analyze

PART –C

1.	Explain the various load distribution theories on the T-beam slab bridges.	BT-4	Analyze
2.	Draw the loading standard for IRC class AA loading and also Explain the IRC Specifications for live load for IRC class 70R loading?	BT-4	Analyze
3.	Explain elaborately the various types of loadings on the Railway and Road bridges. Explain the design of these bridges according to IRC Codes	BT-3	Application
4.	Explain the procedure for shear stress calculation in Solid slab bridges.	BT-3	Application
5.	Design a reinforced slab culvert for a national highway crossing to suit the following data. Carriage way – Two lane (7.5m wide), Foot path – 1m on either side, Clear Span – 6m , Wearing coat 80mm, width of bearing – 400mm and materials M25 Grade concrete, Fe415 Grade HYSD Bars and loading IRC Class AA Tracked loading.	BT-4	Analyze

	Design the R.C Slab deck and sketch the details of reinforcement in the longitudinal and cross section of the slab. The design should conform to the specifications of IRC: 6-2000 and IRC: 21-2000 Codes.		

UNIT – II LONG SPAN RC BRIDGES

Tee beam and slab bridges- General features - Pigeaurd's Curve - Courbon's theory – Continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts – Segmental bridges-Advantages-General features-Design principles only.

PART – A

Sl.No	Questions	BT Level	Competence
1.	List the ideal situations to choose a balanced cantilever bridge.	BT-1	Remember
2.	List out the various forms of box girder bridge.	BT-1	Remember
3.	List the main components of Balanced Cantilever Bridge.	BT-1	Remember
4.	List and Sketch the types of loading considered in box culverts.	BT-1	Remember
5.	Define stringers.	BT-1	Remember
6.	State about cross guides?	BT-1	Remember
7.	In What situation balanced cantilever bridges are considered?	BT-2	Understand
8.	Discuss about the articulation in the cantilever bridges.	BT-2	Understand
9.	Explain briefly the analysis of continuous bridges.	BT-2	Understand
10.	Explain how the concentrated load is calculated in Box Culvert.	BT-2	Understand
11.	Sketch the various types of Box girder type prestressed concrete bridges.	BT-3	Application
12.	Draw the typical profile of three span continuous bridges.	BT-3	Application
13.	Write the main advantages of having a diaphragm in box girder bridges?	BT-3	Application
14.	What are the design loads for box culvert?	BT-2	Understand
15.	Examine the relation between depth of main span and mid span in case of R.C Balanced Cantilever Bridges	BT-2	Understand
16.	Examine the relation between depth support to depth at mid span in case of R.C Balanced Cantilever Bridges	BT-2	Understand
17.	Evaluate the radius and thickness of arch bridges?	BT-2	Understand
18.	Evaluate the equation for calculating afflux.	BT-2	Understand
19.	Write down the advantages of continuous bridges?	BT-1	Remember
20.	Write in short about the box culvert.	BT-1	Remember
21.	Advantages Of Box Culvert	BT-2	Understand
22.	Write the IRC specifications for Road bridges.	BT-1	Remember
23.	Write a note on the importance of impact factor in the design of bridges?	BT-1	Remember
24.	What are the considerations in determining the effect of wind loads?	BT-1	Remember

