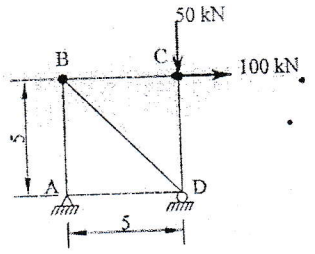
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure I (*CE 551*)

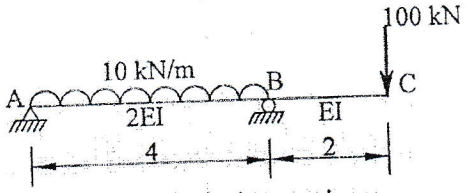
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain principle of superposition with necessary sketch and examples. [4]
   b) A cantilever beam of length 8 m having circular cross section of diameter 20 cm is subjected to a load of 15 kN and a twisting moment of 8 kNm at its end. Calculate the strain energies due to bending and torsion. Assume necessary data. [6]
   c) Using virtual work method, Calculate horizontal displacement at joint C of the given truss. Take AE to be constant. [6]



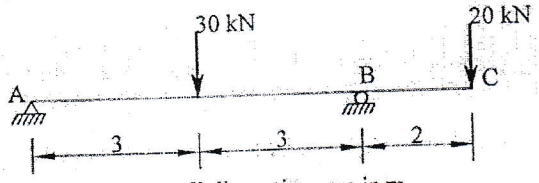
All dimensions are in m

2. a) Calculate vertical deflection at free end of the given overhanging beam using moment area method. Take EI to be constant. [6]



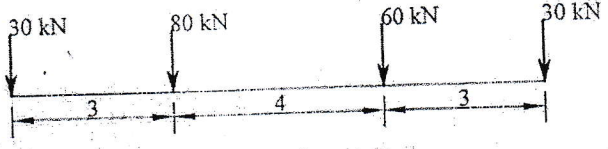
All dimensions are in m

   b) Find the slope at A and deflection at C, using conjugate beam method for the given beam. Take EI is constant. [10]



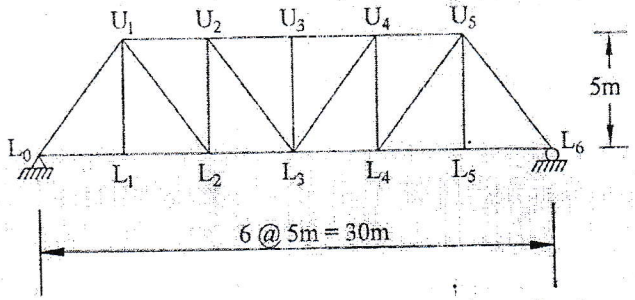
All dimensions are in m

3. a) Four-wheel loads of 30kN, 80kN,60kN and 30kN as shown in figure move from right to left on a simply supported beam of span 20m. Calculate absolute maximum bending moment that can be expected in the beam. [7]



All dimensions are in m

b) Draw influence line diagram for members L_0U_1,L_oL_1 and U_2L_2 when unit load moves on the chords. [9]



4. a) Prove that the bending moment developed at any section of a three hinged parabolic arch loaded with udl over the entire span is zero. [4]

   b) A parabolic 3-hinged arch has a span of 20 m with a central rise of 5 m. The arch is loaded with two point loads of 20 kN and 30 kN at a distance of 3 m and 7 m respectively, from the left support. It also carries a UDL of 25kN/m over right half of the span. Determine the bending moment, normal thrust and radial shear at 5m from left support. [12]

5. a) How will you determine the bending moment at a section when a load train P_1,P_2,P_3,P_4 and P_5 move in a simply supported beam. Assume all missing data suitably. [6]

   b) A suspension bridge has a span of 150 m attached with two 3 hinged stiffening girders supported by two cables. The central sag in the cable is 15 m. The UDL of 15 kN/m acts on the right-half of the span. Determine the shear force and bending moment at a distance of 50 m from the right end. Also, determine the maximum tension in the cable. Assume, the road has a width of 5m. [10]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

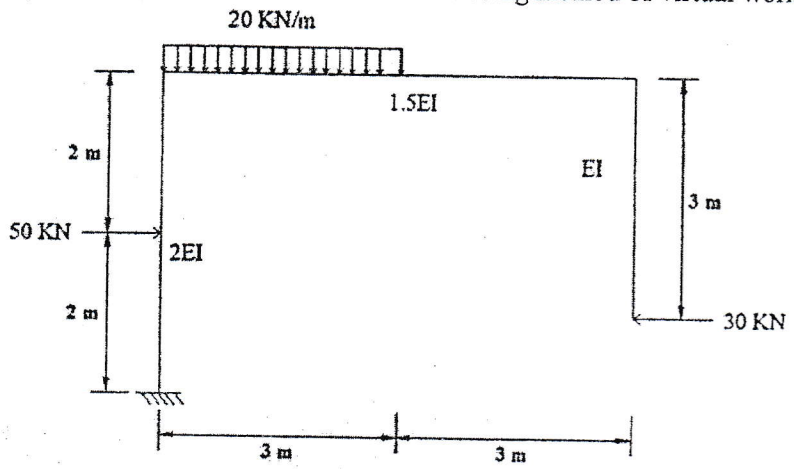
Subject: - Theory of Structure I *(CE 551)*

- ✓ 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) Explain two basic concepts of structural analysis. Explain briefly use of computers in structural analysis. [2+2]

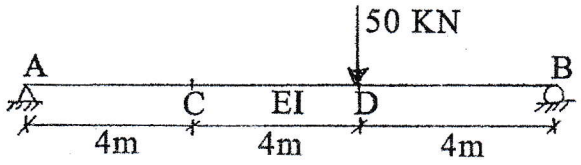
   b) Define strain energy and complimentary strain energy. Derive an expression for dynamic multiplier when a mass falls on the mid span of a simply supported beam. [2+3]

   c) Determine the horizontal deflection at free end using method of virtual work. [7]



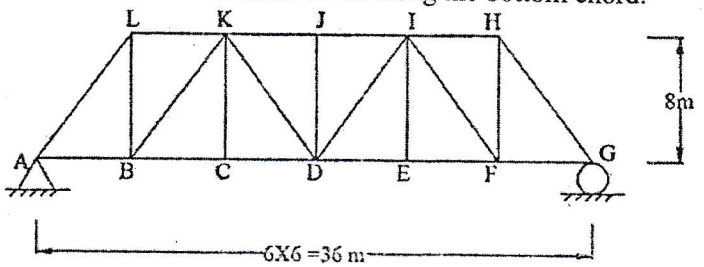
2. a) Explain how the boundary conditions are changed while converting real beam to a conjugate beam with reference to conjugate beam with reference to conjugate beam theorems. [4]

   b) Using moment area method, calculate the slope at supports, deflection at points C and D. Also calculate maximum deflection in the beam and its location. [12]



3. a) Determine maximum bending moment at a point at a distance 20m from right support in a simply supported girder of span 50m. when four concentrated loads of 100KN, 150KN, 200KN and 150KN each separated from adjacent load by 3m move from right to left with 100KN load leading. Also determine the absolute maximum bending moment in the beam. [10]

b) Draw influence line diagram for member DK, DJ, and DE of the truss as shown in figure below. Assume the unit load moves along the bottom chord. [6]



4. a) A three hinged symmetrical circular arch has a span 100m and a rise of 10m. It is subjected to a rolling load of 50KN/m of span 25m moving from left to right. Determine maximum horizontal thrust and maximum bending moment at 15m from left support with the help of influence line diagram. Also determine absolute maximum bending moment. [12]

b) Explain how natural point for axial thrust in a arch is determined? [4]

5. a) Explain how you obtain maximum bending moment at a section when UDL shorter than a span is moving in a simply supported beam of length '*l*'. [6]

b) A suspension cable having dip 15 m supports a three hinged stiffening girder 150m long which supports point loads 180KN and 150KN at distance 50m and 100m respectively from the left support. The dead of the grider is 7.5 KN/m. Determine the values of SF and BM at a section 30m from the left support. Also determine the maximum tension and length of the cable. [10]

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Examination Control Division
2076 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE 551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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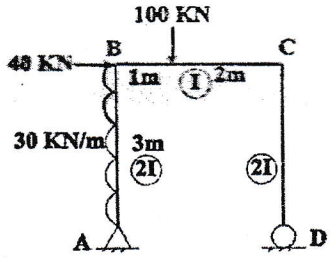
- ✓ *Assume suitable data if necessary.*

1. a) Explain the principle of super position with suitable examples and mention its limitations. [4]

   b) Calculate horizontal deflection at roller support of the following frame using virtual work method. [12]



2. a) For a beam having a rectangular cross-section and subjected to bending, derive an expression for the strain energy due to moment deformation only. [4]

   b) Using conjugate beam method, calculate slope and deflection at point C, free end of the beam loaded as shown here. [12]

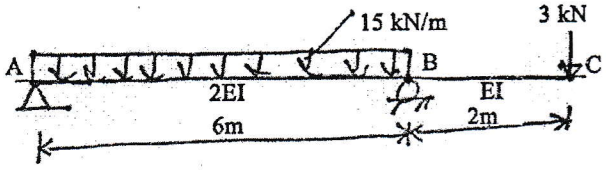


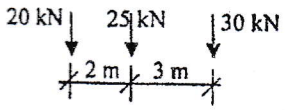
Figure: Load on beam

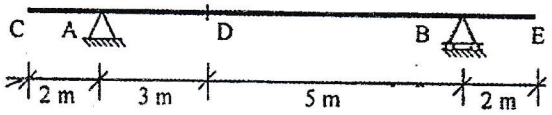
3. a) Derive the formulas for determination of structural quantities by using influence line diagram when the loads being applied are in the form of concentrated force uniform distributed load and couple. [6]

   b) A three hinged parabolic arch of span 100m and rise 12m carries a UDL of intensity 20 KN/m of length 60m moving from left to right. Calculate horizontal thrust and maximum bending moments at a distance 10m from the left end; using ILD. [10]

4. a) Find the bending moment, radial shear and normal thrust at any section of a three hinged symmetrical parabolic arch loaded with uniformly distributed load w kN/m^2 over its entire span. Neglect the self-weight of the arch. [6]

   b) For the overhang beam, draw the Influence Line Diagram for moment at D and then using that ILD to determine the maximum positive and negative moment at the D due to the three concentrated loads as shown in figure below which moves from left to right. [10]





5. a) Calculate the deflection at the free end of a cantilever beam both due to bending and shear separately when a concentrated force is applied at the free end. Take the section of the beam to be rectangular with the breadth to depth ratio to be half. [4]

   b) A suspension bridge, 200m span, has two three-hinged stiffening girders supported by two cables with a central dip of 20m. The dead load of the bridge is 50kN/m run and in addition, it supports three point loads of 800kN each placed along the centre line of the roadway and dividing the span in four equal parts. Calculate the maximum tension and minimum tension with their locations in the cable and the length of the cable. [12]

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2076 Bhadra

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Level	BE	Full Marks	80
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Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE 551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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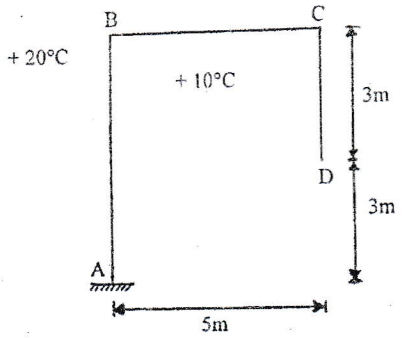
1. a) Explain about Principle of Superposition stating the conditions of its application with examples. [4]

