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

1(a) Find the fixed end moments and draw BMD for the beam shown in Fig.1a. The support B sinks by 1 cm. Take $E=200$ Gpa and $I=10,000$ cm$^4$. Use Mohr's theorem.

![Fig. 1a](image)

1(b) A fixed beam carries varying load as shown in Fig.1b. Find the fixed end moments and draw the bending moment diagram for the beam. The support B rotates by 1 radian. Take $E=200$ Gpa and $I=10,000$ cm$^4$. Use Mohr's theorem.

![Fig. 1b](image)

Contd.....2.
1(a) Determine the degree of kinematic indeterminacy for the structure shown in Fig. 2a-c. Also draw the deflected shape.

![Diagram](image1)

1(b) Analyse the continuous beam as shown in Fig. 2d and draw the bending moment and shear force diagrams. Values of moment of inertia are shown against the members. The support C sinks by 10mm and support D rises by 20mm. Use three moment equations method (Claypron’s theorem). Take $E = 210 \text{GPa}$ and $I = 10,000 \text{cm}^4$.

![Diagram](image2)

2 Analyse the frame as shown in Fig. 3 and draw BMD. Use slope deflection or moment distribution method.

![Diagram](image3)

3 Determine $\Sigma \delta V$ for the truss as shown in Fig. 4. Joint D is point of reference. Take $E = 200 \text{ GPa}$.

Contd……3.
; \( A_c = 24,000 \text{mm}^2 \) and \( A_i = 12,000 \text{mm}^2 \).

**Fig. 4**

**OR**

3' Determine the force in the redundant member for the frame as shown in Fig. 5. Take \( E = 200 \text{ GPa} \); \( A_c = 6,000 \text{mm}^2 \) and \( A_i = 3000 \text{mm}^2 \).

**Fig. 5**

4 The parabolic arches shown in Fig. 6 pinned to one another and to a column BD at B, are hinged to abutments at A and C. The arches has variable moment of inertia \( I = I_c \sec \theta \). If the column restraint is \( 450 \text{kN/cm} \) for side sway due to the horizontal thrust at B. Find the horizontal thrust in each arch and draw the BMD. Neglect any vertical yield of the column at B. \( I_c = 40,000 \text{cm}^4 \); \( E = 200 \text{GPa} \). Also find Normal and Tangential force at 10m from abutment A.

\( \text{contd...} \)
5(a) Prove that under self weight the shape of the cable is catenary and its length is
\[ S = \frac{H}{w} \sinh \frac{wx}{H} \]  

5(b) A three hinged stiffening girder of a suspension bridge of 120m is subjected to two point loads of 240kN and 300kN at distances of 25m and 80m from the left end. Find the shear force and bending moment for the girder at a distance of 40m from the left end. The supporting cable has a central dip of 12m. Find also the maximum tension in the cable and draw BMD for the girder.

OR

5'(a) Prove that in case of unsymmetrical cable having uniformly distributed load \( w \) unit/m on entire span AB of length l, the horizontal component of tension in the cable is
\[ \frac{w l^2}{2(\sqrt{d_1} + \sqrt{d_2})^2} \]
where, \( d_1 \) and \( d_2 \) are maximum dips from support A and B respectively.

5'(b) A suspension bridge 80m span has two hinged stiffening girders supported by two cables having a central dip of 10m. The dead load on the bridge is 5kN/m² and the live load is 10kN/m² which covers the left half of the span. Determine the shear force and bending moment for the girder at 25m from the left end. Find also the maximum tension in the cable for this position of load. The roadway is 6m.
Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. | Question | M.M.
--- | --- | ---
1(a) | Derive Hagen-Poiseuille's equation for laminar flow through a circular pipe. Oil of relative density 0.92 and dynamic viscosity 0.105Ns/m² flows through two parallel plates kept 1.2 cm apart. If the velocity midway between the plates is 2.1m/s, determine the boundary shear stress and head loss in a distance of 25 m. | [10]
1(b) | Explain Pr-Buckingham Principle of dimensional analysis. Derive scales for acceleration, force and power based on Reynolds Law. | [05]

OR

1(a)' | Explain the mixing length theory. If the velocities in a 60 cm pipe carrying oil are 4.5 m/s and 4.2m/s on the centre line and at a radial distance of 10 cm from the axis. Calculate the discharge in the pipe for smooth and rough cases. | [08]
1(b)' | Discuss various types of similarities law with examples. Develop a relation between maximum and average velocities for laminar flow between parallel plates. | [07]

2(a) | Explain the boundary layer separation with a neat sketch. Discuss the variation of $C_D$ with $Re$ in the case of cylinder. | [5]
2(b) | Thickness of the turbulent boundary layer at the end of 3.0 m long plate is 4.2cm. If the fluid is water at 15°C, determine (i) Reynolds number at the trailing edge of the plate (ii) free stream velocity (iii) average shear stress on | [10]

Contd.....2.
the plate, and (iv) shear stress at the end of the plate. Assume \( v = 1.2 \times 10^{-6} \text{ m}^2/\text{s} \).