25.	Relate the stress which governs the design of super structural elements of the bridge.	BT-2	Understand

PART –B

1.	List the various steps involved in the design of an arch bridge with neat sketch of the cross sectional details.	BT-4	Analyze
2.	State and discuss the design principles of balanced cantilever bridges.	BT-4	Analyze
3.	State and explain in detail about the design of Box culvert	BT-4	Analyze
4.	List the various steps involved in the design of balanced cantilever bridge with neat sketch of the cross sectional details.	BT-4	Analyze
5.	Explain in detail about the various steps involved in the design of articulation. Also explain the design consideration	BT-4	Analyze
6.	Discuss the design principles of continuous bridges	BT-2	Understand
7.	List the advantages of balanced cantilever bridge.	BT-2	Understand
8.	Write the design steps for a two span continuous reinforced concrete bridge with girders of variable cross section.	BT-3	Application
9.	Write in detail about a box girder bridge with types and behavior of box girder bridges neat sketches.	BT-3	Application
10.	Write the advantages of box culvert bridge.	BT-3	Application
11.	Enumerate the various steps involved in the design of box girder bridge with neat sketch of the cross sectional details.	BT-4	Analyze
12.	Design a balance cantilever bridge for the following data. Span center to center of bearings : 40m Clear width of road way :8m Load : Two lanes of class A M30 grade concrete and HYSD steel of Fe 500.	BT-4	Analyze
13.	Evaluate the articulation of a balanced cantilever bridge for the following data: Dead load reaction from suspended span = 500 kN Dead load from stiffener (Diaphram) at articulation = 18 kN Live load reaction from suspended span = 500 kN Depth of articulation = 1170 mm Total depth of girder at articulation = 3225 mm	BT-4	Analyze
14.	Write short note on: Steel arch bridge and Cantilever bridges.	BT-3	Application
15.	With a flow chart explain the development of Simply supported bridge, Arch bridge, Suspension bridge and Truss and Girder bridges.	BT-3	Application
16.	Explain the appearance, characteristics, advantages and disadvantages of Beam Bridges.	BT-3	Application
17.	Explain in detail about the design of Box culvert.	BT-3	Application

PART –C

1.	Explain the analysis and design of continuous bridges with neat sketches. What are the advantages of continuous bridges with variable moment of inertia?	BT-3	Application
2.	Discuss about the various methods for distribution of live loads among the longitudinal girders.	BT-3	Application
3.	Evaluate a RCC Box Culvert having a clear way of vent size 3.5m x 3.5m. Live load and dead load on the culvert is 30 kN/m^2 and 10 kN/m^2respectively. Unit weight of soil is 16 kN/m^3. Angle of repose is 30°and use M20 grade concrete and	BT-4	Analyze

	Fe415 grade steel. Assume any other data if necessary.		
4.	Design the deck slab of the double cantilever bridge to suit the following data. Total length of the bridge = 99m Carriage path = 7.5 m wide Foot path = 1.8 m on either side Spacing of the T beam 1.8 m c/c Loading IRC class 70R loading Materials M20 grade concrete and Fe415 grade steel is used.	BT-4	Analyze
5.	Discuss about the various types of culverts and causeway.		

UNIT – III: PRESTRESSED CONCRETE BRIDGES

Pre-stressed concrete bridges-Preliminary dimensions-Flexural and torsional parameters – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections.

PART – A

Sl.No	Questions	BT Level	Competence
1.	Write the critical loading stages in pre-stressed concrete bridges.	BT-1	Remember
2.	State the uses of pigeaurd's curves.	BT-1	Remember
3.	List the functions of end block in a prestressed girder.	BT-1	Remember
4.	List out the basic difference between pre-tensioning and post-tensioning.	BT-1	Remember
5.	Memorize the stages of loading to be considered in Prestressed concrete bridge.	BT-1	Remember
6.	State maximum and minimum prestressing forces.	BT-1	Remember
7.	Explain when you will adopt Courbon's method.	BT-2	Understand
8.	Explain what do you mean by distribution coefficient?	BT-2	Understand
9.	Explain how will you find Bending Moment in slabs spanning in two directions	BT-2	Understand
10.	Explain about the end block.	BT-2	Understand
11.	Illustrate concordant cable profile.	BT-3	Application
12.	Demonstrate the guidelines for control of cracking to satisfy the serviceability requirements as per IRC 21 code.	BT-3	Application
13.	Sketch any two cross sections of Prestressed concrete bridge decks.	BT-3	Application
14.	Examine the advantages of prestressed concrete bridges.	BT-2	Understand
15.	Define short term and long term deflection.	BT-3	Application
16.	Discriminate the condition to be satisfied for courbon's theory?	BT-2	Understand
17.	Evaluate reaction factor using Courbon's Theory.	BT-3	Application
18.	Select the main advantages of post tensioning in post tensioning in bridge girder	BT-2	Understand
19.	Write the different types of beam used in pre-tensioned prestressed concrete bridges.	BT-3	Application
20.	Write the advantages of prestressed concrete bridges.	BT-3	Application