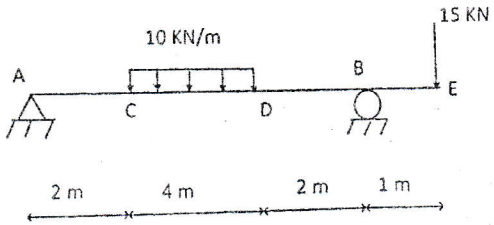
   b) Derive an expression for Strain energy stored in a rectangular beam due to Shear. [6]

   c) Calculate horizontal and vertical deflection at the free end of the given frame due to temperature variation as stated in figure. The thickness of member is 20 cm and coefficient of linear expansion is 12×10^{-6} /°C. [6]

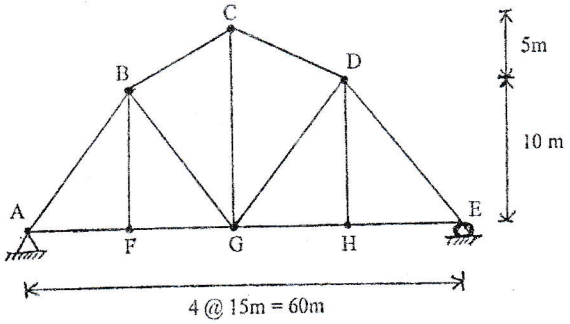


2. a) Define Conjugate Beam theorems for analysis of structures. [4]

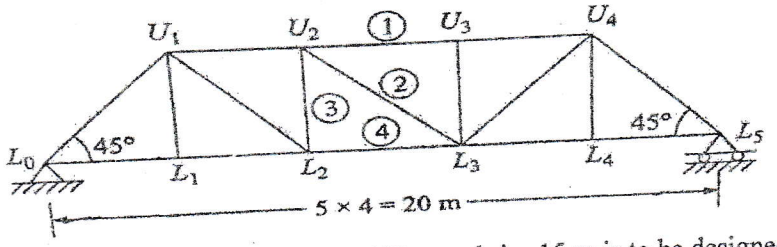
   b) Using moment-area theorems, calculate the slope and deflection at end E of the beam shown in the figure. Also calculate the deflection at 4 m from the support A. [12]



3. a) Draw influence line diagram for members FG and BG of the given truss. [8]



b) Determine the maximum forces in the members 2, 3 and 4 of given truss when uniformly distributed load of 10 KN/m longer than the span transverse along the girder. [8]



4. a) A three hinged parabolic arch of span 100 m and rise 15 m is to be designed to carry a rolling load of 50 KN/m of span 10 m. Determine the maximum bending moment, radial shear, and normal thrust at 60 m from the left support with the help of influence line diagrams. [14]

   b) Define the neutral point for bending moment at a section of the three higed arch. Derive the expression to calculate location of neutral point for the above mentioned condition. [6]

5. A cable suspension bridge of 100 m span has two three hinged stiffening girder supported by two cables having a central dip of 10m. The roadway has a width of 5m. The dead load on the bridge is 5 KN/m^2 while the live load is 10 KN/m^2 which act on the right half of the span. Determine the SF and BM in the girder at 20m from left support. Also find the maximum tension in the cable for this position of live load. [12]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Baisakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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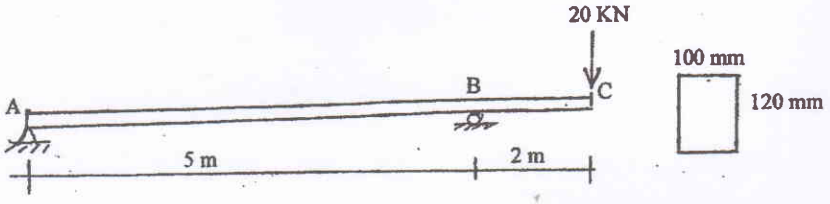
1. a) Explain linear and non linear behaviour of structure with suitable force displacement diagram. [4]

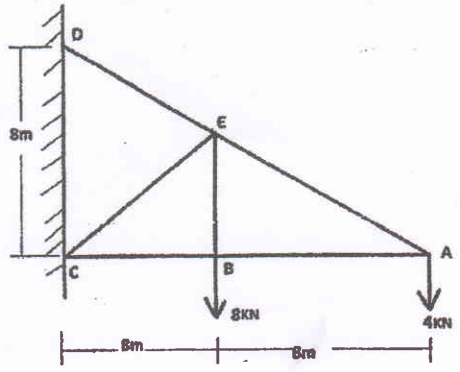
   b) Determine strain energies due to bending and shear in the overhanging beam shown in figure below and also determine deflection at C by using real work method. [12]

   $E = 200\ KN/mm^2$ $G = 80\ KN/mm^2$



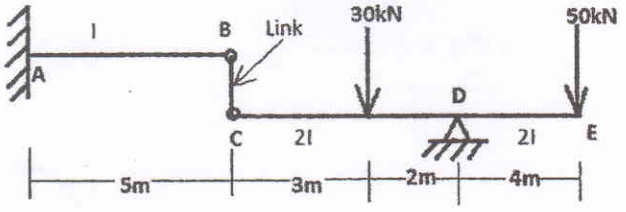
2. a) Explain the principle of super position with suitable example. [4]

   b) Determine the vertical deflection of joint E. All the top chord member are subjected to temperature rise 30°c and the members AE and EC are 5mm too long while fabrication. Take coefficient of the thermal expansion as $12*10^{-6}$/°c, modulus of elasticity as $200kN/mm^2$, cross sectional area of each members is 1500 mm^2. [12]

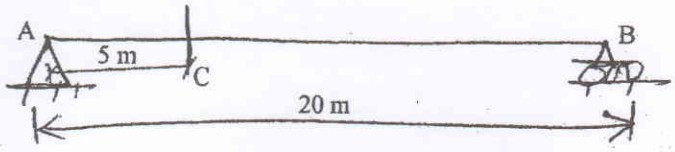


3. a) State and proof first theorem of moment area method. [4]

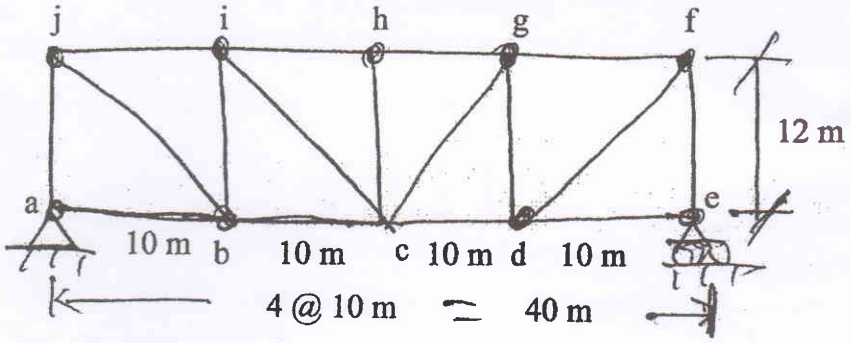
   b) For the beam shown in figure below, find the deflection and slope at E and B, take $I = 6*10^7\ mm^4$ and $E = 200\ kN/mm^2$. [12]



4. a) Draw the influence lines for support reactions, shear force and bending moment at a section 5m from the left support of a simply supported beam of 20m span. [6]

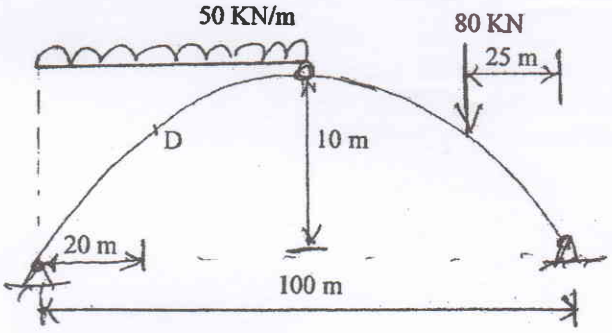


b) Draw influence line diagrams for the forces in member bc, hg and df of the truss. The load moves in the upper chord of the truss. [10]



5. a) Explain graphical method to determine the reactions of a three hinged arch when it is subjected to a single concentrated load. [4]

b) In the three hinged parabolic arch shown in figure below determine bending moment, normal thrust and radial shear force at section D. [12]



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02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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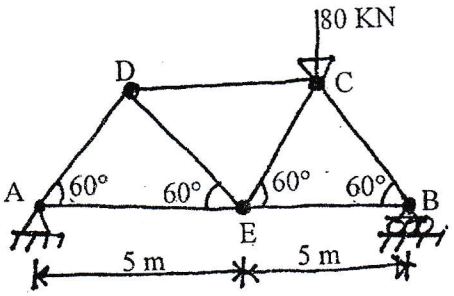
- ✓ *Assume **suitable** data if necessary.*

1. a) What is structure analysis? Explain the basic approaches of structural analysis. [1+3]

   b) Determine the vertical deflection of joint E due to the decrease in temperature by 20°C in member CD and member CE being 8 mm too long. [12]

Take $E = 200\times10^3 N/mm^2$
$\alpha = 12\times10^{-6}/°C$

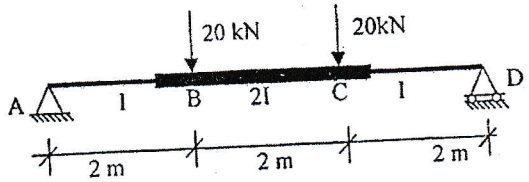


Horizontal member area $= 2000\ mm^2$
Vertical/inclined member area = $1000\ mm^2$

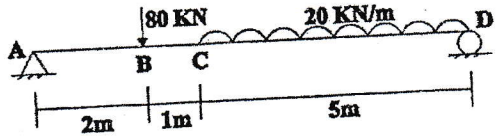
Load on truss

2. a) Explain what is neutral point in influence line diagram (ILD) of structural of quantities. Describe how neutral points are determined in ILD of bending moment and shear force in a three hinged arch. [4]

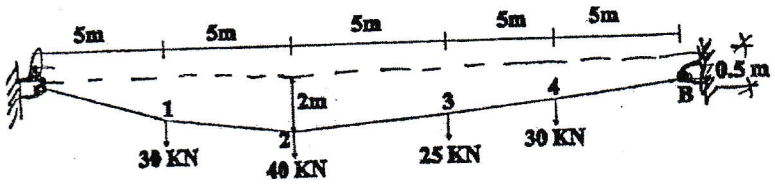
   b) A symmetrical beam ABCD is simply supported at its ends A and D over a span of 6 m. It is made up of three portions with different values if I, the length of the middle portion with the value of 2I is 3 m and the portion with the values of I is 1.5 m each. The beam carries two point loads of 20 kN at B and C. Find the slope and deflection A, B, C and D using the conjugate beam method. Take E = 200 kN/mm^2 and I = $2*10^{10} mm^4$. [12]



3. a) Using ILD, calculate reaction at A and BM at C. [6]



b) A suspension cable is suspended between two supports at a distance 25 m. and loaded as shown in figure below. Calculate maximum tension in each segment of cable, if level difference between A and B is 0.5 m and dip under second load is 2 m. [10]

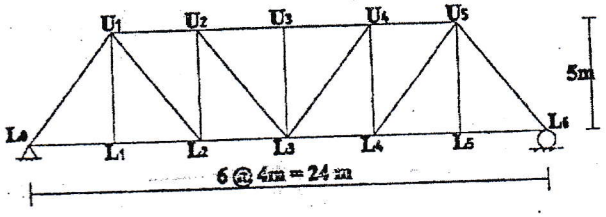


4. a) State and explain the theorems of moment area method. [6]

b) A three hinged symmetric parabolic arch has a span of 32 m and a rise of 8 m. It is subjected to two rolling loads of magnitudes 80 kN and 40 kN separately by a distance of 3 m. The load moves from right to left with 80 kN load leading. Determine the maximum positive moment and negative moment at a section 8 m from the left support. [10

5. a) Calculate the uniform distributed load transferred to the main cable due to a point load applied to the three hinged stiffening girder, Assume suitable data. [6]

b) Draw LID for U_2L_2, U_1L_2 and U_1L_1. [10]



