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- N. B.: 1. Question number 1 is compulsory.
- 2. Attempt any three from remaining questions.
- 3. Figures to the right indicate full marks.

1. (a) To find degree of static and kinematic indeterminacy of structures as shown in figure 1. [8]

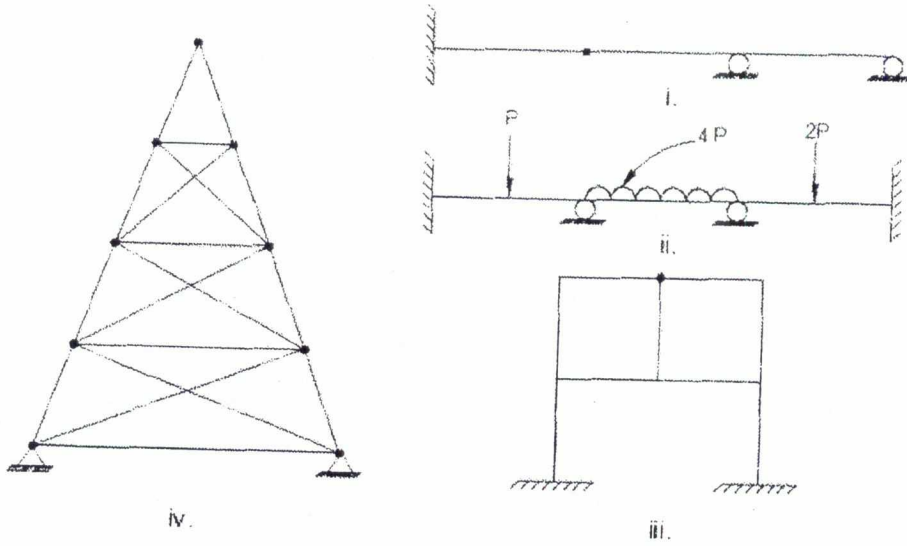


Figure 1

(b) The members of a steel bent frame are subjected to temperature variation as shown in figure 2. Find the vertical deflection at free end 'C' considering axial deformation in members. [7]  
Take depth of each member as 500 mm &  $\alpha = 12 \times 10^{-6} / ^\circ\text{C}$ .

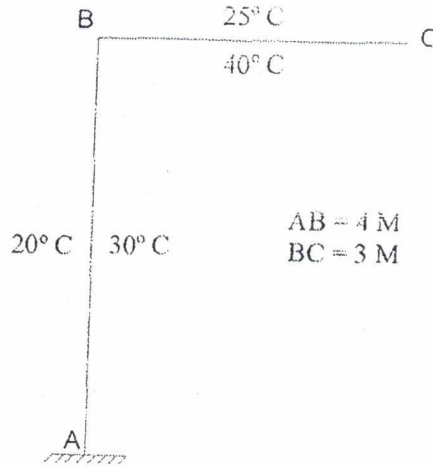


Figure 2

(c) Differentiate between Force method and Displacement method. [5]

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2. (a) Define Plastic hinge and mechanism. [2]  
 (b) Define Carry over factor and relative stiffness. [2]  
 (c) Define shape factor and load factor. [2]  
 (d) Analyse the continuous beam loaded and supported as shown in figure 3. Using **Clapeyron's theorem of three moments or Moment Distribution method**. The support B settles by 8mm during loading. Draw SFD & BMD.  $EI = 1600 \text{ kN-m}^2$  [14]



Figure 3

3. A portal frame ABCD is loaded and supported as shown in figure 4. Use **Flexibility method** for analysis, draw BMD and deflected shape of the frame. [20]
4. A portal frame ABCD is loaded and supported as shown in figure 4. Use **Stiffness method** for analysis, draw BMD and deflected shape of the frame. [20]