21.	Draw the stress distribution at mid span of a rectangular beam pretressed concentrically	BT-1	Remember
22.	Define Supplementary reinforcement.	BT-1	Remember
23.	Write the expression for ultimate flexural strength of the beam	BT-1	Remember
24.	Write the expression for ultimate Shear strength of the beam	BT-1	Remember
25.	Differentiate between bonded and unbounded in Post Tension	BT-1	Remember

PART – B

1.	Explain in detail about the design steps of T-beam using Pigeud's theory	BT-4	Analyze
2.	List the different steps involved in the design of prestressed concrete bridges.	BT-4	Analyze
3.	Explain the design of main girder of a prestressed continuous bridge to suit the following data Two continuous span of 60 m each Width of Road : 7.5 m Wearing coat thickness = 80mm Loading IRC class 'AA' Tracked vehicle Loss ratio = 0.8 Concrete grade M50 for PSC and M25 for RCC steel – 1500 Mpa and 250 Mpa for RCC stress.	BT-3	Application
4.	Select the sectional properties and internal forces of a I-section for the prestressed concrete girder are given below: Top flange = 1200 mm x 250 mm Web = 200 mm x 800mm Bottom flange = 500 mm x 450 mm F_{ck} = 50 Mpa F_{ci} = 40 Mpa F_{ct} = 20 Mpa M_{girder} = 3008 kN-m (due to dead DL) BM for the outer girder including impact factor and reaction factor = 1706 kN-m (due to LL). Design the prestressing cable for the section.	BT-4	Analyze
5.	Explain a post tensioned prestressed concrete slab bridge deck has the following data: Clear span = 10 m Width of bearing = 400 mm Clear width of roadway = 7.5 m Footpath on either side = 1 m Width of kerbs = 600 mm Thickness of wearing coat = 80 mm Live load = IRC Class AA Tracked Vehicle Design the deck slab for bending only. Assume M40 concrete and 7 mm diameter HTS wires with an ultimate tensile strength of 1500 N/mm^2 housed in cables with 12 wires and anchored by Freyssinet anchorage of 150 mm diameter. Loss ratio is 0.80.	BT-3	Application
6.	Design a post tensioned pre-stressed concrete bridge deck for the following data. Effective span : 30m Width of road :9m Kerbs: 750mm on each side IRC class A loading for deck slab concrete grade is M30 and for girderM60. Cube strength at transfer: 40N/mm^2 Modulus of Elasticity of concrete Ec:35N/mm^2 Loss ratio:0.85	BT-3	Application

	7mm diameter wire (High tensile) having strength of 1500N/mm^2 are available for use. Design the bridge deck and sketch the details.		
7.	Solve post tensioned prestressed concrete slab bridge deck using the following data: Width of carriage way = 8.5m Clear span = 14m Loading IRC class A Width of kerbs = 500mm Width of bearings = 500mm Type of structure = Class-I Materials = M40 grade concrete Fe415 steel and 7mm diameter high tensile wires with ultimate tensile strength of 1500Mpa housed in cables with 12 wires and anchored by Freyssinest anchorage of 150mm diameter. The compressive strength at transfer = 35 Mpa.	BT-3	Application
8.	Examine simply supported beam of span 8m and section 500 x 700 mm is prestressed by a parabolic cable having an eccentricity of 100mm at centre of span and zero at supports with a prestressing force of 1500kN. If beam supports an udl of 42 kN/m. Find the extreme stresses at mid span section.	BT-4	Analyze
9.	Examine simply supported beam of span 10m and section 600 x 800 mm is prestressed by a parabolic cable having an eccentricity of 80mm at centre of span and zero at supports with a prestressing force of 1800kN. If beam supports an udl of 52 kN/m. Find the extreme stresses at mid span section.	BT-4	Analyze
10.	Evaluate the T-beam pretensioned girder for the following data: Spacing of main T beam is 3m and span of T beam is 20m. Assume the thickness of wearing coat is 100mm, loading IRC class AA tracked vehicle and assume loss 20%. Use M60 PSC and M20 for RCC. Take stress in steel 1500 N/mm^2 for PSC and 230 N/mm^2 for RCC. Assume any other data if necessary.	BT-4	Analyze
11.	Design a PSC bridge for the following data Clear span = 18 m ; effective span = 18.8 m Total length of the girder = 19.6 m ; Clear roadway = 7.5 m Design for one span.	BT-3	Application
12.	Design a prestressed concrete slab given the following data Span (clear) = 5.0 m Live load = IRC Class 70R Road = National Highway Materials = M50 concrete and Fe 415 grade steel Footpath:1.2m on each side Permissible compressive stress in concrete at transfer = 18 Mpa	BT-3	Application
13.	Design a prestressed concrete slab given the following data Span (clear) = 5.5 m Live load = IRC Class 70R Road = National Highway Materials = M40 concrete and Fe 415 grade steel Permissible compressive stress in concrete at transfer = 18 Mpa	BT-3	Application
14.	Design the longitudinal girders of a post-tensioned prestressed concrete bridge to suit the following data. Width of the road = 7.5 m Effective span = 25 m Kerbs = 600mm on either side Live load IRC class AA Tracked vehicle.	BT-3	Application