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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE551)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
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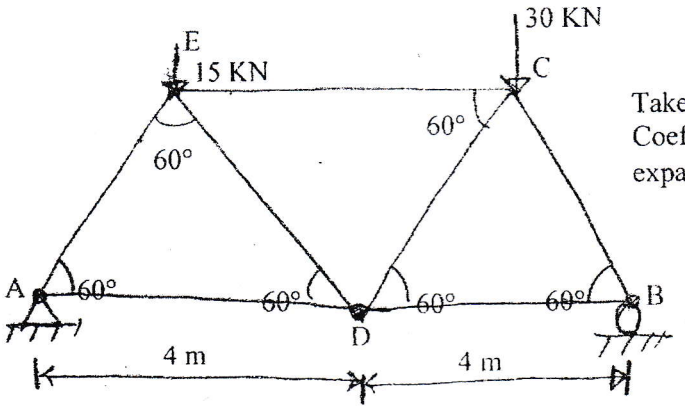
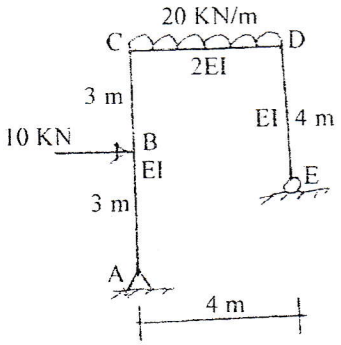
1. a) Determine the vertical deflection of Joint 'D' of the truss due to (i) loading shown (ii) members DE and DC being 5 mm too long and (iii) temperature of member CD along is rise up by 20°C. [12]



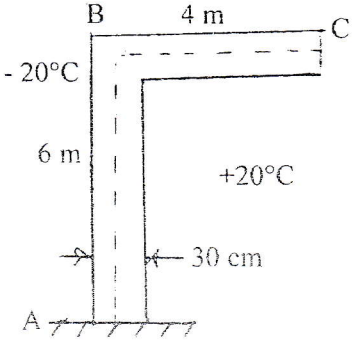
Take $E=200\times10^3 N/mm^2$
Coefficient of thermal expansion$=12\times10^{-6}/°C$

b) Explain the material non-linearity and Geometrical non-linearity with neat sketches. [4]

2. a) Determine horizontal deflection at E of the frame shown in figure below. [10]

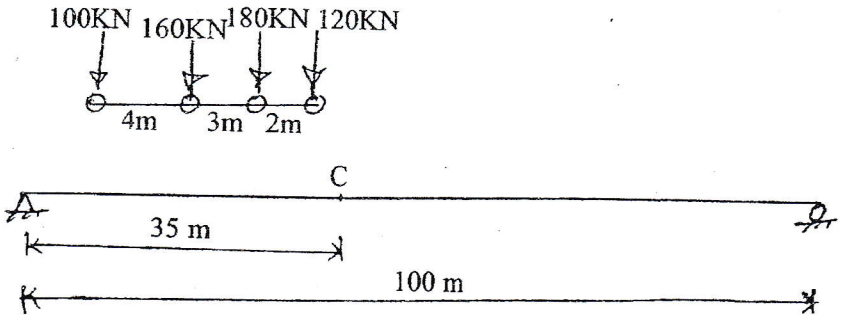


b) Determine horizontal and vertical deflection of point C of the frame shown in figure below due the temperature variation. [6]



3. a) Define influence line diagram. Explain its use. [4]

   b) Determine maximum banding moment at section C and also the absolute maximum bending moment when the set of concentrated loads moves from left to right of the girder shown in figure below. [12]



4. A three hinged circular arch has a span of 100m and a rise of 10m. Two point loads of 20 kN and 30 kN, spaced 5m apart, roll over the arch from left to right with 20 kN load loading. Using the influence line diagram, find the maximum bending moments at a section 25m from the left support. Also find normal thrust and radial shear at the same section corresponding to the maximum bending moment. [16]

5. a) Enlist the different components of a suspension bridge. [4]

   b) The stiffening girder of suspension bridge of span 120m has hinged at the end and in the middle span, the cable is suspended between two points separated horizontally by 120m and vertically by 6m. The maximum deep of the cable is 12m from upper end point. Two points loads 200kN and 100kN are concentrated at 30m and 55m from higher end. Calculate and draw shear force diagram and bending moment diagram for girder. [12]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure I *(CE551)*

- ✓ 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) Describe the types of structures based on material used. [4]

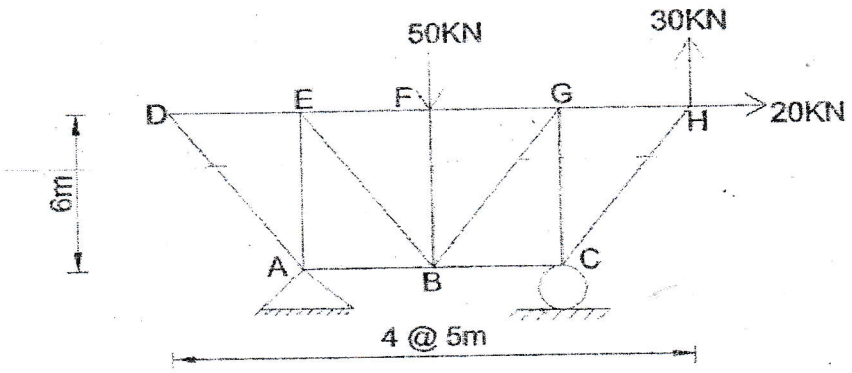
   b) A suspension bridge, 150 m span, has two three hinged stiffening girders supported by two cables with a central dip of 20 m. If four point loads of 200 KN, 150 KN, 300 KN and 100 KN with equal spacing of 4 m are moving from left to right along the central lines of the roadway having 200 KN as a leading load. Determine maximum bending moment at 40 m from left support. Also determine maximum tension in the cable. [6+4]

2. a) List the steps to follow and illustrate them in an example for determination of displacement in a structural system using virtual work (unit load) method. [4]

   b) A cantilever beam of length 4 m and having circular cross section of diameter 15 cm is subjected to a concentrated load of 10 KN and a twisting moment 5 KNm at its end. Calculate the strain energies due to bending, shear and torsion. E = 200 KN/mm^2, G = 80 KN/mm^2. [8]

3. a) State and prove theorems of movement area method. [4]

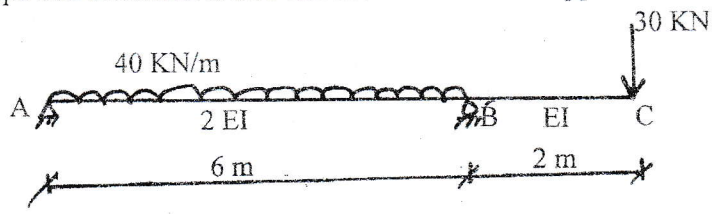
   b) Determine the vertical deflection of joint B. All the top chord members are subjected to temperature rise of 20°C and all the vertical members are 10mm too long. Take coefficient of thermal expansion as 12×10^{-6}/°C, Modulus of elasticity as 200KN/mm^2. Cross-sectional area of each member is 1500 mm^2. [10]



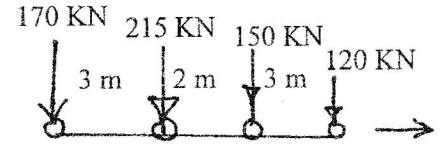
4. a) Derive expression for calculation of structural of quantities by using influence line diagram when the loads applied are concentrated force, uniform distributed load and couple. [6]

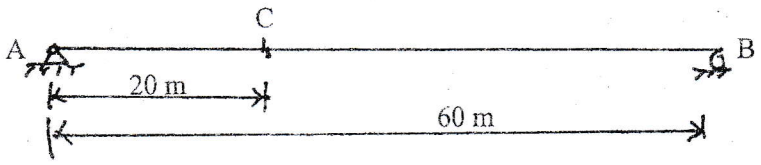
   b) A three hinged symmetrical circular arch has a span 50 m and a rise of 10 m. It is subjected to a rolling load of 50 KN/m of span 10 m moving from left to right. Determine maximum bending moment, radial shear and normal thrust at 15 m from left support with the help of influence line diagram. [10]

5. a) Determine slope and deflection at free end and 2 m from left support. [12]



b) Determine maximum bending moment at C and absolute maximum bending moment in the girder shown in figure below when four concentrated loads move from left to right. [12]





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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure I *(CE551)*

- ✓ 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) Differentiate between linear and non-linear behavior of structures and explain their uses in theory of structures. [4]

   b) The suspension cable is suspended from two piers 180 m apart, left support being 5 m above the other. The cable carries uniformly distributed load of 15 KN/m in plan and has its lowest point 10 m below the lower support. The ends of the cables are attached to saddles on rollers on top of piers and the back stays which may be assumed straight are inclined at 60° to the vertical. Determine: [10]

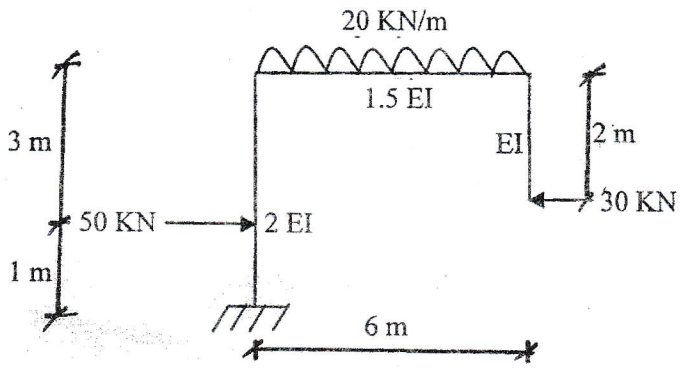
      i) Maximum tension in the cable
      ii) The length of the cable
      iii) Maximum thrust on the pier

2. a) Explain what is virtual work (unit load) method and give an example to illustrate it. [4]

   b) A bar of 3 cm diameter and of length 130 cm is supported rigidly in the vertical position at the top and is provided with a hollow falling mass and a collar at the bottom which supports a spring 10 cm long. Find the stress developed if the falling mass is 4 kg and it falls from the height of 1.15 m measured from the collar top. Take stiffness of the spring k as 40 KN/m and E as 210 GN/m^2. [8]

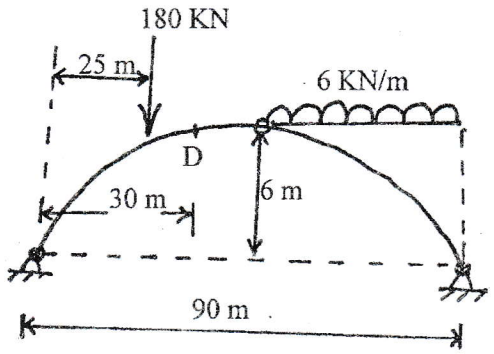
3. a) What are conjugate beam theorems? Explain its use with an example. [4]

   b) Determine the rotation and vertical deflection at free end. [10]

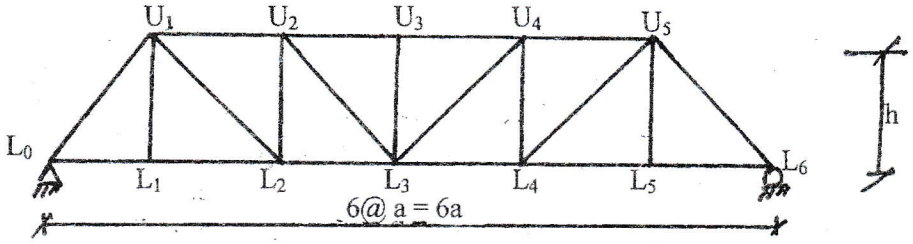


4. a) Derive expressions for calculation of structural quantities by using influence line diagram, when the loads applied are concentrated force, uniform distributed load and couple. [6]