OR

2'(a) Describe the Magnus Effect with a neat sketch. Derive Kutta-Joukowski equation for lift.

2'(b) Explain the concept of hydrodynamically smooth and rough surface. A 5m wide and 40 m long smooth flat plate is towed through water ( \( \mu = 0.01 \text{ poise} \) ) at a speed of 6.0 m/s. Determine the total drag on one side of the plate and the drag on the first 3 m of the plate.

3 Three pipes are connected in parallel between two reservoirs between A and B. The details of the pipe line data are given as:

<table>
<thead>
<tr>
<th>Pipe</th>
<th>Diameters (cm)</th>
<th>Length (m)</th>
<th>f</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>1000</td>
<td>0.022</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>800</td>
<td>0.018</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>950</td>
<td>0.020</td>
</tr>
</tbody>
</table>

If the difference in water level elevations of the two reservoirs is 12 m, estimate the discharge in each pipe. Also discuss various types of losses and their estimation in pipe networks.

OR

3' Derive pipe flow parameters for pipes connected in series. Describe various steps for the solution of the pipe network using Hardy cross method.

4(a) Prove that the maximum power will be developed when peripheral velocity is half the jet velocity for the impulse turbine.

4(b) Draw velocity diagrams at inlet and outlet for the centrifugal pump with neat sketch. Explain the working principle of the Pelton wheel turbine.

4(c) 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(d) Write short notes on characteristics and performance curves for a pump.
2015-16
B. TECH. WINTER (VI SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
TRANSPORTATION ENGINEERING
(CE-317)

Maximum Marks: 60 Credits: 04 Duration: Three Hours

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

Q. No. Question M.M.
1(a) Discuss the outcomes of Jaykar’s committee. Name three different organizations [06]
established as per the recommendations of Jaykar’s committee. Explain the dates
of establishment and functions of these organizations.

OR

1(a') Discuss the steps for practical design of super elevation. [06]

1(b) Design the super elevation required at a horizontal curve of radius 300 m for
[06]
design speed of 60 kmph. Assume other data suitably.

2(a) With the help of neat sketch, discuss in detail about plate bearing test to determine
[06]
the supporting power of subgrade soil.

OR

2'(a) What are the various tests carried out on stone aggregate? Discuss any two of them
[06]
in detail.

2(b) Enumerate various types of bituminous construction in use. Discuss any one of
[06]
them in detail as per the Ministry of Road Transport and Highways (MORT&H)
guidelines.

Contd....2.
3(a) Briefly explain the steps for the design of flexible pavement as per the recommendations of IRC: 37-2001.

3(b) Calculate the stresses at interior, edge and corner of a cement concrete pavement by Wetergaard’s stress equation using the following data:

   - Modulus of elasticity of concrete = 3 x 10^5 kg/cm^2
   - Poisson’s ratio of concrete = 0.15
   - Thickness of concrete pavement = 18 cm
   - Modulus of subgrade reaction = 8.5 kg/cm^3
   - Wheel load = 8160 kg
   - Radius of loaded area = 16 cm

4(a) Define gauge, wear and creep of railway track. Discuss the possible causes and effects of wear and creep. Why uniformity of gauges is necessary in any country?

4(b) Discuss different types of sleepers used in Indian Railways and explain their relative merits and demerits in detail. Find out the number of sleepers required for 6.0 km long broad gauge railway track having sleeper density of (n+6).

OR

4'(a) Differentiate between the following:
   (i) Station and Yard
   (ii) Junction and Terminal Stations
   (iii) Gravity Yard and Hump Yards

4'(b) Draw a neat sketch of right hand turn out. Determine the mean tractive effort developed by an engine of train from the following data:

   (i) Wheel load = 6.0 tones
   (ii) Difference in steam pressure = 4.0 kg/cm^2
   (iii) Dia. of piston = 30 cm
   (iv) Length of stroke = 40 cm
   (v) Dia. of wheel = 1.5 m

Also check whether the working of engine is satisfactory or unsatisfactory.