	Grade of concrete for deck slab is M25 and for beam M50 Cube strength at transfer = f_{ck} = 35 N/mm^2 Permissible compressive stress at transfer = f_t = 17.5 N/mm^2 Permissible compressive stress at working load = f_{cw} = 16.5 N/mm^2 Loss ratio = 0.807mm diameter high tensile wires having a characteristic tensile strength f_p =1500 N/mm^2 and for steel are available for use.		
15.	Explain the various methods available for analysis of slab carrying the live load.	BT-3	Application
16.	Compare and contrast the advantages and disadvantages of pre-stress concrete.	BT-4	Analyze
17.	Enumerate the various prestressing and post-tensioned systems in detail.	BT-4	Analyze

PART – C

1.	Discuss about the Courbon's Theory	BT-4	Analyze
2.	Explain the design of main girder of a pretensioned continuous bridge to suit the following data. Two continuous span of 60 m each Width of Road = 7.5 m. Wearing Coat thickness = 80mm. Loading IRC class 'AA' Tracked vehicle. Loss ratio = 0.8,Concrete grade M50 for PSC and M25 for RCC steel – 1500 Mpa and 250 Mpa for RCC stress.	BT-4	Analyze
3.	Explain in detail about the design principles of Prestressed concrete bridges.	BT-3	Application
4.	Sketch the cross section of a T-beam superstructure and indicate the different components. Describe briefly how can you design each component.	BT-3	Application
5.	Write in detail about the Post-tensioned prestressed concrete bridge decks.	BT-3	Application

UNIT – IV: STEEL BRIDGES

General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

PART – A

Sl.No	Questions	BT Level	Competence
1.	Draw a neat sketch of steel cable stayed bridge and mark its salient parts.	BT-1	Remember
2.	What is the purpose of providing Lateral Bracings in plate girder bridges?	BT-1	Remember
3.	List the codal provisions of stiffeners.	BT-1	Remember
4.	List any four types of trusses used in bridge construction.	BT-1	Remember
5.	State the effect of repeated loading	BT-1	Remember
6.	List out the three types of truss bridge.	BT-1	Remember
7.	Describe what is dynamic argument in load calculation?	BT-2	Understand
8.	Explain bearing stiffeners.	BT-2	Understand
9.	Explain the loads considered in Railway bridges.	BT-2	Understand

10.	Explain the vertical and horizontal stiffeners.	BT-2	Understand
11.	Draw a neat sketch of draft type truss girders.	BT-3	Application
12.	Sketch a Box Girder bridge indicating its components.	BT-3	Application
13.	Draw a typical cross section of plate girder bridge with stiffeners.	BT-3	Application
14.	Examine why we provide horizontal stiffeners.	BT-3	Application
15.	Criticize how will you find the economical depth of the Plate Girder?	BT-3	Application
16.	Differentiate between 'Propped' and 'Unpropped' construction.	BT-1	Remember
17.	Defend lateral bracing in the deck type welded girder bridge.	BT-1	Remember
18.	Evaluate the main function of vertical and bearing stiffeners in a plate girder? How they differ?	BT-1	Remember
19.	Write the effect of secondary stresses in the steel bridges?	BT-3	Application
20.	Write the advantages of plate girder bridges?	BT-3	Application
21.	Explain the various components of the plate girder bridge.	BT-1	Remember
22.	List the different types of shear connectors used in the composite bridge.	BT-3	Application
23.	Write the advantages of the composite bridge.	BT-1	Remember
24.	List the different types of connectors used in the composite bridge.	BT-3	Application
25.	Define plate girder.	BT-2	Understand