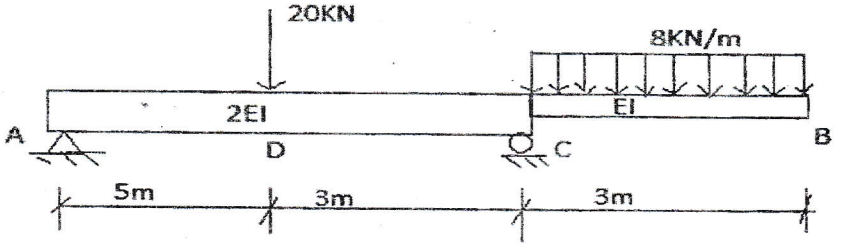
   b) Determine Bending moment, radial shear force and normal thrust at point D of the three hinged parabolic arch shown in figure below. [10]



5. a) Draw ILD for forces in member U1L1, U2U3, U2L3, U2L2, L2L3 and U3L3 for a given truss, when the load is moving on the bottom chord. [12]



   b) Calculate deflection at point B and D using Conjugate beam method. [12]



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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE551)*

- ✓ 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) What is principle of superposition? How is it useful in determination of deflection of beam? [4]

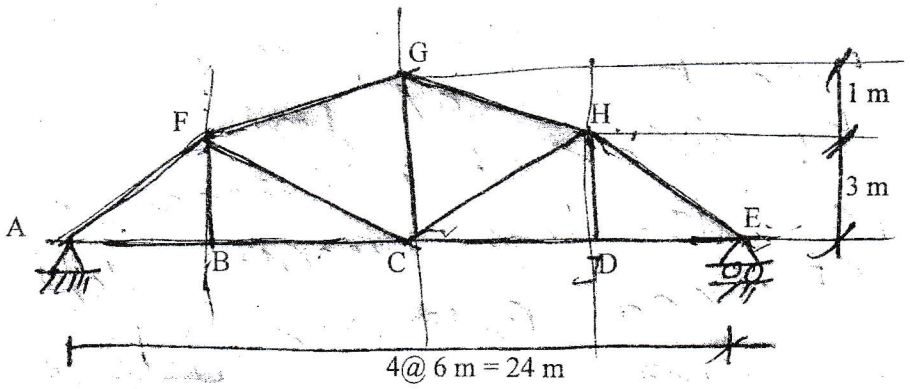
   b) A three hinged symmetrical parabolic arch has a span of 40 m and rise of 10 m. Draw ILD for: [12]
      i) Horizontal thrust
      ii) BM at section 8 m from left support
      iii) ILD for normal thrust and radial shear at the same section.

2. a) Explain what are conjugate beam theorems? Prove them. [4]

   b) A uniform shaft ABC is simply supported in bearings A and B and overhanging to C. AB = l and BC = a. When a transverse force P acts at C, show that the maximum deflection in the portion AB is $\frac{pal^2}{9\sqrt{3}EI}$ [12]

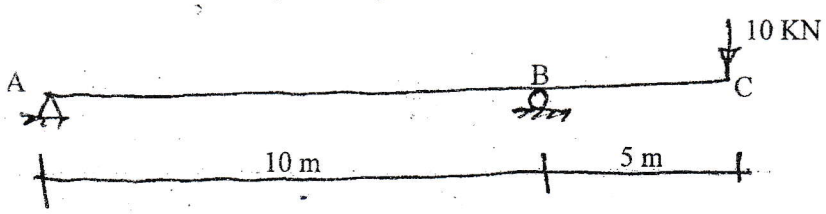
3. a) Explain what is dynamic multiplier and derive the formula for it when a mass falls on mid span of a simply supported beam. [4]

   b) Determine the maximum force in the member CF and BC of the truss as shown due to a live load of 28 KN/m longer than the span passing over the truss. [12]



4. a) Show that there is no bending moment at any section of a parabolic arch (three hinged) subjected to load uniformly distributed over horizontal span. [4]

   b) Determine the deflection and slope at C in the overhanging beam shown in figure below by using virtual work (unit load) method. Take EI = 100000 KNm^2. [12]



5. a) Explain how a structural quantity (bending moment, shear force etc) can be calculated from influence line diagram due to loads-concentrated force distributed load and couple. [6]

b) A suspension bridge, 100 m span has two three hinged stiffening Girders supported by two cables with a central dip of 10 m. The dead load is a uniformly distributed load of 40 KN/m for the entire span and in addition, it supports three point loads of 200 KN each placed along the center line of the roadway, dividing the span in four equal parts. Calculate the maximum tension and minimum tension with their locations in the cable and the length of the cable, also draw shear force and bending moment diagrams for the girders. [10]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE551)*

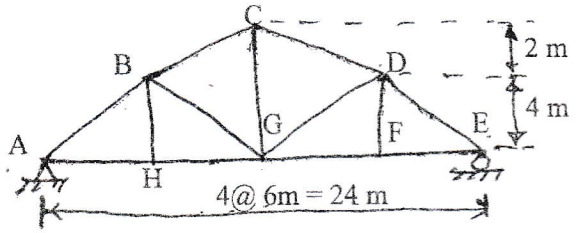
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Enunciate the principle of superposition and explain with suitable example. [4]

   b) A simply supported beam carries a point load W at mid span L. The middle one third portion of length has flexural rigidity 2 EI and rest two third portion has flexural rigidity EI. Determine the maximum deflection and slope at supports. Use conjugate beam method. [12]

2. a) A rectangular beam 25cm×50cm (b×d) is simply supported on a span of 6 m and carries a central load of 100 KN. Calculate the strain energy due to shear. Neglect self weight of the beam. Take $E = 2\times10^6$ kg/cm^2 and $G = 0.85\times10^6$ kg/cm^2. [4]

   b) Draw influence line diagram for forces in members BC and BG and determine maximum force in member BC when uniformly distributed load 6 KN/m of length 8 m moves. [12]

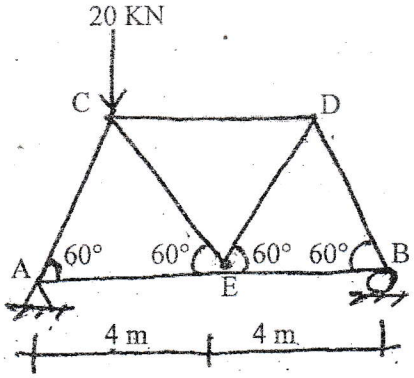


3. a) Define real work and virtual work for deformable structures. [4]

   b) A three hinged circular arch has span 40 m and rise 5 m. Make a sketch of the arch and given the equation to it. It carries a concentrated load 60 KN at 8 m from the right support and uniformly distributed load 4 KN/m over left half portion. Determine bending moment, radial shear force and normal thrust at a section 10 m from the left support. [12]

4. a) What is neutral point in an influence line diagram of an arch? Determine it for a three hinged arch for an ILD for bending moment diagram at a section. [6]

   b) Determine the vertical defection of joint E due to the increase in temperature of 20°C of member CD and member CE being 5 mm too long. [10]



Take $E = 200$ KN/mm^2
$\alpha = 12\times10^{-6}$/°C
Area = 1000 mm^2
for all members

5. a) Define influence line diagram and explain how it is different from other structural quantity diagrams like bending moment diagram, shear force diagram etc. [4]

b) A suspension cable having central dip 15 m supports a three hinged stiffening girder 150 m long which supports point loads 180 KN at 50 m from left support and 120 KN at 30 m from the right support. The dead load of the girder is 5 KN/m. Determine Bending moment and shear force at a section 30 m from the left support. Also determine the maximum tension in the cable and length of cable. [12]

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10/10 M.

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

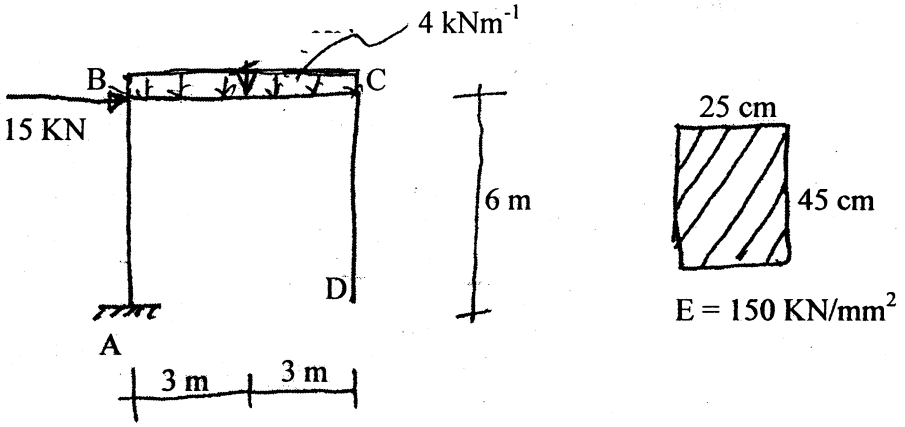
Exam.	OLD Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure I *(EG562CE)*

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

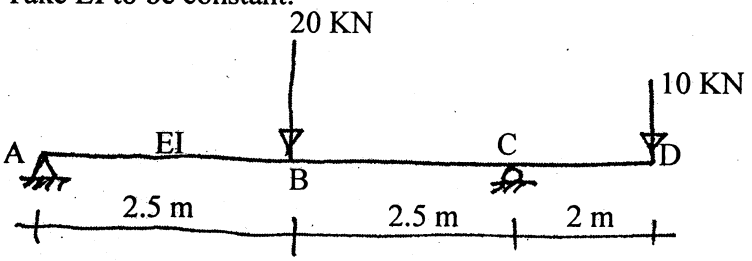
1. a) What is strain energy? Explain with an example real work method to calculate the deflection of a beam. [1+3]

   b) Determine the vertical deflection at point D of the frame loaded as shown in figure below: [12]



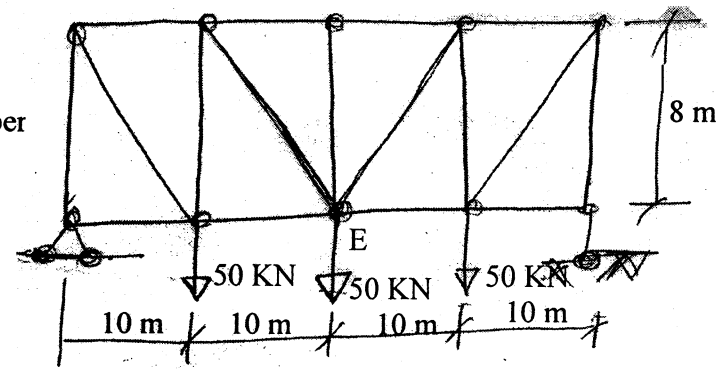
2. a) State and derive formulae for conjugate beam method. [6]

   b) Determine vertical deflection at D of the beam shown in figure below by using moment area method. Take EI to be constant. [10]

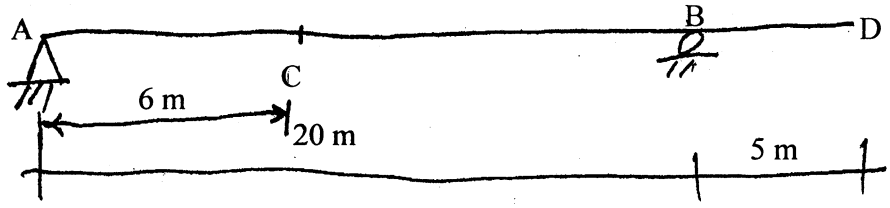


3. Determine the deflection at E of the pin-jointed Truss shown in figure below by using Virtual work method. [16]

Take area for all member to be constant
$A = 400\ mm^2$
$E = 200 \times 10^3\ N/mm^2$



