1(a)  (i) What are the advantages and disadvantages of indeterminate structures? [3+3]
(ii) Find out kinematic and static indeterminacy for the structures shown in Fig 1(a-c).

1(b) Find the fixed end moments and draw the bending moment diagram for the beam shown in Fig.2. The support B is sinking by 1cm. Use Mohr's theorem. Take E=200 GPa and $I=8000 \text{cm}^4$.
1. A continuous beam ABCD is loaded as shown in Fig.3. Support B sinks by 1cm. Draw shear and bending moment diagrams for the beam. Use three moment equations method (Cleprons’s theorem). Take $E=210 \text{GPa}$ and $I=10,000 \text{cm}^4$.

![Fig. 3](image)

2. Analyse the frame as shown in Fig.4 and draw BMD. Take $E=200 \text{GPa}$ and $I=10^8 \text{mm}^4$. Use slope deflection or moment distribution method.

![Fig. 4](image)

3. Analyse the frame as shown in Fig.5 using the unit load method. The unit load is applied on joint L1. Take $E=200 \text{GPa}$; Area of cross section for strut = $1200 \text{mm}^2$ and Area of cross-section for tie bar = $1000 \text{mm}^2$.

Contd.....3.
3' Analyse the frame as shown in Fig. 6 and determine the force in the redundant member AC given that $E=200 \text{ GPa}$; Area of cross section for strut $=1200 \text{mm}^2$ and Area of cross-section for tie bar $=1000 \text{mm}^2$.

4(a) An arch in the form of a parabola with axis vertical has hinges at abutments and at the vertex. The abutments are at different levels, the horizontal span being 'L' and the height of the vertex

Contd....4.
above abutments being \( h_1 \) and \( h_2 \). Show that the horizontal thrust due to load \( w \)/unit length uniformly distributed across the span is 

\[
\frac{wL^2}{2(h_1 + h_2)^2}
\]

4(b) Two parabolic arches have a common hinge at \( B \) that forms part of a roller bearing there and are hinged to the springing at \( A \) and \( C \). If \( E \) is same for both the arches and \( l = l_c \) \( \sec \theta \), determine the normal thrust and bending moment at the crown of the left hand arch under the given load (Fig.7).

![Fig. 7](image)

5(a) Show that the length of the cable supported at same level with uniformly distributed load on span is 

\[
L + \frac{8d^2}{3L}
\]

5(b) An un-stiffened suspension cable carries a uniformly distributed load of 10kN/m over a span of 30m as shown in Fig.8. The suspension cable is supported on frictionless rollers fixed at the piers. The cable is inclined at 30° to the horizontal. One pier is 4.5m below the other and the maximum dip at the lowest point is 3m below the lower pier. Calculate (a) maximum and minimum tension in the cable and (b) the horizontal and vertical force at each pier.

![Fig. 8](image)
A suspension bridge with two hinged stiffening girder as shown in Fig. 9 has a span 120m. The span of the cable is parabolic with central dip 18m. A live load of 3 kN/m crosses the central half of the deck. Determine the horizontal component of tension in the cable. The diameter of the cable is 40 mm; the moment of inertia of the girder = $2 \times 10^9$ mm$^4$. Take $E = 200 \text{GPa}$ for both cable and girder. Draw BMD for the girder.
2015-16
III Year B.E. (Evening)) EXAMINATION
CIVIL ENGINEERING
ENGINEERING HYDRAULICS-I
(ECE-316)

Maximum Marks: 60
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.

1(a) Derive Hagen-Poiseuille equation and state assumptions made in the derivation.

1(b) The drag \( F \), exerted on geometrically similar airplanes is a function of \( V, L, \rho, \mu \) and \( E \).
   Determine the general form of dimensionally homogeneous equation.

(1) Explain the variation of friction factor \( f \) with \( Re \) with a neat sketch.

OR

1'(a) A crude oil of viscosity 0.9 poise and relative density 0.9 is flowing through a
   horizontal circular pipe of diameter 12cm and length 12m. Calculate the difference of
   pressure at two ends of pipe, if 900 N of the oil is collected in a tank in 30s.

1'(b) Describe Buckingham Pi-theorem for dimensional analysis. Derive velocity scale for
   Froude Law. Explain various types of similarities with suitable examples.

1'(c) Explain Prandtl mixing length theory for turbulence.

2(a) A thin rectangular plate 2.25 m long and 12.5 m wide is towed through water
   \((v=1.48\times10^{-6} \text{m}^2/\text{s})\) at 1.0 m/s velocity. Determine the total drag force on both sides of
   the plate and also shear stress at trailing edge of the plate.

2(b) Determine an expression for \( \delta/x \) and \( C_f \) for the velocity distribution in a laminar
   boundary layer given by \( f = \frac{3}{2} \eta^{-\frac{1}{2}} \eta^3 \), where \( f = u/U \) and \( \eta = y/\delta \).
2(c) Explain vortex shedding downstream of a cylinder with a neat sketch. Discuss role of alternate vortex shedding in the design of tall structure.

OR

2'(a) A circular cylinder 2.0 m in diameter and 12 m long is rotated at 360 rpm with its axis perpendicular to the air stream having velocity of 37.7 m/s. Determine (i) circulation (ii) theoretical lift and (iii) position of stagnation points. If actual lift and drag coefficients are given as 1.47 and 0.52 respectively, compute actual lift, drag and the direction of resultant force. Assume mass density of air as 1.236 kg/m³.