PART B

1.	List the procedure for the design of lateral bracings and cross frames.	BT-3	Application
2.	Explain the effect of wind on steel bridges.	BT-3	Application
3.	Explain the step by step procedure of design of vertical and horizontal stiffeners.	BT-3	Application
4.	Explain in detail about the design procedure for through type steel highway bridges based on IS codal provisions.	BT-3	Application
5.	With a simple sketch explain the classification of steel bridges.	BT-3	Application
6.	Solve the main section of a plate girder for the following data: Span = 50 m, dead load / track is 6 kN/m EULL for BM calculation / track 2000 kN EULL for shearing calculation / track 2200 kN, side slope embankment is 1.5:1, average bed level 100m, high flood level 112m and top of rail level is 115m. Take width of embankment is 5m. Assume any other data if necessary.	BT-3	Application
7.	Calculate a steel beam culvert with a clear span of 6m to carry a broad gauge single track on main line.	BT-4	Analyze
8.	Design a plate girder for the following data: Span = 35 m Dead load of the track = 7.5 kN/m Live load (EUDL) for bending moment = 1405 kN Live load (EUDL) for shear force = 1614 kN.	BT-4	Analyze
9.	A warren truss is proposed for a deck type steel trussed bridge to cover a span of 30m. The cross girders are spaced at 6m intervals. Road width=8m; Kerbs= 650mm on each side. Spacing of stringer beams are 1.975m. Loading IRC class A loading. M40 grade concrete, Fe415 Tor steel are used. adopt rolled steel sections for the truss members. Design the deck	BT-4	Analyze

	slab and truss members.		
10.	Calculate a plate girder to carry a super imposed load of 175kN/m on an effective span of 16.5 m	BT-4	Analyze
11.	Solve a welded plate girder for a B.G track using the following data Effective span of the plate girder = 20m Dead load of the track = 8kN/m EUDL of live load on track for Bending Moment = 2000kN EUDL of live load on track for shear force = 2000kN	BT-5	Evaluate
12.	A plate girder is to be designed for a B.G track to suit the following data. Span of the bridge = 20m Dead load of the track = 7.5 kN/m EULL for B.M calculation / track = 2027 kN EULL for shear calculation / track = 2224 kN Solve for the plate girder alone. Stiffeners and bracings need not to be designed.	BT-5	Evaluate
13.	Design a steel trussed bridges to suit the following data: Effective span = 30m Roadway = 8 m (two lane) Kerb = 600 mm Loading = IRC class AA tracked vehicle Materials = M25 grade concrete and Fe415 HYSD bars for deck slab. Rolled steel sections with an yield stress of 245 N/mm^2.	BT-4	Analyze
14.	Design a central section of the plate girder for a deck type plate girder railway bridge for single track broad gauge main line loading. The following data are given . Effective span = 22 m Spacing of the plate girder = 2m C/C Weight of main rails = 0.44 kN/m Weight of guard rails = 0.26 kN/m Weight of fastenings = 0.28 kN/m of track Timber sleeper dimensions = 0.25 m x 0.15 m x 2.8 m at 0.4 m C/C Density of Timber = 7.4 kN/m^3 Take permissible stresses as per railway bridge codes.	BT-4	Analyze
15.	Discuss about the various elements of a plate girder in detail with neat sketch.	BT-4	Analyze
16.	Explain the appearance, characteristics, advantages and disadvantages of Truss Bridges.	BT-4	Analyze
17.	Discuss the major causes of bridge failures. Indicate how these failures could be avoided.	BT-4	Analyze