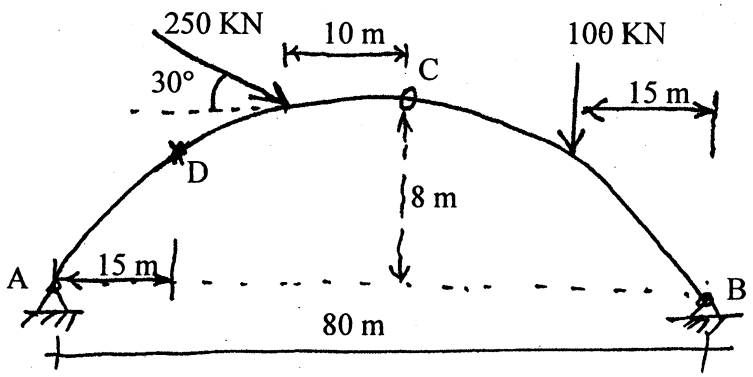
4. a) Draw influence line diagram for shear force at C of the overhanging beam shown in figure below. [6]



b) Determine maximum negative and positive bending moment at section C of the overhanging beam shown in Q.N. 4a when uniform distributed load of intensity 15 KN/m of length 4 m rolls over the beam from left to right. [10]

5. a) Derive the formula for determination of neutral point in influence line diagram of bending moment for a given section in a three hinged parabolic arch. [6]

b) A three hinged parabolic arch having span 80 m and central rise 8 m is loaded as shown in figure below. Determine bending moment, normal trust and radial shear force at section D. [10]



6. A suspension cable bridge has a three hinged girder supported by two cables. The roadway is 6 m wide. The girder has its self weight 5 KN/m^2. The live load consists of two concentrated loads 200 KN at 20 m from left support and 150 KN at 10 m right from the 200 KN load. The span is 120 m and central dip is 12 m. The live loads are acting at the central of the girder. Determine shear force and bending moment at section 25 m from left support of the girder. Also determine required cross sectional area of the cable if the allowable tensile stress of cable material is 120 N/mm^2. [16]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

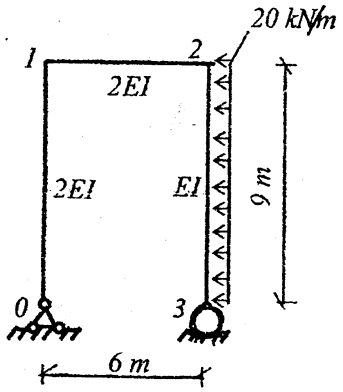
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE551)*

- ✓ 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) Use influence line diagram to determine most critical position of a stretch of uniform distributed load and a set of concentrated forces to give maximum bending moment at a given section of a simply supported beam. Assume the length of the uniform distributed load and the set of concentrated forces to be less than the span of the beam. [6]

   b) Calculate horizontal displacement of the roller support and angular displacement of the fixed hinge of the given portal frame by using unit load (virtual work) method. Express the result in terms of sectional stiffness EI. [12]



2. a) Define strain energy and explain with examples the difference between gradually and suddenly applied direct loads. Derive the expression for strain energy due to shear force in a beam in bending. [6]

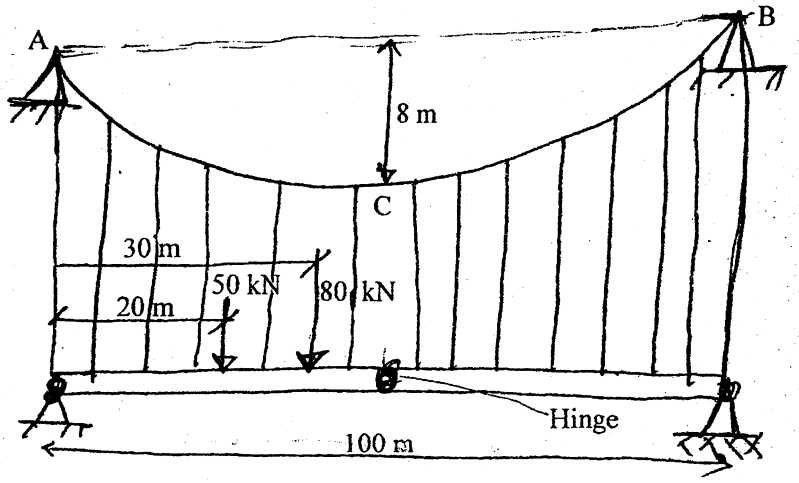
   b) A simply supported beam of span 4 m with an overhang of length 2 m on right side of the beam is loaded in the span with uniform distributed load of intensity 2 kN/m. The overhang is loaded with a concentrated force of magnitude 3 kN at the free end. Calculate the deflection of the free end of the overhang and slope at the support. Use conjugate beam method. [12]

3. a) Explain the characteristics of structural mechanics and describe with suitable examples what are the two basic approaches of structural analysis. [6]

   b) Draw a simple rectangular plane truss having span of four equal bays and with horizontal, vertical and inclined members. Show required dimensions of the truss. Draw influence line diagrams for forces in one of the each horizontal vertical and inclined members. Consider the given truss is deck type. [12]

4. A three hinged symmetrical parabolic arch of span 20 m and rise 4 m is with a point load of magnitude 4 kN at 4 m distance from the left hinge. First, draw influence line diagram (ILD) for bending moment (BM), radial shear (RS), and normal thrust (NT) for the section where the point load is and then calculate the values of BM, RS and NT at the section using the ILDs. Also check these values of internal forces at the section by first principle using equilibrium equations. [13]

5. Determine the cross sectional area required for the cable loaded as shown in figure below if the permissible tensile stress of the cable material is 1500 N/mm^2. The self weight of the girder is 10 kN/m. Draw bending moment diagram of three hinged stiffening girder and also calculate the length of cable. [13]



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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structures *(CE551)*

- ✓ 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.*

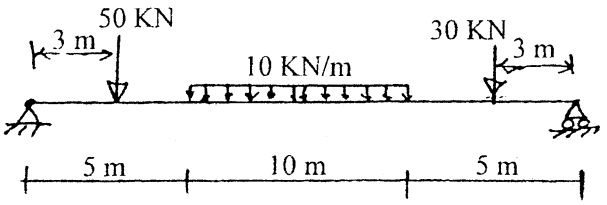
1. a) Explain with suitable force-displacement diagram, the elastic, inelastic, linear and non-linear behaviour of structure. [4]

   b) A bar of 2 cm diameter and of length 125 cm is supported rigidly in the vertical position at the top and is provided with a holow falling mass and a collar at the bottom which supports a spring 10 cm long. Find the stress developed if the falling mass is 4 kg and it fals from the height of one meter measured from the collar top. Take g = 9.81 m/s^2, stiffness of the spring (k) = 40 KN/m and E = 210 GN/m^2. [6]

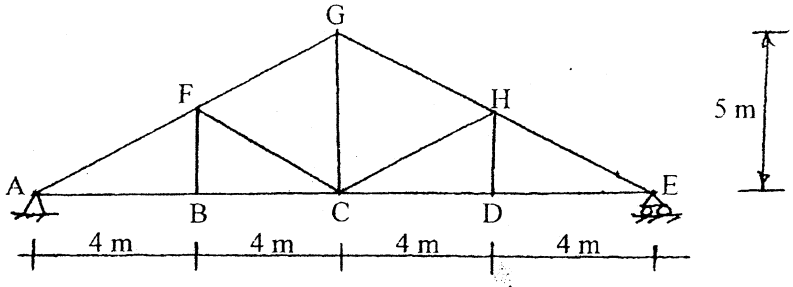
2. a) Use virtual work method to determine the mid-span deflection for a simply supported steel beam of depth 300 mm carrying a superimposed udl of 20 KN/m over a span of 5 m, if the temperature of the top surface is 40°C and at bottom surface is 30°C. Assume the temperature to vary linearly over the depth of the beam. Take coefficient of thermal expansion = 11.7 × 10^{-6}/°C E = 210 GN/m^2 and moment of inertia = 15000 cm^4. [10]

   b) Using influence line diagram prove that for a uniformly distributed load shorter than span, the bending moment at a section is maximum when the position of the load is such that the section divides the span and the load in the same ratio. [5]

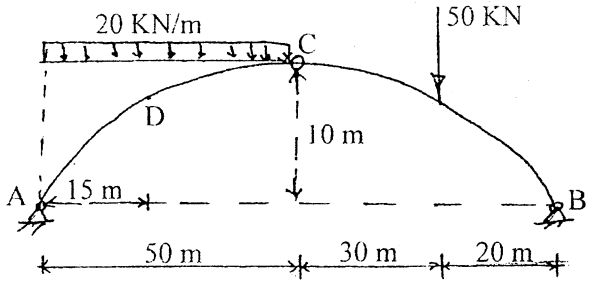
3. a) Draw influence line diagram for bending moment and shear force at mid span of the beam of span 20 m and determine bending moment and shear force at that section due to the loads shown in figure using the influence line diagram. [10]



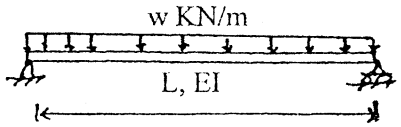
   b) Draw influence line diagram for forces in member FG and BC of the truss shown in figure below and determine maximum forces in these members when a single concentrated load 100 KN rolls over the span of the truss. [5]



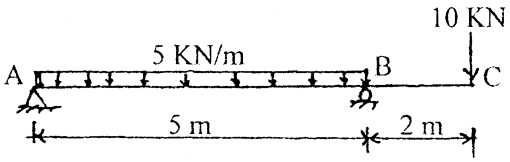
4. In the three hinged parabolic arch loaded as shown below, determine reactions at supports and also find bending moment, normal thrust and radial shear force at section D 15 m far from A. Draw influence line diagram for bending moment and normal thrust at that point and again determine the bending moment and normal thrust at D by using the ild. [15]



5. a) Determine the deflection at mid span of a simply supported beam subjected to uniformly distributed load w KN/m on the whole span by moment area. [7]

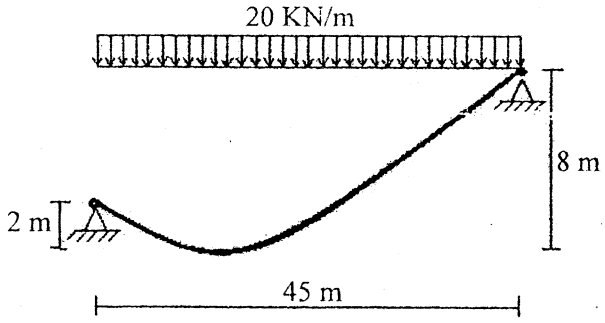


b) Determine the vertical deflection and rotation at free end C of the overhanging beam ABC loaded as shown in figure below by using conjugate beam method. [8]



6. A cable is suspended and loaded as shown in figure. Calculate: [10]

a) Length of cable
b) Horizontal component of tension in cable
c) Magnitude and position of maximum tension occurring in cable



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'03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Magh

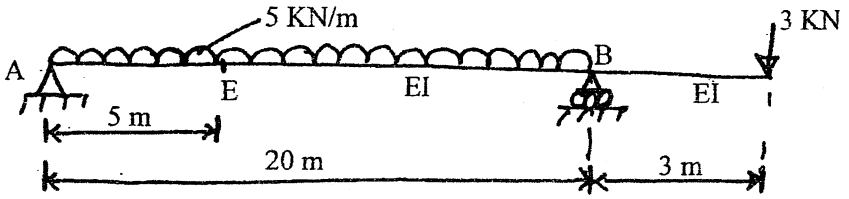
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE551)*

- ✓ 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.*

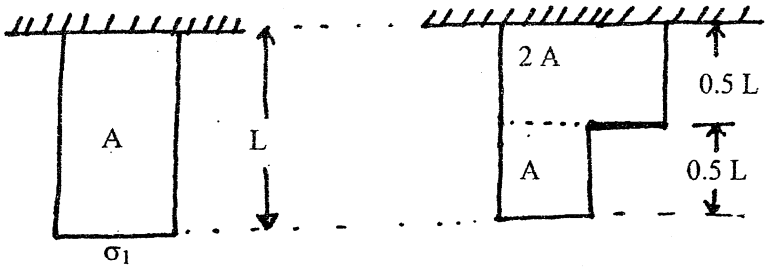
1. a) Explain with an example, how would you use method of superposition in deforming deflections. Also, explain why it is necessary to determine deflections in the design of a structure. [4+2]

   b) Find slopes at supports and deflection at E of the beam given in figure below. Use conjugate beam method for deflection and slope calculations. [10]