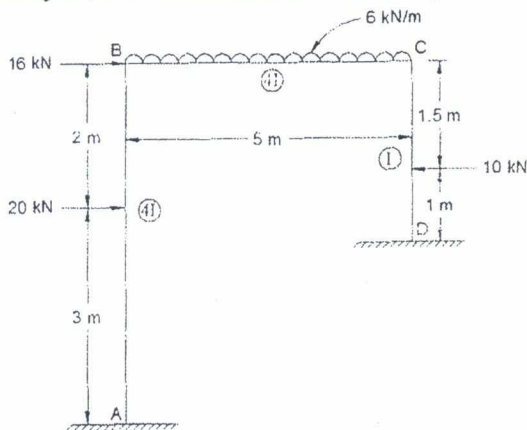


Figure 4

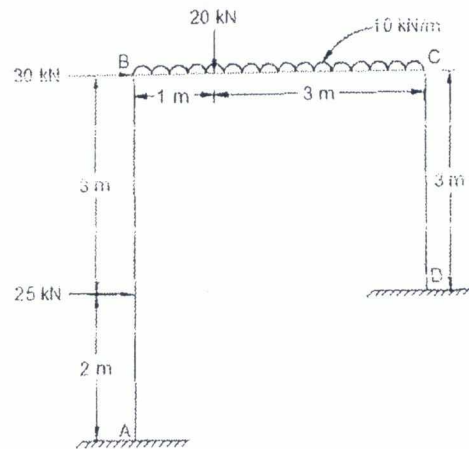


Figure 5

5. Using **Slope Deflection Method or Moment Distribution Method**, analyse the frame loaded and supported as shown in figure 5. Also draw BMD and deflected shape of the frame. [20]
6. (a) A two hinged parabolic arch of span 30 meter and rise 6 m carries uniformly distributed load of 20 kN/m on left half span and downward point load of 10kN at 5m from right hand support. Find the reaction at supports and draw BMD. [12]
- OR
- (a) Using Force method or least work method, Analyse the pin jointed frame loaded & supported as shown in figure 6. Also find forces in all members. Take  $AE$  constant for all members. [12]

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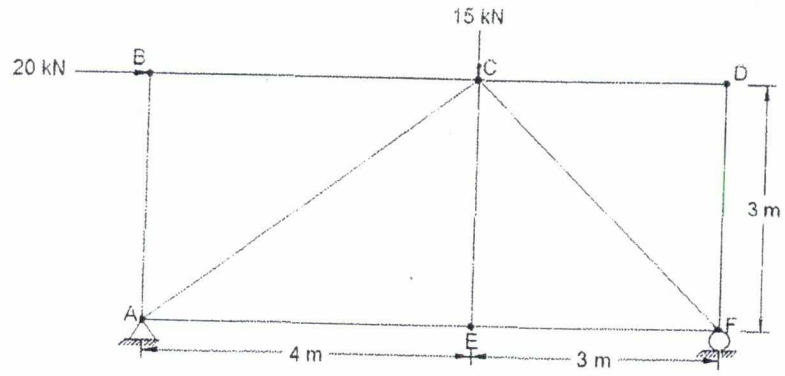


Figure 6

- (b) Calculate the plastic moment capacity required for the continuous beam with working load as shown in figure 7. [8]

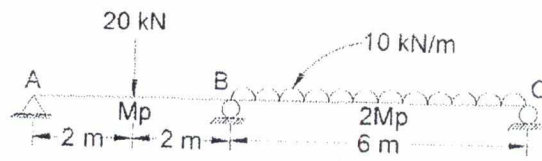


Figure 7

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- N. B.:
- (1) Question No. 1 is compulsory.
  - (2) Attempt any three from remaining five questions.
  - (3) Figures to the right indicate the full marks.
  - (4) Assume suitable data if not given and justify the same.

- Q.1 (A) Write characteristics of flow net. 05  
(B) What do you mean by borehole logs? Write at least five number of information which it reflects. 05  
(C) Write the use of particle size distribution curve. 05  
(D) Explain the factors affecting the permeability of soil. 05

- Q.2 (A) Explain how to determine the preconsolidation pressure by Casagrande Method. 05  
(B) A moist soil has weight of 1260 gms and volume of 605 cc at a moisture content of 11%. If the specific gravity of soil grains is 2.66, determine the void ratio, degree of saturation, and percentage air voids. 10  
(C) Establish the relationship between  $\sigma_1$ ,  $\sigma_3$ ,  $c$ , and  $\phi$ . 05

