TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Chaitra

Exam.	Regular (New Course)		
Level	BE	Full Marks	60
Programme	BCE	Pass Marks	24
Year / Part	II / I	Time	3 hrs.

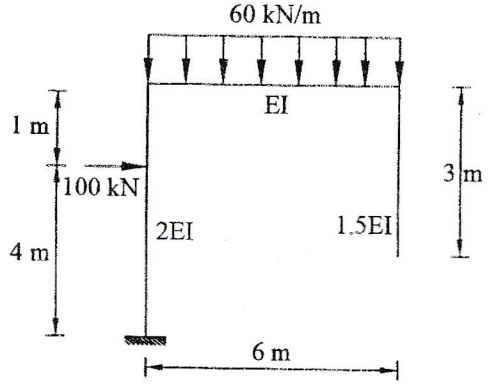
Subject: - Theory of Structure I (*ENCE 202*)

- ✓ *Candidates are required to give their answers in their own words as far as practicable.*
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

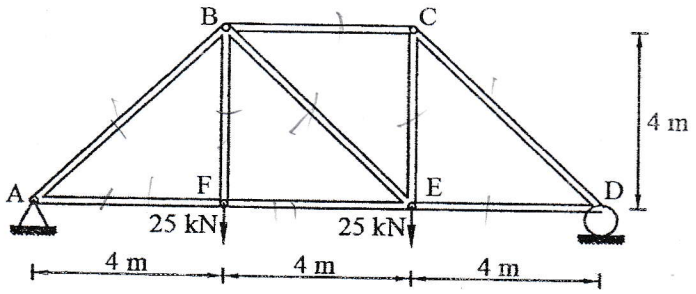
1. a) Mention the necessity of structural idealization with an example. [3]

   b) Define impact factor. A block of weight 'W' is dropped from a height 'h' at the center of a simply supported beam of length ℓ and cross section b × d (width × depth). Derive the expression for the impact factor. [4]

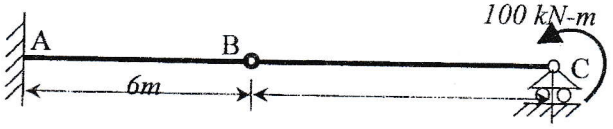
2. a) Determine vertical deflection and rotation at free end of given cantilever frame shown in figure below using virtual work method. [6]



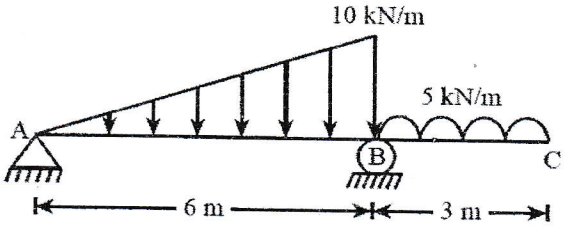
   b) For given truss as shown in figure below, determine vertical deflection at joint E. The cross sectional area of inclined members is 250 mm^2 and rest members are 500 mm^2. Also, member BE is too short by 3.0 mm. Take, E = 210 GPa. [7]



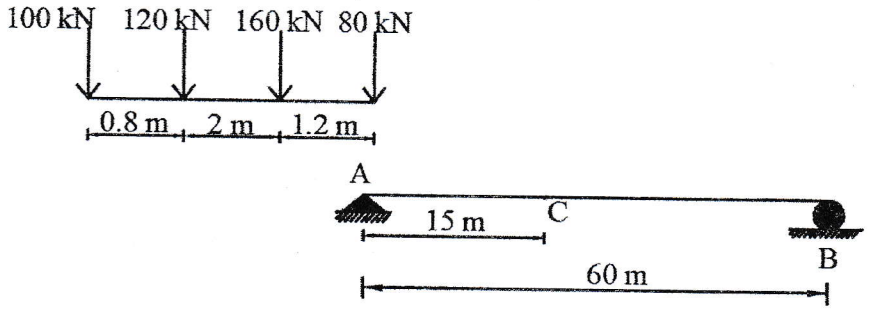
3. a) A propped cantilever beam ABC of length 14 m with internal hinge at B is given in figure below. An external counter-clockwise moment of 100 kNm is acting at support C. Using conjugate beam method, determine deflection at B and slopes at the left and right of B in terms of EI. Consider uniform rigidity (EI) of the beam. [5]



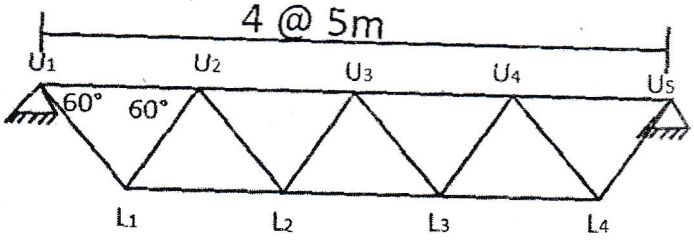
b) Determine the slope and vertical deflection at point C for the beam shown in figure below using conjugate beam method. Take EI constant throughout. [5]