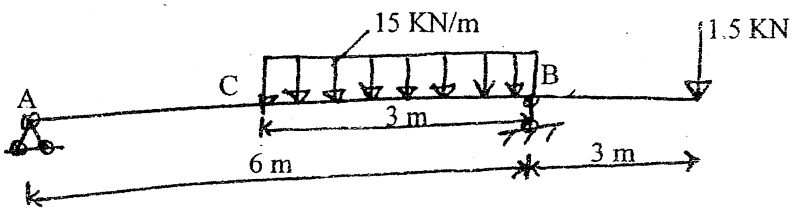
2. a) Define virtual work method and real work method with neat sketches. What are limitations of real work method? [6]

   b) Two plastics bars as shown in figure below are to absorb the same amount of energy delivered by the axial forces. Neglecting stress concentrations compare the stresses in two bars. [10]

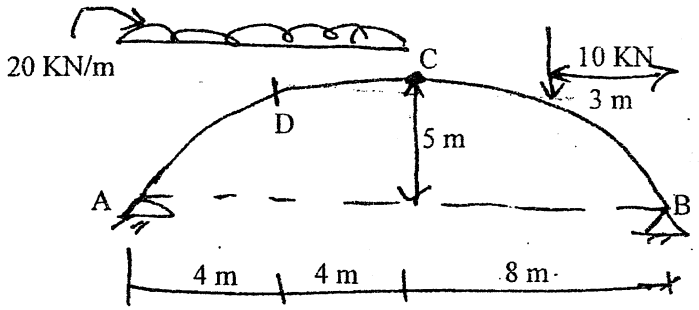


3. a) Use influence line diagram to determine most critical position of a stretch of uniform distribution load to give maximum bending moment at a given section of a simply supported beam. Assume the length of the uniform distributed load less than the span of the beam. [6]

   b) Determine R_A, R_B, S.F. at C and B.M at 'C' of the given structure as shown in figure below using influence line diagram concept. [10]



4. a) Determine B.M normal thrust, Radial shear at point D of circular arch as shown in figure below. Also draw bending moment diagram. [12]



b) Explain different types of arches used in various Civil Engineering structures. [4]

5. a) Explain with a simple example the steps involved in determining displacement of a point in a structural system applying unit load method. [6]

b) A cable is hanging from two points A and B, 80 m apart horizontally, left end A being lower than the right end by 10 m. It supports a uniform load of 1.5 KN/m along the horizontal span. Determine: [10]

i) The position of the lowest point if it sag is 7.5 m
ii) Length of the cable
iii) Horizontal tension and tension at the two ends.

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure *(CE551)*

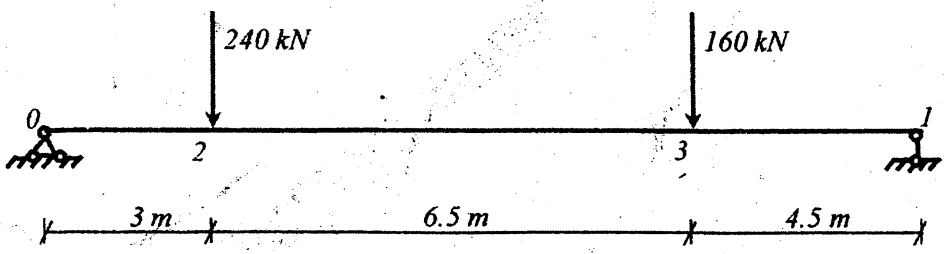
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain two basic approaches of structural analysis. Also explain briefly the non-linearity in structural analysis. [3+3]

   b) A three-hinged symmetrical circular arch is of 12 m span and 4 m rise. Draw influence line diagram for bending moment, radial shear and normal thrust in the section at distance of 3 m from the left support. Use the diagrams to determine these internal forces in the section when the left half of the span is loaded with a uniformly distributed load of intensity 20 kNm^{-1} and a vertical concentrated load of magnitude 40 kN at a distance of 3 m from the right support. [10]

2. a) Write down the formula for determination of total strain energy due to axial force, bending moment, shear force and torsion in a structural system. Derive the expression for energy due to shear force in an element of a structural system. [6]

   b) Using conjugate beam method, calculate slopes at the supports and at the points beneath the loads for the given simply supported beam and also calculate the deflections of the points beneath the loads. Take EI = 3.36×10^{11} $kNmm^2$. [10]

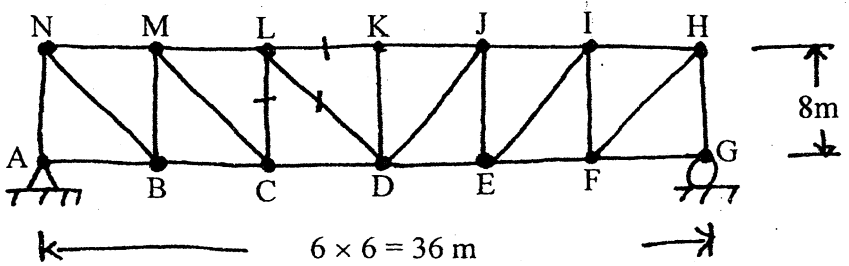


3. a) State and prove moment area theorems for determining deflections at any point of a beam. [6]

   b) Calculate the displacements in two orthogonal directions and also the slope at the free end of the given frame due to the temperature effect as shown. Take EI to be constant for the frame. [10]

4. a) Explain with necessary sketches the steps involved in determining bending moment, radial shear and normal thrust in a three hinged arch by graphical method. [6]

   b) Draw influence line diagram for the members LC, LK and LD when the load moves in the lower chord of the given truss as shown in figure. [10]



5. a) Explain with neat sketches tower structures as well as wind cables and ties. [6]

   b) Use influence line diagrams to determine reactions at the supports, bending moments and shear forces beneath the applied forces in the beam shown in Question No. 2(b). [10]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Poush

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structures I *(CE551)*

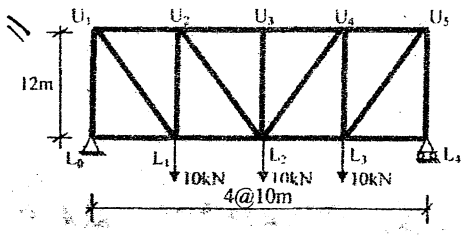
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Differentiate between linear and non-linear behavior of structures and explain their uses in theory of structures. [6]

   b) A cable is supported at two points 20 m apart at the same level. It is used to support three equidistant loads, first load is 40 kN, second is 30kN and third is 20 kN. The central dip of the cable is 0.96 m. find the length of the cable required and its sectional area if the safe tensile stress is 250 kN/mm^2. Also give the geometry (shape and dip) of the cable when it is hanging only with its weight (without the given loads). [10]

2. a) Define and explain strain energy. Use strain energy method to show the deflection due to shear in an ordinary beam can be neglected in comparison to the deflection due to bending. Assume ratio of Young's modules to modules of rigidity to be 2.4 and shape factor for shear 1.2. [8]

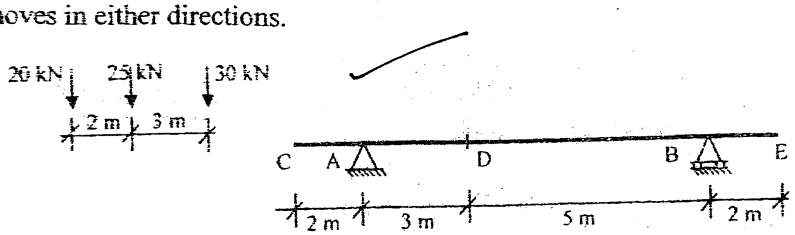
   b) Determine, using virtual work method, the vertical deflection of joint L_2. The L/A values for diagonal and vertical members are 12 mm^{-1} and for horizontal members are 6 mm^{-1}. Take E = 200*10^3 N/mm^2 for all members. (i) Find vertical deflection due to loads as shown in figure (ii) Find the additional deflection if the top boom is subjected to a temperature rise of 20°C. Take the value of coeffic. of linear expansion (α) = 10.8*10^{-6}/°C. [8]



3. A horizontal girder of steel having uniform section 14 m long is simply supported at its end. It carries concentrated loads of 120 kN and 80 kN at two points 3 m and 4.5 m from the two ends supports respectively. Calculate the deflection and slopes of the girder at the point under the loads using moment area method. Take I = 16* 10^8 mm^4 and E = 210 kN/mm^2. Verify the results using conjugate beam method. Also find magnitude and location of the maximum deflection in the beam. [16]

4. A three hinged symmetrical parabolic arch has a span of 18 m and rise of 3 m. It carries a concentrated load of 80 kN at 4.5 m from the right support and a distributed load of 5 kN/m over half portion. Determine the moment, thrust and radial shear at each 3 m interval and draw their diagrams on horizontal 'X' axis for the arch. [16]

5. a) For the overhang beam determine the maximum positive and negative bending moment and shear force at D due to the three concentrated loads as shown in figure which moves in either directions. [8]



b) A suspension cable is suspended from two piers 200 m apart, left support being 5 m above the other. The cable carries a uniformly distributed load of 15 kN/m in plan and has its lowest point 10 m below the lower support. The ends of the cables are attached to saddles on rollers on top of piers and the backstays which may be assumed straight are inclined at 60° to the vertical. Determine: (i) The length of cable (ii) Maximum tension in cable and (iii) Maximum thrust and moment on pier. [8]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

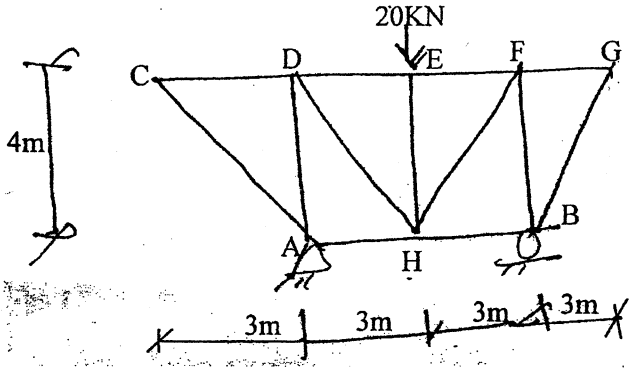
Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structures I *(CE551)*

- ✓ 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) Define strain energy and complementary strain energy. Also derive relationship of strain energy due to bending. [6]

   b) Determine the vertical deflection of joint H. All the top chord members are subjected to temperature rise of 20°C and all vertical members are 10mm too long. Take $\alpha=12\times10^{-6}$/°C, E=200KN/mm^2. Cross sectional area of each member is 1500mm^2. [10]

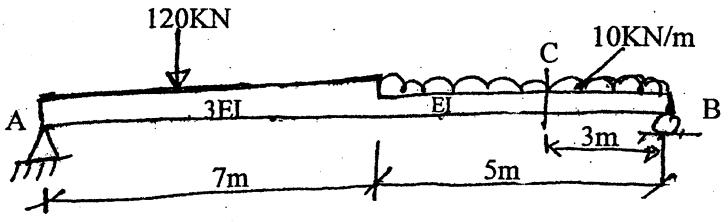


2. a) Describe the structures based on material used and methods of their analysis. [4]

   b) A suspension bridge of 120m span has two three hinged stiffening girder supported by two cables having a central dip of 12m. The road way has a width of 6m. The dead load on the bridge is 5KN/m^2 while the live load is 10KN/m^2 which act on the left half of span. Determine the shear force and bending moment in the girder at 30m from left end. Also find maximum tension in the cable for this position of live load. [12]