2'(b) Explain the terms: (i) Deformation drag (ii) Form drag (iii) Strouhal number (iv) Magnus effect (v) Boundary layer separation (vi) Lamina sublayer (vii) Momentum boundary layer thickness.

3 (a) Determine the distribution of discharge in branching system of pipes as shown in the Fig. 1.

![Fig. 1](image-url)

OR

3' Derive an expression for the basic parameters of a pipe system connected in parallel.
Determine the discharge in the pipe system as shown in Fig. 2.

4(a) Explain the working principle of Pelton wheel turbine. Prove that the maximum power will be developed when peripheral velocity is half of the jet velocity.

4(b) Design a Francis turbine with the following data:
Net head = 70 m; Permissible specific speed = 80; Power output = 400 kW; Hydraulic efficiency = 94%; Overall efficiency = 85%; Speed ratio = 0.75; Breadth to diameter ratio = 0.1; Inner diameter to outer diameter ratio = 0.5; K = 0.95
Velocity of flow remains constant throughout and the flow is radial at exit.

4(c) Explain the velocity triangles at inlet and outlet of a centrifugal pump with a neat sketch.
Maximum Marks: 60

Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

1(a) Explain ruling, limiting and exceptional gradients. Specify the values recommended by IRC for plains and hills. [06]

1(b) The ruling gradient of a hill is 1 in 20. What should be the compensation in gradient and compensated gradient on a horizontal curve of radius 100m after allowing for curve resistance. [06]

OR

1’(a) Explain the importance of overtaking sight distance in the design of highways. [06]

1’(b) The speeds of overtaking and overtaken vehicles are 100 Km/hr and 50 Km/hr respectively on a 2- way traffic road. Calculate the safe overtaking sight distance if the acceleration of the overtaking vehicle is 0.99 m/sec². [06]

2(a) What are the various tests for estimating the suitability of road stones? Also, discuss the objects of conducting these tests in brief with advantages. [06]

2(b) Enumerate different types of plants and equipments used in the construction of roads and discuss about them in brief. [06]

OR

2’(a) Differentiate between flexible and rigid pavements with proper explanation of merits and demerits of each type. [06]
2'(b) Discuss the importance of maintenance of pavements. Also, discuss about various types of maintenance on the roads.

3
Explain the method of design of joints in concrete pavements. Give the equations for spacing of expansion and contraction joints.
Determine the spacing between contraction joints for 4.5 m slab width having a thickness of 20 cm for a RCC slab. A total reinforcement of 8 kg/cm² is provided and is equally distributed in both directions.
Take, $f = 1.5$, $w = 2400$ kg/m³, $S_C = 1.6$ kg/m², $S_S = 1200$ kg/cm², unit weight of steel = 7500 kg/m³, Factor of safety = 2.

4(a) Explain the necessity of sleepers in Railway Track. What are the desirable qualities of good sleepers? Discuss different types of sleepers used in Indian Railways. Find out number of sleepers for 5.0 km long B.G. railway track having sleeper density of $(n+5)$.

4(b) What do you understand by creep of rails? Explain various theories of creep and discuss preventive and remedial measures that can be taken.

OR

4'(a) What are the main functions of a railway station? Classify and discuss the various requirements of a railway station. Differentiate between Junction and Terminal stations.

4'(b) Explain briefly the various types of train resistances, mean tractive effort and hauling capacity of Locomotive. How will you check the working of engine of train?

5(a) Write short notes on any four of the following:
   (i) Wind rose diagram   (ii) Calm Period   (iii) Airport Classification   (iv) Basic Runway Length(v) Airport Capacity   (v) Cross wind Component

Contd.....3.
5(b) The following is the average wind data for 10 years. Determine the maximum wind coverage and the best orientation of runway.

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<th>Percent Time with Wind Velocity (km/hr)</th>
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<tr>
<td>NNW</td>
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</tbody>
</table>
1 (a) Find out the fully plastic moment in the portal frame shown in figure below. The frame has a uniform cross section throughout.

1 (b) Design a bracket connection using fillet weld to transfer an end reaction of 250 kN due to factored load as shown in figure below. The end reaction from girder acts at an eccentricity of 300 mm from the face of the column flange. The yield and ultimate strengths of steel are 250 MPa and 410 MPa respectively.
1' (b) Design a bolted bracket connection to support an end reaction of 250 kN due to factored load. The eccentricity of end reaction is shown in figure below. Use M20 bolt of grade 4.6. The thickness of the bracket may be taken as 12 mm. Take yield and ultimate strength of steel are 250 MPa and 410 MPa respectively.

2 Design a double angle tension member connected on each side of 10mm thick gusset plate to carry an axial factored load of 375 kN. Use 20mm diameter black bolts of property class 4.6. Assume shop connections. Assume the yield and ultimate stress of steel used as 250 MPa and 410 MPa respectively.

3 What are the factors which influence the strength of column? Design a built up column comprising of two rolled steel I-sections to resist a factored axial compressive load of 4000 kN. Length of column is 5 m and is restrained in translation and rotation at base but not in translation at top. Use Fe410 grade steel.

Contd......3.
Also design single lacing system.

OR

3' Plot the load vs slenderness ratio of a column. A battened column consists of 2 ISMC 300 placed back to back. Length of the column is 4m with both ends hinged. Use Fe410 grade steel. Determine the size of the batten plate and check for force and stresses in batten plate.

4 Design an unstiffened welded plate girder of span 24 m to carry a superimposed load of 35 kN/m. Check the moment and shear capacity of the section. Check also for end bearing stiffener. Assume the yield and ultimate stress of steel used as 250 MPa and 410 MPa respectively.