Duration:3 Hours **Maximum Marks: 80**

N. B.: 1. **Question number 1** is **compulsory**; attempt **any three** out of the remaining five questions.
2. Assume suitable **data** if **required** and mention it clearly.
3. **Answer and design** must be in accordance with **IRC and bridge rules**.
4. **IRC-6 and IRC-112** are permitted in the examination.
5. **Support answers** and **solutions** with suitable **sketches.**

Q1. Attempt any five.

A State following statements as true or false. If false, rewrite the correct statement. **04**

i) Nose-to-tail distance between IRC Class A or IRC Class B train vehicles shall not be less than 90 m.

ii) Dispersion of Live loads along the span through the wearing coat, deck slab, and filling shall be considered while calculating BM in the deck slab designed as one way slab.

iii) IRC Class A loading is to be normally adopted on all roads on which timber bridges are constructed.

iv) For the design of foot-over bridges the loading shall be taken as 5 kN/m^2.

B What investigations are to be done and what data is to be collected before the site selection of a bridge? **04**

C What is the provision to account dynamic effect of imposed load for roadway bridges? How do different factors influence it? Calculate the impact factor for the following cases. **04**

i. A bridge of span 8.2 m is designed to carry IRC class AA load.

ii. A PSC longitudinal girder for a bridge of span 40 m is to be designed to carry an IRC class A vehicles.

D What is a well foundation? Sketch components of well foundation. What is the permissible limit for tilt and shift of well foundation? **04**

E How does load get transferred in case of a PSC girder bridge from vehicle to earth? Support your answer with sketch. **04**

F What do you mean by economical span of a bridge? Develop equation for the same. **04**

G What are the advantages of a balanced cantilever bridge over a simply supported bridge and a continuous bridge? A 75m gap is to be bridged by a balanced cantilever bridge. Suggest spacing between supports and projections for a balanced cantilever bridge. **04**

Q2 A Calculate the live load bending moment and live load shear force for the **'one-way deck slab'** for the following requirements: **15**

Effective span	7.0 m
Width of roadway including footpath	10.0 m
Thickness of wearing coat	100 mm
Thickness of deck slab	500 mm
Live load	IRC Class AA tracked vehicle

Also check whether the same deck slab is safe or not to resist BM due to IRC class 70R tracked vehicle, and comment on it.

B What different factors influence the selection of a particular type of bearing? Explain Elastomeric bearing in brief. **05**

Q3 A simply supported post-tensioned prestressed concrete deck slab bridge of 13.5 m effective span is designed to carry **IRC-Class 70R** loading. Verify its safety in the limit state of serviceability of cracking & maximum compression and limit state of collapse flexure for the following specifications. **20**

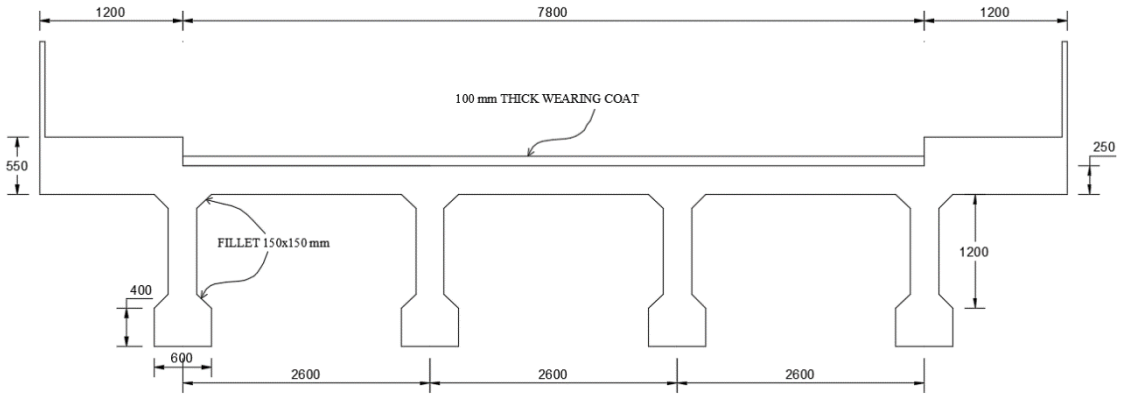
Carriage width: 7.5 m;