3. a) Explain difference between moment area method and conjugate beam method with suitable examples. [4]

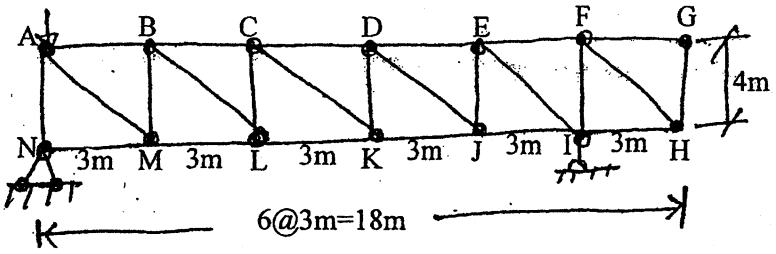
   b) Using conjugate beam method, find slope and deflection at point (C) of following loaded beam: [12]



4. A three hinged parabolic arch has a span of 160m and a rise of 25m. A uniformly distributed load of intensity 30KN/m of length 60m rolls over the arch from left to the right. Using the influence line diagram, find the maximum bending moment at a section 50m from the right support. Also find normal thrust and radial shear at the section corresponding to the maximum bending moment. [16]

5. a) What is influence line diagram? Explain its uses and advantages in Civil Engineering field. [2+2]

   b) Using influence line diagram, obtain member force in AB, CD, EJ and FH for the following loaded pin-jointed truss as shown in figure below. [12]



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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Bhadra

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structures I *(CE551)*

- ✓ 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.*

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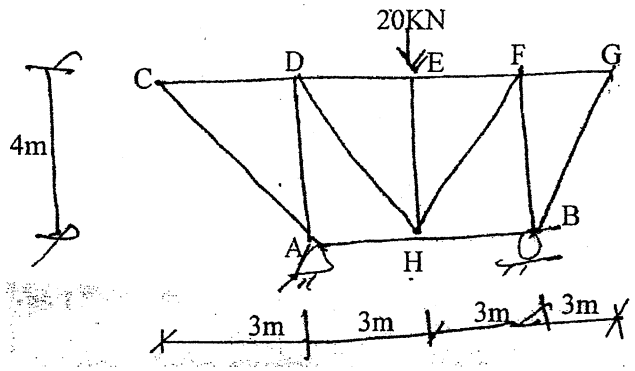
   b) Determine the vertical deflection of joint H. All the top chord members are subjected to temperature rise of 20°C and all vertical members are 10mm too long. Take $\alpha=12\times10^{-6}$/°C, E=200KN/mm^2. Cross sectional area of each member is 1500mm^2. [10]

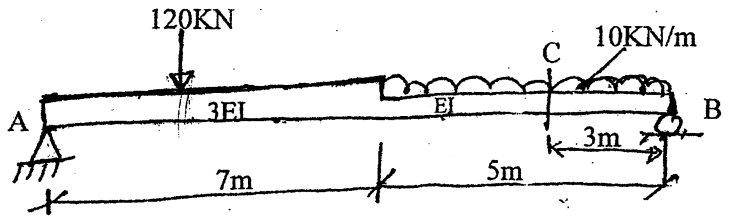


2. a) Describe the structures based on material used and methods of their analysis. [4]

   b) A suspension bridge of 120m span has two three hinged stiffening girder supported by two cables having a central dip of 12m. The road way has a width of 6m. The dead load on the bridge is 5KN/m^2 while the live load is 10KN/m^2 which act on the left half of span. Determine the shear force and bending moment in the girder at 30m from left end. Also find maximum tension in the cable for this position of live load. [12]

3. a) Explain difference between moment area method and conjugate beam method with suitable examples. [4]

   b) Using conjugate beam method, find slope and deflection at point (C) of following loaded beam: [12]



4. A three hinged parabolic arch has a span of 160m and a rise of 25m. A uniformly distributed load of intensity 30KN/m of length 60m rolls over the arch from left to the right. Using the influence line diagram, find the maximum bending moment at a section 50m from the right support. Also find normal thrust and radial shear at the section corresponding to the maximum bending moment. [16]

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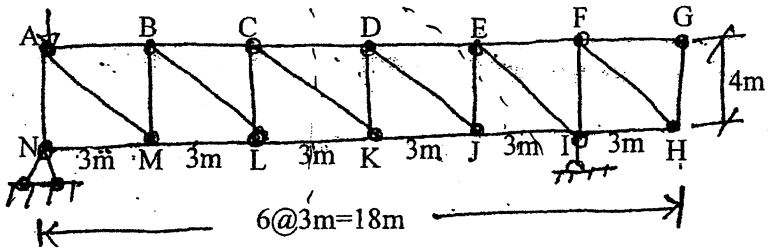

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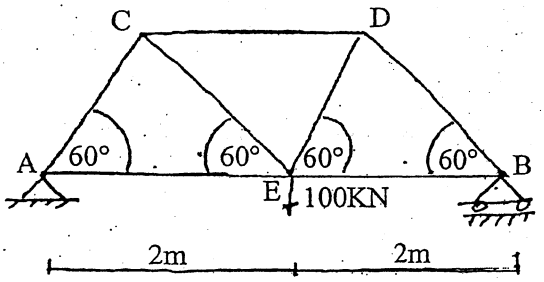
03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure

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

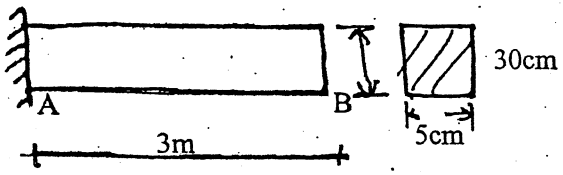
1. a) Determine the vertical deflection of joint E of the truss due to (i) loading shown (ii) members CE and DE being 8mm too long and (iii) temperature of member CD alone is decreased by 15°C. Given: Cross-sectional area of all members = 1000mm^2, young' modulus = 2 ×10^{5}N/mm^2, and coefficient of thermal expansion = 12 × 10^{-6}/°C. [12]



b) Explain the use of computer based methods in structural analysis. [4]

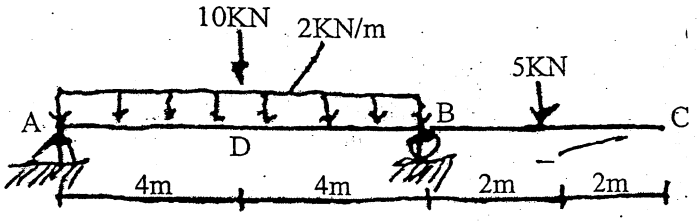
2. a) For a beam having a rectangular cross-section and subjected to lateral loads, derive an expression for the strain energy due to shear deformation only. [8]

b) The bottom of the beam shown below is subjected to a temperature of 200°C, while the temperature of its top is 50°C. If the coefficient of linear expansion α = 12 × 10^{-6}/°C, determine the vertical displacement of its free end B due to temperature gradient. The beam has a rectangular cross-section with a depth of 30cm. [8]

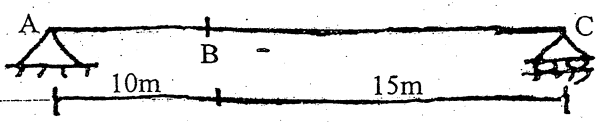


3. a) Explain moment area theorem with suitable example. [4]

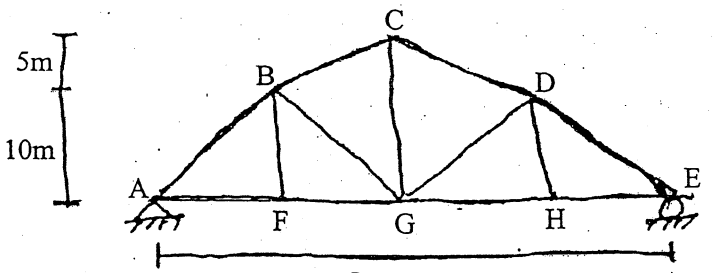
b) Using conjugate beam method, calculate slope and deflection at point C, free end of the beam, loaded as shown below. EI is constant. [12]



4. a) Draw the influence lines for bending moment and shear force at a section 10m from the left support of a simply supported beam of 25m span. [8]



b) Draw influence line diagrams for the forces in members AB, BC and BG of the truss. The load moves in the lower chord of the truss. [8]



4 @ 15m = 60m

5. A three hinged circular arch has a span of 120m and a rise of 15m. Two point loads of 8 KN and 12KN, spaced 10m apart, roll over the arch from left to right with 8KN load leading. Using the influence line diagram, find the maximum bending moments at a section 30m from the left support. Also find normal thrust and radial shear at the same section corresponding to the maximum bending moment. [16]

6. A suspension bridge, 400m span, has two three-hinged stiffening girders supported by two cables with a central dip of 30m. The dead load of the bridge is 30 KN/m. run and in addition, it supports three point loads of 300KN each placed along the centre line of the roadway and dividing the span in four equal parts. Calculate the maximum tension and minimum tension with their locations in the cable and the length of the cable. [16]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Five questions.*
- ✓ *The figures in the margin indicate Full Marks.*
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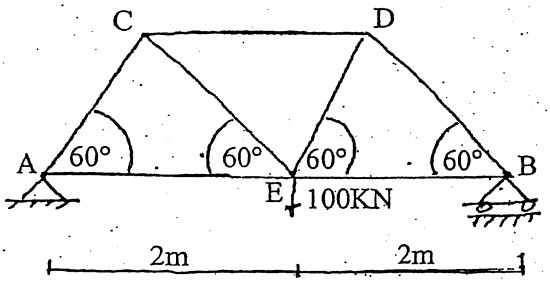
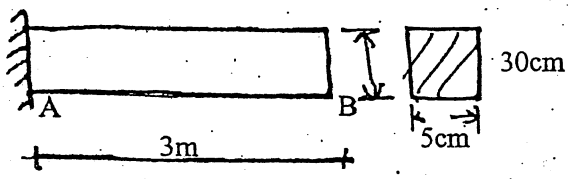
1. a) Determine the vertical deflection of joint E of the truss due to (i) loading shown (ii) members CE and DE being 8mm too long and (iii) temperature of member CD alone is decreased by 15°C. Given: Cross-sectional area of all members = 1000mm^2, young' modulus = 2 ×10^{5}N/mm^2, and coefficient of thermal expansion = 12 × 10^{-6}/°C. [12]



b) Explain the use of computer based methods in structural analysis. [4]

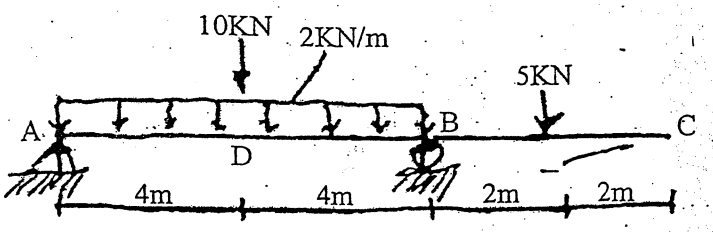
2. a) For a beam having a rectangular cross-section and subjected to lateral loads, derive an expression for the strain energy due to shear deformation only. [8]

b) The bottom of the beam shown below is subjected to a temperature of 200°C, while the temperature of its top is 50°C. If the coefficient of linear expansion $\alpha = 12 \times 10^{-6}$/°C, determine the vertical displacement of its free end B due to temperature gradient. The beam has a rectangular cross-section with a depth of 30cm. [8]

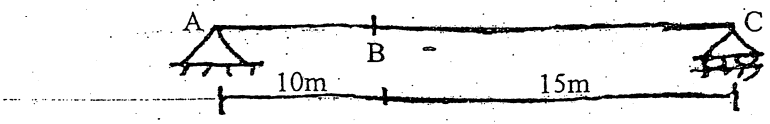


3. a) Explain moment area theorem with suitable example. [4]