PART –C

1.	Justify the merits of steel bridges with an example.	BT-3	Application
2.	Discuss the major causes of bridge failures. Indicate how these failures could be avoided.	BT-3	Application
3.	Calculate a plate girder to carry a super imposed load of 200kN/m on an effective span of 18.5 m	BT-4	Analyze
4.	A railway bridge consists of welded plate girders of 30 m span. The equivalent live load on the girder is 75 kN/m uniformly distributed over the span Evaluate the midspan section of the plate girder. Design also the end bearing	BT-5	Evaluate

	stiffener.		
5.	Design a deck type welded plate girder bridge to suit the following data: Effective span of the girder = 30m, Dead load (open floor) = 7.5kN-m, Equivalent total live load bending moment calculation/track=2727kN, Equivalent total live load shear calculation/track=2927kN, Top of rail level=108.00, side slopes of embankment=1.5:1, Foundation level =100.50, width of abutment = 4m. Design the main plate girder with intermediate and bearing stiffeners and lateral bracing.	BT-4	Analyze

UNIT – V: BEARINGS AND SUBSTRUCTURES

Bridge bearings – Plate, Roller and Rocker bearings-Elastomeric bearings – Design of piers and abutments of different types – Types of bridge foundations – Design of foundations.

PART – A

Sl.No	Questions	BT Level	Competence
1.	Define bearings	BT-1	Remember
2.	State the condition of a stability of the abutment of a bridge.	BT-1	Remember
3.	Define Pneumatic Bearing?	BT-1	Remember
4.	State for sandy soil which type of foundation is ideal.	BT-1	Remember
5.	List the advantages of piers constructed monolithically with the bridge deck over the usage of bearings	BT-1	Remember
6.	State under what conditions, can we use shallow foundation?	BT-1	Remember
7.	What are the materials generally used for the construction of piers and abutments?	BT-2	Understand
8.	Explain the consideration in selecting the orientation of wing walls in the design of bridge abutments.	BT-2	Understand
9.	Explain the function of an expansion joint?	BT-2	Understand
10.	Classify the expansion type bearings.	BT-2	Understand
11.	Draw the typical neat sketch of a rocker roller bearing.	BT-3	Application
12.	Draw a typical sketch of an abutment and wing wall	BT-3	Application
13.	Write the functions of bearings in a bridge?	BT-3	Application
14.	Criticize the forces acting on a pier?	BT-1	Remember
15.	Examine which type of foundation is ideal for clay soil? Why?	BT-2	Understand
16.	Distinguish between Pier and Abutment with reference to Bridge substructure	BT-2	Understand
17.	Evaluate the loads and forces to be considered in the design of a bridge pier?	BT-3	Application
18.	Select the different types of foundation used in bridges?	BT-3	Application
19.	Write the different types of foundation used for bridge structures?	BT-1	Remember
20.	Write down the importance and types of bearings.	BT-1	Remember
21.	Classify the types of abutment.	BT-2	Understand
22.	List the stability analysis of abutments.	BT-1	Remember
23.	Explain the consideration for selection of bearings.	BT-2	Understand
24.	Explain the types of bearings.	BT-2	Understand
25.	List the various forces acting on bearings	BT-2	Understand