Contd......3.
5(a) Mention the airside and landside components of an airport. Draw a layout plan to show their configuration and connectivity with each other.

5(b) Discuss the classification of airports. Mention the values of basic runway length and width of runway and single isolated wheel load for an A2 Type of airport.

5(c) Mentioning the prescribed correction in basic runway length due to effective gradient explain the consequences on take-off and landing of aircrafts due to large longitudinal gradient values.

The Longitudinal gradients of a runway are as given in Table 1. Calculate the effective gradient of the runway and compute the corrected length of runway if the basic runway length is 2000m.

**Table 1: Longitudinal Gradients of a runway**

<table>
<thead>
<tr>
<th>Length of runway segments (m)</th>
<th>Gradient (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 -300</td>
<td>+1.1</td>
</tr>
<tr>
<td>300-800</td>
<td>-1</td>
</tr>
<tr>
<td>800-1200</td>
<td>+0.8</td>
</tr>
<tr>
<td>1200-2000</td>
<td>+0.5</td>
</tr>
</tbody>
</table>
Q 1A Answer any two from Q1.A (a to c)

a. Find the maximum number of 20mm bolts that can be accommodated in one row in a 180mm wide flat.

b. Two plates of 8mm and 16mm thickness are to be jointed using longitudinal fillet weld. Suggest a suitable size of weld and length of end returns

c. A butt joint has 12 bolts arranged in diamond pattern. Draw the arrangement of bolts and name the section at which the tensile strength will be critical in the main plate.

(2)

Q 1B An 1SA 100mm x 100mm x 10mm carries a factored tensile force of 100kN. It is to be jointed with a 12mm thick gusset plate. Design a high strength bolted joint when (a) no slip is permitted (b) when slip is permitted. Steel grade is Fe 410

(10)

OR

Contd......2
Q.1B'. Two plates 10mm and 18 mm thick are to be joined by double cover butt joint.
Design the joint for the following data
Factored design load = 750kN
Bolt diameter = 20mm
Thickness of cover plates= 8mm
Grade of steel Fe 415
Grade of bolts 4.6

Q. 2A Explain unsymmetrical bending in purlins of a roof truss

Q. 2B 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. Assume shop connections. Assume the yield and ultimate stress of steel used as 250 MPa and 410 MPa respectively.

Q. 3 Design an unstiffened welded plate girder of span 24m to carry a superimposed load of 35kN/m. Check only the moment and shear capacity of the section. Assume the yield and ultimate stress of steel used as 250 MPa and 410 MPa respectively.

Q. 4 Design a built up column comprising of two rolled steel I sections to resist a factored axial compressive load of 4000kN. Length of column is 5m and is restrained in translation and rotation at base but not in translation at top. Use Fe410 grade steel. Also design single lacing system and welded connection of lacing with the main members and neglect the design of the tie plates

OR

Q. 4' Design a built up column comprising of two rolled steel channel sections to resist a factored axial compressive load of 1350 kN. Length of column is 5m and is restrained in translation and rotation at base but not in translation at top. Use Fe410 grade steel. Find the sections of end and intermediate batten and check for forces in battens. Design of connections is not required.
Q. 5 A. What is the impact allowance in percentage to be applied to the vertical forces transferred to the wheels of an electric overhead travelling crane in a gantry girder.

Q. 5 B. The following data refers to a gantry carrying a manually operated overhead travelling crane.

- Crane Capacity: 200KN
- Self-weight of crane girder excluding trolley: 200KN
- Self-weight of trolley, electric motor, hook etc: 40KN
- Minimum hook approach: 1.2m
- Wheel Base: 3.5m
- c/c distance between gantry rail: 16m
- c/c distance between columns (span of gantry girder): 8m
- Self-weight of rail: 300N/m
- Diameter of crane wheels: 150mm
- Steel of Grade Fe 410.

Determine
(i) the maximum moment and shear force due to vertical loads and
(ii) check whether ISMB 600 with ISMC 300 on compression flange is adequate in limiting deflection

(2+10)

OR

Q. 5'a Is the shape factor of rectangular cross section higher than the shape factor of an I section. If yes, give reasons

(2)

Q. 5'b Find the collapse load for a single bay single storey portal frame, fixed at the ends for following data

- Span of beam = 3m
- Moment capacity of Beam= 2M_p
- Concentrated Vertical load at centre of span = 2W
- Concentrated Horizontal Load at column top = W
- Height of column = 3m
- Moment capacity of column= M_p

(10)