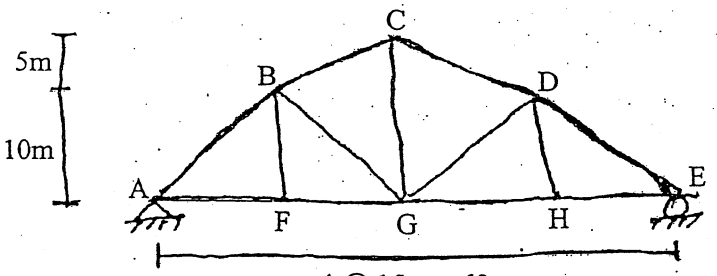
b) Using conjugate beam method, calculate slope and deflection at point C, free end of the beam, loaded as shown below. EI is constant. [12]



4. a) Draw the influence lines for bending moment and shear force at a section 10m from the left support of a simply supported beam of 25m span. [8]



b) Draw influence line diagrams for the forces in members AB, BC and BG of the truss. The load moves in the lower chord of the truss. [8]



5. A three hinged circular arch has a span of 120m and a rise of 15m. Two point loads of 8 KN and 12KN, spaced 10m apart, roll over the arch from left to right with 8KN load leading. Using the influence line diagram, find the maximum bending moments at a section 30m from the left support. Also find normal thrust and radial shear at the same section corresponding to the maximum bending moment. [16]

6. A suspension bridge, 400m span, has two three-hinged stiffening girders supported by two cables with a central dip of 30m. The dead load of the bridge is 30 KN/m. run and in addition, it supports three point loads of 300KN each placed along the centre line of the roadway and dividing the span in four equal parts. Calculate the maximum tension and minimum tension with their locations in the cable and the length of the cable. [16]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Kartik

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structure I

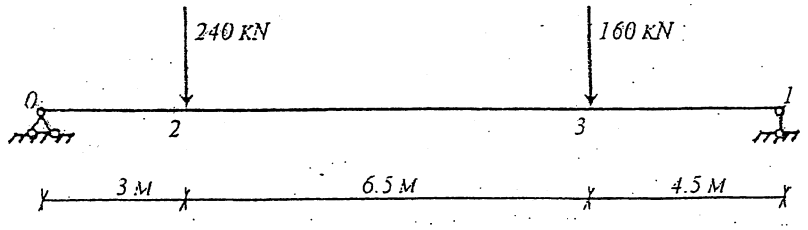
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Five questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Enunciate the two theorems from the moment area method for the determination of displacements of beam and explain it with a simple example. [6]

   b) A three-hinged symmetrical circular arch is of 12m span and 4m rise. Draw influence line diagram for bending moment, radial shear and normal thrust in the section at distance of 3m from the left support. Use the diagrams to determine these internal forces in the section when the left half of the span is loaded with a uniform distributed load of intensity 20 kNm^{-1} and a vertical concentrated load of magnitude 40 kN at a distance of 3m from the right support. [10]

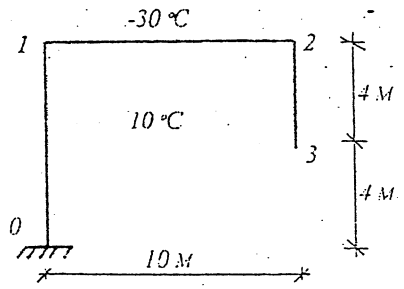
2. a) Write down the formula for determination of total strain energy due to axial force, bending moment, shear force and torsion in a structural system. Derive the expression for energy due to shear force in an element of a structural system. [6]

   b) Using conjugate beam method, calculate slopes at the supports and at the points beneath the loads for the given simply supported beam and also calculate the deflections of the points beneath the loads. Take EI = 3.36×10^{11} $kNmm^2$. [10]



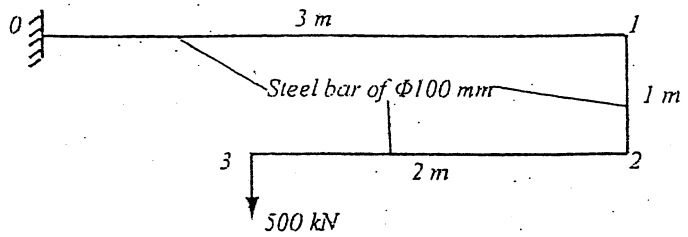
3. a) Explain with necessary sketches the steps involved in determining bending moment, radial shear and normal thrust in a three hinged arch by graphical method. [6]

   b) Calculate the displacements in two orthogonal directions and also the slope at the free end of the given frame due to the temperature effect as shown. Take EI to be constant for the frame. [10]



4. a) Use influence line diagram to determine most critical position of a stretch of uniformly distributed load to give maximum bending moment at a given section of a simply supported beam. Assume the length of the uniformly distributed load less than the span of the beam. [6]

b) Use strain energy method for the given frame to calculate the vertical displacement of the point with load 500 kN. The frame is made of steel rod Φ100mm. Take $E = 2\times10^5 N/mm^2$. [10]



5. a) Determine the geometry of the shape and calculate the length required for a high tension line between any two towers. Take the span between the two towers and the weight per unit length of the cable to be ℓ and γ respectively. [6]

b) Use influence line diagrams to determine reactions at the supports, bending moments and shear forces beneath the applied forces in the beam shown in Question No. 2(b). [10]

6. a) Explain with a simple example the steps involved in determining the displacement of a point in a structural system applying unit load method. [6]

b) A symmetrical suspension bridge with a three hinged stiffening girder of span 120m and having a central dip of 12m is loaded with two point loads of magnitude 240 kN and 300 kN at a distance 25m and 80m respectively from the left end. Draw bending moment diagram for the girder and also calculate bending moments at the distances 25m, 40m and 80m from the left support. [10]

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2065 Chaitra

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Theory of Structures I

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

1. a) Determine the vertical deflection of point C in the frame shown in fig-1. [8]
$E = 200\ KN/mm^2$ $I = 30 \times 10^6\ mm^4$

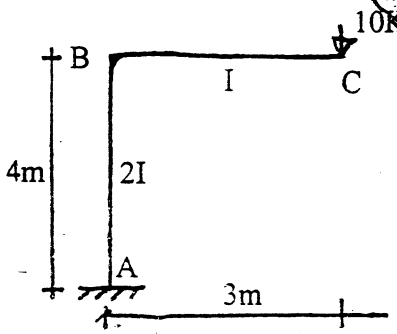

Fig-1

b) Calculate the vertical deflection of free end D of the beam loaded as shown in fig-2 by using virtual work method. Take EI as constant through out. [8]

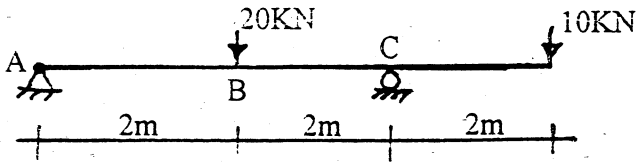

Fig-2

2. a) Determine the slope at A and B and deflection at D of the beam loaded as shown in fig-3 using moment area method. Take EI as constant. [8]

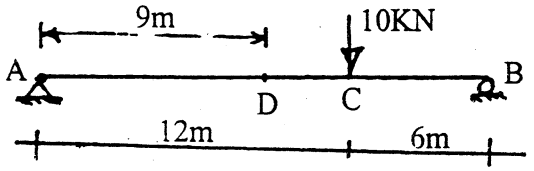

Fig-3

b) Determine the rotation at A and deflection at C in the overhanging beam shown in fig-4 by using conjugate beam method. [8]

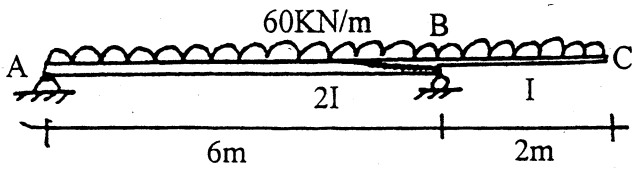

Fig-4

3. a) Find the maximum bending moment at C for the beam and loading as shown in fig-5. [8]

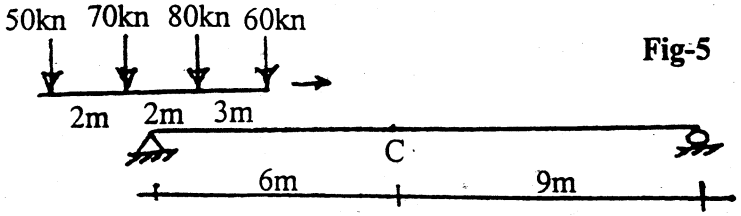

Fig-5

b) Draw influence line diagram for bending moment at F (5m right of A) and for the stress in the support BD of the structure shown in fig-6. [8]

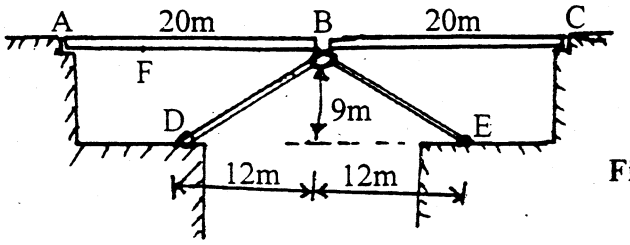

Fig-6

4. a) Draw influence line diagram and calculate the bending moment at mid span C for the beam shown in fig-7. [8]

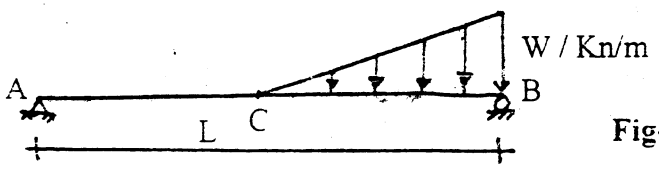

Fig-7

b) Draw influence line diagram for members U3L3 and L3L4 of the truss shown in fig-8. [8]

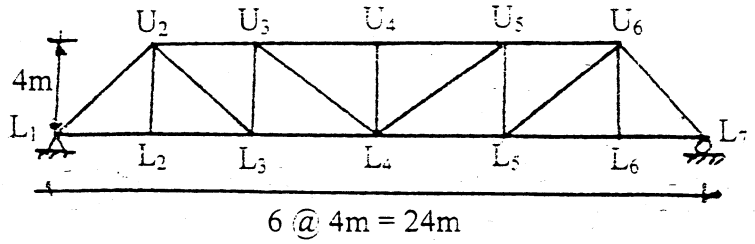

Fig-8

5. A three hinged parabolic arch as shown in fig-9 is loaded with udl 2 KN/m on the left 8m length. Calculate [16]

a) Direction and magnitude of reaction at supports.
b) The bending moment, normal thrust and radial shear at 4m from left end.
c) Draw bending moment diagram showing maximum positive and negative values.

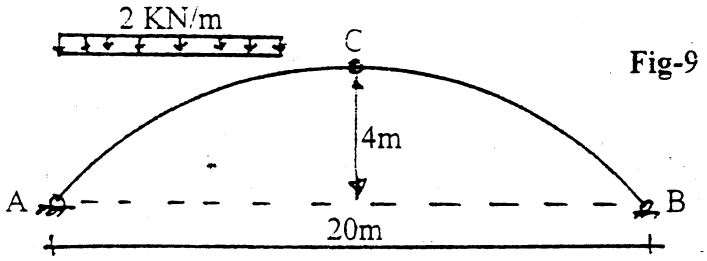

Fig-9

6. a) A suspension cable of span L has its ends at the height h_1 and h_2 above the lowest point of cable. It carries a uniformly distributed load of w per unit run of the span. Show that the horizontal reaction at each end is given by $H = \frac{WL^2}{2(\sqrt{h_1} + \sqrt{h_2})^2}$. [8]

b) A cable is stretched over a gap of 300m and carries uniformly distributed load of 300 kg/m horizontally. If the central dip is 1.5m. Calculate the maximum tension in the cable. Also find the length of cable. [8]

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