PART-B

1.	Write down the detailed stability analysis of abutment and pier structure in the bridge construction.	BT-3	Application
2.	List the design loads to be considered in abutments? Explain the step by step procedure of design of the abutment.	BT-3	Application
3.	Define Rocker bearing and Design a reinforced concrete rocker bearing to transmit a support reaction of 1000 kN. Adopt M40 grade concrete and Fe415 grade steel. Permissible bearing stress in concrete is 7 N/mm^2. Sketch the details of reinforcement in the concrete rocker bearing.	BT-4	Analyze
4.	Explain the design principles of Elastomeric bearing for Post-Tensioning girder PSC bridge with its errection details?	BT-4	Analyze
5.	Classify the various type of fixed bearings What are the components of well foundations in bridge construction? Give the. advantages of well foundation	BT-4	Analyze
6.	Design a mild steel rocker bearing for transmitting superstructure respective load of 1400kN. Allowable pressure on bearing block:4MPa Permissible Bending stress:165MPa Permissible Bearing stress: 100MPa Permissible shear stress: 100MPa Abed plate of size 500mm x 1000mm cable provided.	BT-4	Analyze
7.	Sketch and design a mild steel rocker bearing for transmitting superstructure reactive load of 1400 kN. Sketch and design a mild steel rocker bearing for transmitting superstructure. Allowable pressure on bearing block = 4 Mpa Permissible bending stress = 165 Mpa Permissible bearing stress = 100 Mpa Permissible shear stress = 100 Mpa A bed plate of size 500 mm x 1000mm cable provided.	BT-3	Application
8.	Solve for a suitable pier for 16m girder bridge for the following data: Clear width of roadway = 6.8 m Live load on bridge = Class A Height of pier = 8m Mean velocity of current = 3m/sec High flood level = 7m	BT-3	Application
9.	Sketch and design a mild steel rocker bearing for transmitting superstructure reactive load of 1600 kN. Sketch and design a mild steel rocker bearing for transmitting superstructure. Allowable pressure on bearing block = 5 Mpa Permissible bending stress = 185 Mpa Permissible bearing stress = 110 Mpa Permissible shear stress = 110 Mpa A bed plate of size 600 mm x 1200mm cable provided.	BT-3	Application
10.	Examine and design a group of 6 piles to carry a total load 4000kN. The piles are spaced at 0.9m c/c. Hard strata is available at a depth of 8m. Use M25 grade concrete and Fe415 grade steel.	BT-4	Analyze
11.	Examine and design a group of 6 piles to carry a total load 6000kN. The piles are spaced at 0.9m c/c. Hard strata is available at a depth of 10m. Use M25 grade concrete and Fe415 grade steel.	BT-4	Analyze
12.	Evaluate and design an elastomeric unreinforced neoprene pad bearing to be placed beneath a girder of a bridge to suit	BT-5	Evaluate

	the following data. Span of the girder = 16m Dimensions of the girder = 300mm x 1600mm No. of girders = 3 Slab thickness = 300mm No. of lanes = 2 Live load = IRC Class AA Horizontal force = 100kN Coefficient of friction = 0.35		
13.	Design a well foundation for a bridge using the following particulars Diameter of the well = 3m Depth of the well = 15m Type of soil = stiff clay Materials to be used = M30 concrete and Fe415 steel.	BT-4	Analyze
14.	Design a well foundation for a bridge using the following particulars Diameter of the well = 4m Depth of the well = 20m Type of soil = stiff clay Materials to be used = M40 concrete and Fe415 steel.	BT-4	Analyze
15.	Discuss in detail about well foundation with neat sketch.	BT-3	Application
16.	Design a steel rocker roller bearing to transmit a load of 2000kN. The concrete used in pier is of M30 grade adopt mild steel rollers of 2 numbers.	BT-4	Analyze
17.	Design a well foundation for the pier of a major highway bridge to suit the following data. Internal diameter of well=2.5m, type of soil strata = clay, Depth of well = 25m below the bed level. Materials = M30 Concrete and Fe415 Steel.	BT-4	Analyze

PART –C

1.	List and discuss the different types of bearings for bridges	BT-3	Application
2.	Discuss the major causes of bridge failures. Indicate how these failures could be avoided.	BT-4	Analyze
3.	Solve for an isolated footing using the following data: Ultimate Load = 1500 kN Pier Size = 300 mm dia SBC at soil = 200 kN/m^2 Use M20 grade of concrete and Fe415 grade of steel	BT-4	Analyze
4.	Discuss the various types of joints with illustrations and design recommendations.	BT-3	Application
5.	The pier of a major flyover bridge transmit a load of 11200 kN at foundation level. Design number of precast R.C.C pile and suitable pile cap using the following data. Width of pier = 1.2m, length of pier = 9m, Size of the pile = 300mm diameter circular pile, spacing of pile = 1.5m. Material M30 grade concrete and Fe415 steel hard strata available at a depth of 7m below the ground level at bridge site.	BT-4	Analyze

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