- Q.3 (A) In a liquid limit test, specimen of a certain sample of clay at water contents of 31.93, 27.62, 25.51 and 23.30 % required 5, 16, 23, and 42 blows respectively to close the standard groove. The plastic limit of clay is 13%. Natural water content is 18%. Determine the liquid limit, plasticity index, liquidity index, consistency index, flow index, and toughness index. 10  
(B) Explain the primary consolidation by spring analogy system. 05  
(C) For two soils the data is given as below. Classify the soil as per IS: 1498. 05

Soil	LL	PI	%-75 $\mu$	% Gravel	% Sand
A	60	30	90	0	10
B	-	NP	100	0	0

- Q.4 (A) In a falling head permeability test on a soil sample of length  $l_1$  the head of water in the stand pipe takes 5 seconds to fall from 900 mm to 135 mm above the tail water level. When another soil of length 60 mm is placed on top of first soil, the time taken for the head to fall between the same limits is 150 seconds. The permeameter has a cross sectional area of 4560 mm<sup>2</sup>, and a stand pipe area of 130 mm<sup>2</sup>. Calculate the permeability of second soil. 10  
(B) Write a note on methods of boring. 05  
(C) Explain the quick sand condition and derive an expression for same. 05

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Q. P. Code: 18506

- Q.5 (A) Define reinforcing earth material. Classify the Geosynthetics and Geotextile. 05  
 (B) Write a brief note on factors affecting the compaction. 05  
 (C) Given the following data from a consolidated undrained test with pore water pressure measurement, determine the total and effective stress parameters. 10

$\sigma_3$	100 kN/m <sup>2</sup>	200 kN/m <sup>2</sup>
$(\sigma_1 - \sigma_3)_f$	156 kN/m <sup>2</sup>	198 kN/m <sup>2</sup>
$u_f$	58 kN/m <sup>2</sup>	138 kN/m <sup>2</sup>

- Q.6 (A) In a normally consolidated clay of LL = 65.65% and 5 m thickness, the overburden pressure is increased from 250 kN/m<sup>2</sup> by 120 kN/m<sup>2</sup>. Estimate the settlement that takes place; assume the saturated water content and specific gravity of solid are 45% and 2.7 respectively. 05  
 (B) Explain the effect of surcharge and capillary rise on effective pressure. 05  
 (C) Write scope of Geotechnical Engineering in design of deep foundation. Write five points. 05  
 (D) Explain the applicability of Plasticity chart [as per ISCS] in classifying the fine grained soil and how it differs from USCS. 05

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(3 hours)

Max.Marks: 80

- Note: (1) Question no.1 is compulsory  
 (2) Solve any 3 questions out of remaining  
 (3) Assume data wherever necessary and clearly mention the assumptions made.  
 (4) Draw neat figures as required.

- Q1 Solve any Four** 20
- Define Moment of Momentum Equation.
  - Obtain an expression for the force exerted by a jet of water on a flat vertical plate moving in the direction of flow.
  - Describe briefly the functions of main components of Pelton wheel turbine with neat sketches.
  - Obtain an expression for unit speed, unit discharge and unit power for a turbine.
  - What do you mean by manometric efficiency, mechanical efficiency and overall efficiency of a centrifugal pump?
  - Write a short note on Hydraulic Accumulator.
- Q2**
- The angle of reducing bend is  $60^\circ$  (that is the deviation from initial direction to final direction). Its initial diameter is 300 mm and final diameter is 150 mm and is filled in a pipeline carrying a discharge of 360 litres/sec. The pressure at the commencement of the bend is 2.943 bar. The friction loss in the pipe bend may be assumed as 10 percent of kinetic energy at the exit of the bend. Determine the force exerted by the reducing bend. 10
  - A water sprinkler has 10 mm diameter nozzle at either end of a rotating arm, each of which is discharging water in opposite direction at right angle to the rotating arm, at a velocity of 8 m/s. If the axis of rotation is at a distance of 0.15 m from one end and 0.2 m from the other, determine the torque required to hold the arm stationary. If friction is neglected, determine the constant angular speed of the arm 10
- Q3**
- Find the form of equation for discharge  $Q$  through a sharp edged triangular notch assuming  $Q$  depends on the central angle  $\alpha$  of the notch, head  $H$ , gravitational acceleration  $g$ , density  $\rho$ , viscosity  $\mu$ , and surface tension  $\sigma$  of the fluid. 10
  - (a) With Froude's number as the criterion of dynamic similarity for a certain flow situation, work out the scale factors for velocity, time, discharge, acceleration, force, work done and power in terms of the scale factor for length. 10  
 (b) A geometrically similar model of spillway is to be laid to a scale of 1 in 50, calculate the velocity ratio, discharge ratio and acceleration ratio.