Footpath on either side: 1.5 m;

Wearing coat: 100mm;
Depth of deck slab: 500 mm;
Initial strength of concrete is 50 MPa and characteristic strength is 60 MPa
Characteristic strength f_p of prestressing steel is 1600 MPa
Cables are tensioned to 1200 kN initially and spaced 280 mm c/c at 100 mm from soffit of the slab at mid-span. Prestressing force in each cable accounting for all losses is 1020 kN.

Q4 Design an interior slab panel of PSC girder bridge for flexure and shear which has to carry **IRC class A** vehicle. Cross girders are provided at 5 m c/c and longitudinal girders are provided at 2.5 m c/c. Thickness of wearing coat is 90 mm. Use M 30 and Fe 415, refer Pigeaud's Curve. **20**

Q5 Determine design bending moment and shear force on longitudinal girder of a 27 m span bridge, due to IRC Class AA tracked vehicle and self-weight of the bridge superstructure. Clear carriage width is 7.8 m, footpath on either side is 1.2 m and cross girders are provided at 4.5 m c/c. Thickness of deck stab is 250 mm thickness of wearing coat is 100 mm. Area of cross girder is 70% of the area of a longitudinal girder. **20**



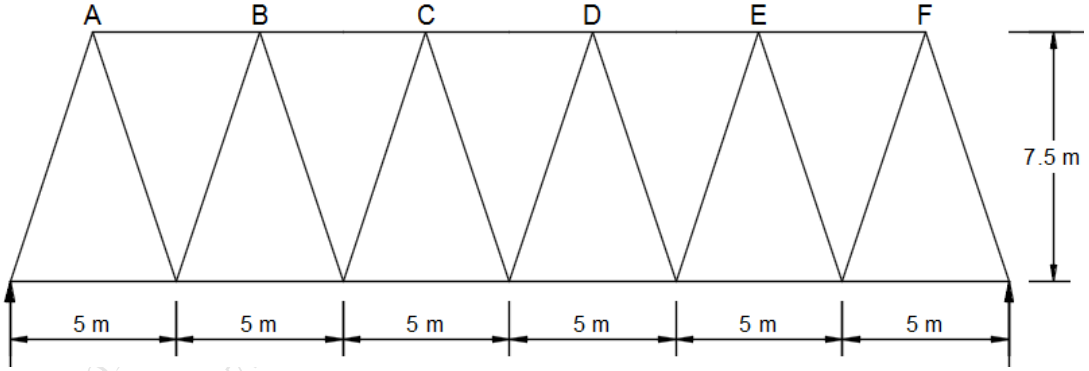
Q6 Determine **design forces** due to **dead** and **live load** in **Top Chord member AF** of a lattice girder bridge of **30 m** span as shown below. **20**

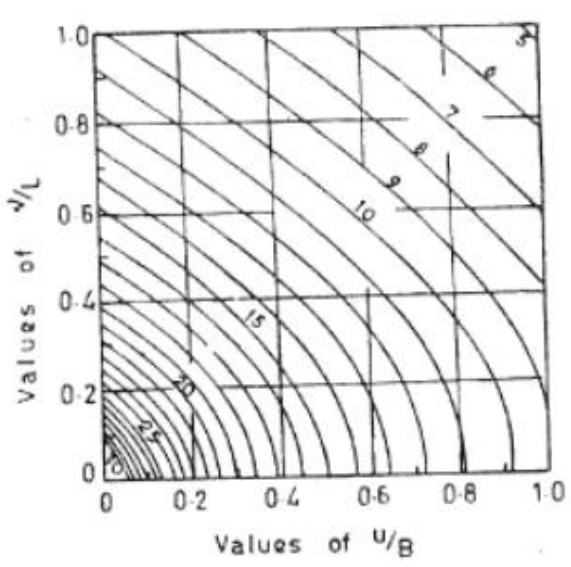
Consider self-weight of different elements like Stringers, Stock rails, Guard rails, Cross beams & bracings, Sleepers & Fasteners etc. as 24 kN/m per track and the self-weight of each girder due to the top chord, bottom chord, diagonals, and vertical members as 20 kN/m.

