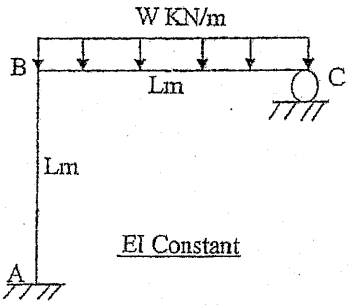
TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

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

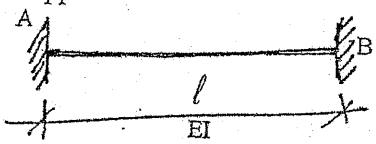
Subject: - Theory of Structures II *(CE 601)*

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

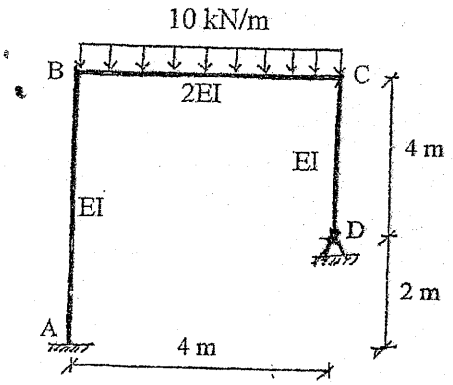
1. a) Explain theorems on displacement with suitable illustration. [4]
   b) Find the reaction at support 'C' using Castigliano's theorem. [6]



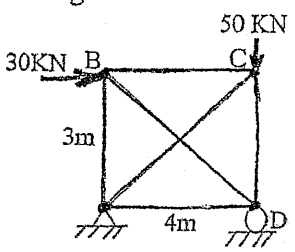
   c) In the given beam support 'B' is settled down by 'Δ' units without rotation. Determine reactions at the supports. [6]



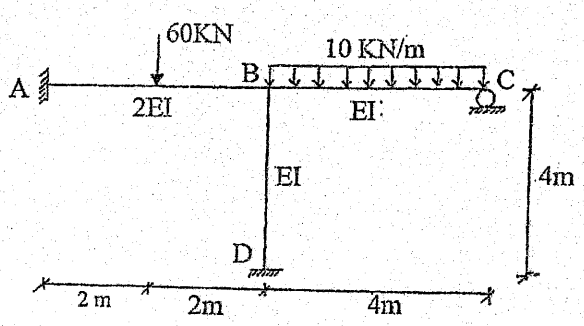
2. a) Determine reactions at hinged support using Force method when support D settles vertically downward by 200/EI. Take EI to be constant. [10]



   b) Find the member forces of given loaded truss for given external loadings and due to rise in temperature of all diagonal members by 20°C. Take AE = 5000KN for all members and coefficient of thermal expansion as 2.06×10^{-6}/°C. Additionally, vertical members are 5mm too long. [10]

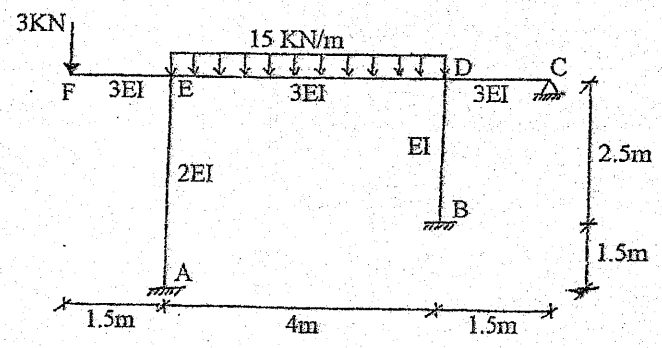


3. Draw BMD of the given frame using Stiffness matrix method. [12]



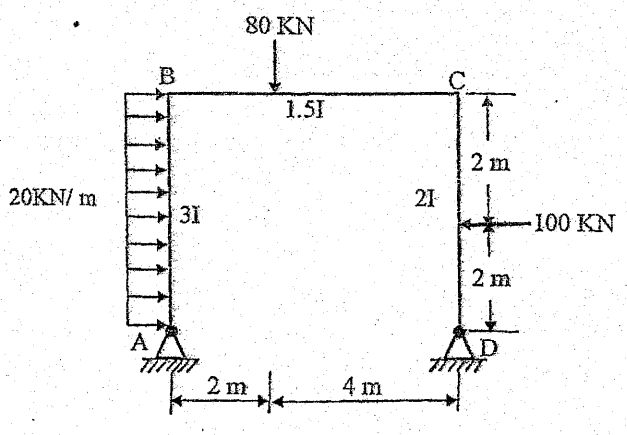
4. a) Derive expressions for Slope deflection equations for continuous beams. [4]

b) Draw BMD of the given frame using moment distribution method. [12]



5. a) Draw ILD for reaction moment at fixed support of the propped cantilever beam of span 10m. Take ordinate interval as 2m. [6]

b) Find the plastic moment capacity of the frame shown in figure below. [10]