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- Q 4 a A pelton wheel is to be designed for a head of 60 m when running at 200 r.p.m. the pelton wheel develops 95.6475 KW shaft power. The velocity of the buckets = 0.45 times the velocity of the jet, overall efficiency = 0.85 and coefficient of velocity is equal to 0.98. 10
- b A reaction turbine works at 500 r.p.m. under a head of 120 m. Its diameter at inlet is 120 cm and the flow area is  $0.4 \text{ m}^2$ . The angles made by absolute and relative velocities at inlet are  $20^\circ$  and  $60^\circ$  respectively with the tangential velocity. Determine:  
 (a) The volume flow rate.  
 (b) Power developed.  
 (c) Hydraulic efficiency. 10
- Q 5 a A Kaplan turbine runner is to be designed to develop 7358 kW shaft power. The net available head is 5m. Assume that the speed ratio is 2.09 and flow ratio is 0.68, and the overall efficiency is 60%. The diameter of the boss is  $1/3$  rd of the diameter of the runner. Find the diameter of the runner, its speed and its specific speed. 10
- b A conical draft tube having inlet and outlet diameters 1 m and 1.5 m discharges water at outlet with a velocity of 2.5 m/s. The total length of the draft tube is 6 m and 1.3 m of the length of draft tube is immersed in water. If the atmospheric pressure head is 10.3 meters of water and loss of head due to friction in the draft tube is equal to  $0.2 \times$  velocity head at outlet of the tube, find Pressure head at inlet and efficiency of the draft tube. 10
- Q 6 a A three stage centrifugal pump has impeller 400 mm in diameter and 20 mm wide. The vane angle at outlet is  $45^\circ$  and the area occupied by the thickness of the vanes may be assumed 8 % of the total area. If the pump delivers  $3.6 \text{ m}^3$  of water per minute when running at 920 r.p.m. determine:  
 (i) Power of the pump,  
 (ii) Manometric head, and  
 (iii) Specific speed.  
 Assume mechanical efficiency as 88% and manometric efficiency as 77%. 10
- b Write a short note on 1. Hydraulic ram 2. Hydraulic lift. 10

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(3 Hours)

[Total marks: 80]

- Note**
1. Question No 1 is compulsory.
  2. Attempt Any 3 out of remaining
  3. Assume any suitable data wherever required.
- Q.1**
- a. State the role of Transportation in economic development of the nation. 5
  - b. Using sleeper density of M+6, Estimate the quantity of track material required for constructing a B.G railway track that is 6km long? 5
  - c. Define creep? How it is measured 5
  - d. Draw and explain the wind rose diagram 5
  - e. What are Docks? What are different types of docks? 5
- Q.2**
- a. a) A  $4^\circ$  curve branches off from an  $2^\circ$  main curve in opposite direction in a B.G. yard. If the speed on the main line is restricted to 35 kmph. Determine the speed restriction on the branch line. 10
  - b. Draw neat sketch of Left hand turnout & Right hand turnout 10
- Q.3**
- a. A taxiway is to be designed for an operating Boeing 707-320 having following characteristics: 10
    - Wheel base = 17.6m      Tread of main gear = 6.6m
    - Turning speed = 40Kmph
    - Co-efficient of friction between tyre and pavement = 0.15
  - b. Explain in brief the factors to be considered while selecting the site for airport 10
- Q.4**
- a. Draw the neat sketch of layout of artificial Harbour 10
  - b. State reasons for Transit curves are provided on both sides of a circular curve on a railway track 10

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- Q.5 a. Briefly describe the significance of Airport drainage 10  
b. Explain in brief the factors to be considered while selecting the site for Harbour. 10
- Q.6 Write short notes on ( Answer any four out of six ) 20
- i. Airport drainage
  - ii. Cross wind component
  - iii. Airport marking and lighting
  - iv. Longitudinal gradient of runway
  - v. Classification of airport as per ICAO
  - vi) Light house and Light ship
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