A bridge is to be designed to carry a single-track **Broad-Gauge Loading-2008** as under;

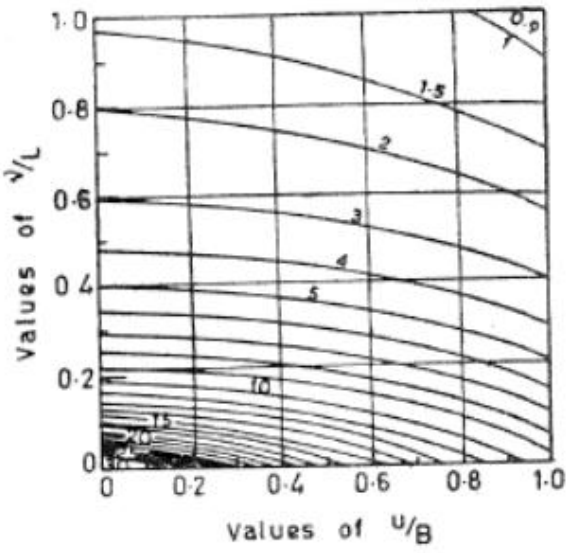
Span (m)	5	10	15	20	25	30
Loading*	745.56	1108.53	1631.60	2065.50	2488.40	2897.38

Loading* = Total live load (kN) per track; Take CDA= [0.15+8/(6+L)]

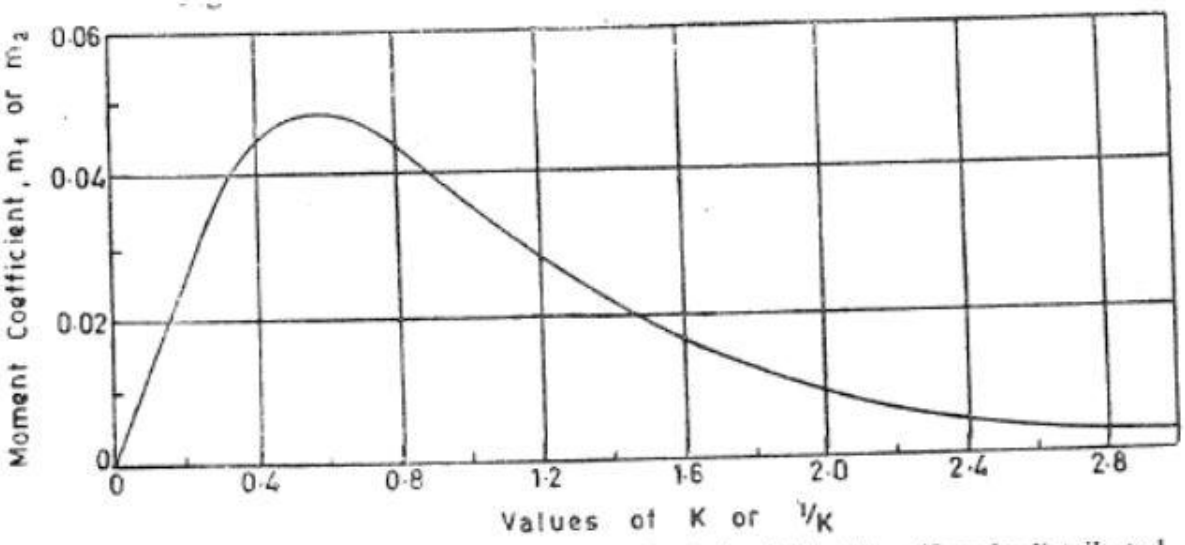




(a) Coefficient $m_1 \times 100$



(b) Coefficient $m_2 \times 100$



Moment coefficients for slabs completely loaded with uniformly distributed load, coefficient is m_1 for K and m_2 for $1/K$