4. a) A train of moving load as shown in figure below crosses beam girder of span 60 m from left to right. Determine maximum bending moment at 15 m from left support. Also determine absolute maximum bending moment in beam girder. [6]



b) Determine the maximum forces in the members U_3U_4, U_3L_3 and L_2L_3 in the following deck type truss bridge if UDL of 60 kN/m longer than the span traverses from left to right in the bridge. [6]



5. A three-hinged parabolic arch, hinged at both supports and at the crown, has a span of 24 m and a central rise of 4 m. The arch carries a concentrated load of 75 kN acting at a distance of 18 m from the right support, and a UDL of 45 kN/m over the left half of the span. Determine bending moment, normal thrust and radial shear at a section 6 m from the left support. Also draw BMD of given arch. [8]

6. a) A 90 m long suspension bridge is supported on two three-hinged stiffening girders hanging by two cables with a central dip of 10 m. Bridge's dead load is 16 kN/m uniformly distributed over the whole span. It carries two-point loads of 250 kN and 300 kN at the distance of 30 m and 60 m from the left end. Find the maximum and minimum tensions in the cable. Also, determine shear force and bending moment in the girder at 40 m from the left support. [7]

b) Describe the procedure to solve space truss by tension coefficient method. [3]

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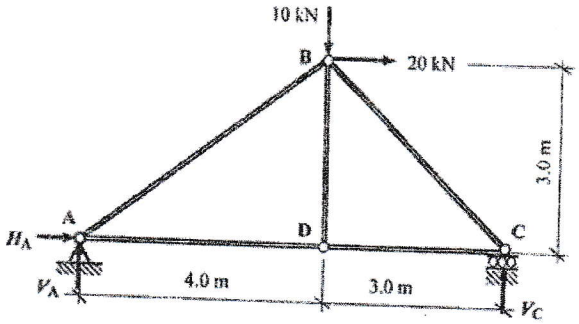
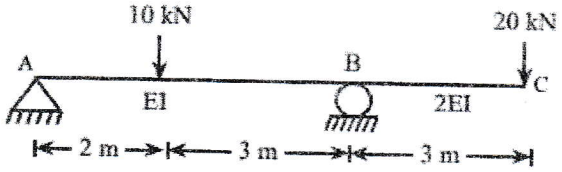
1. a) Describe various types of structures based on load transfer mechanism. [2]

   b) Determine maximum dynamic stress and dynamic deflection in the steel bar of diameter 20 mm and length 2 m caused by a mass of 5 kg falling freely through a distance of 1 m. (i) When rubber compression washer is attached to lower end of rod. (ii) When the rubber washer is removed. Take E = 200 GPa (for steel rod) K = 3 N/mm (For rubber washer) [8]

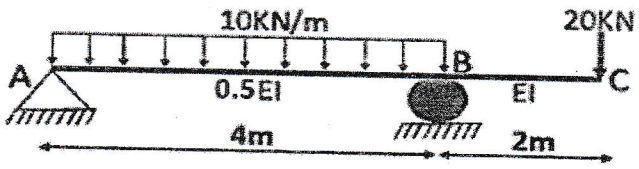
2. A triangular shape truss is loaded as shown in figure below. Using virtual work method, determine vertical deflection at joint D if the member BC is too short by 2.4 mm and AB is too long by 1.8 mm and both member AD and DC are subjected to temperature rise by 10^0C, take coefficient of thermal expansion (α) = 12×10^{-6}/°C and AE = 100×10^3 kN. [8]



3. a) Using moment area method, determine slope at B and C and deflection at C for the beam shown in figure below. Take EI constant throughout. [6]



   b) Determine slope and vertical deflection at point C for the beam shown in figure below, using conjugate beam method. [6]



4. a) Using ILD, determine the maximum bending moment at a point at 20 m from right support in a simply supported girder of span 50 m when four concentrated loads of 100 kN, 150 kN, 200 kN and 150 kN each separated from adjacent load by 3 m moving from right to left with 100 kN load leading. Also calculate the maximum moment under 100 kN load in the beam. [10]

   b) A three hinged parabolic arch has a span of 50 m and a central rise of 6 m. The arch is loaded with uniformly distributed load of 4 kN/m over the left half of the span along with a concentrated load of 20 kN acting vertically at crown. Determine the normal thrust, radial shear and bending moment at 10m from the left support. Draw BMD. [8]

5. a) Using line diagrams, show the different components of a suspension cable system. A suspension cable having span 300 m and central dip 25 m supports a three hinged stiffening girder carrying 180 kN at 50m from left support and 120 kN at 40 m from the right support. The dead load of the girder is 5 kN/m. Determine; [10]

      i) Bending moment and shear force at a section 30m from the left support.
      ii) Maximum tension in the cable and inclination
      iii) Length of the cable
      iv) Draw SFD and BMD for the girder

   b) Describe types of supports for space truss. [2]

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