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

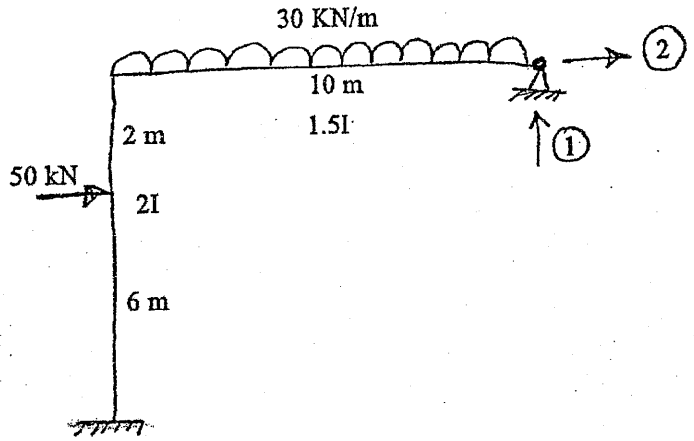
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structure II *(CE 601)*

- ✓ 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.*

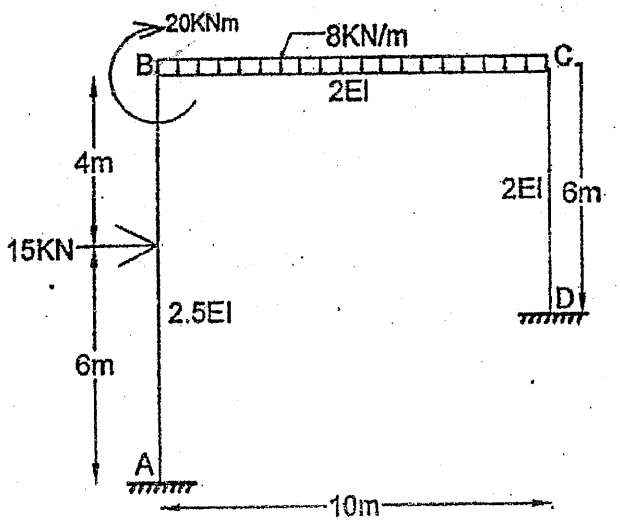
1. a) Define degree of static and kinematic indeterminacies and give suitable examples related to pin jointed, rigid jointed and hybrid structures to explain the concept. [6]

   b) Determine reactions at hinged support in the frame shown in figure below using force method. [10]



2. a) Determine end moments in a fixed beam of span L when left fixed support rotates clockwise by θ_A radian. Take EI as constant. [6]

   b) Compute the final end moments for the following loaded frame using stiffness matrix method. [10]



3. a) Explain with a neat sketch the concept of distribution and carry over factors in moment distribution method and give example. [6]

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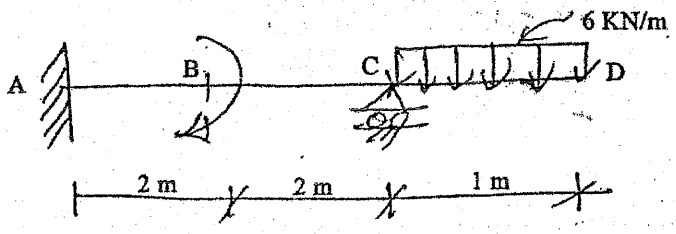
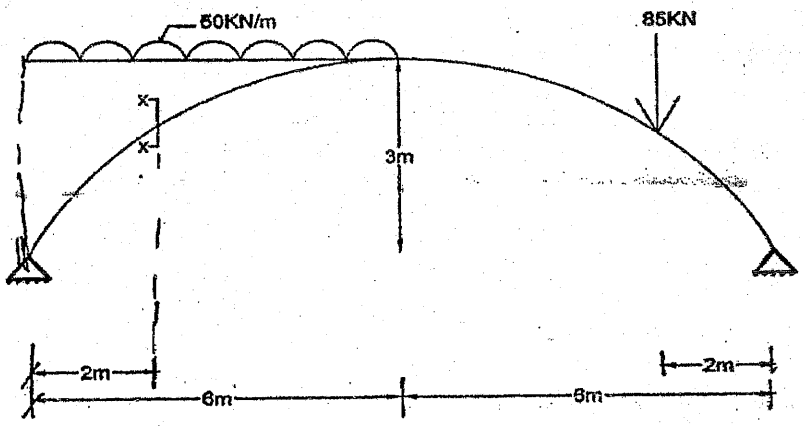
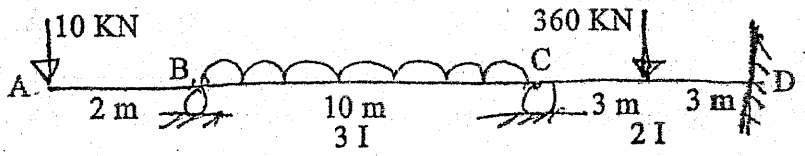
b) Determine the support reaction at support 'C' using Castigliano's theorem. EI=constant throughout. [10]



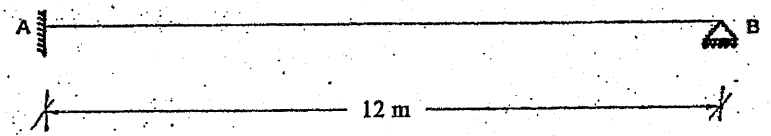
4. a) Find the bending moment at a given section x-x of the following loaded two hinged parabolic arch due to given loading. Take $EI_C=10000KNm^2$. [6]



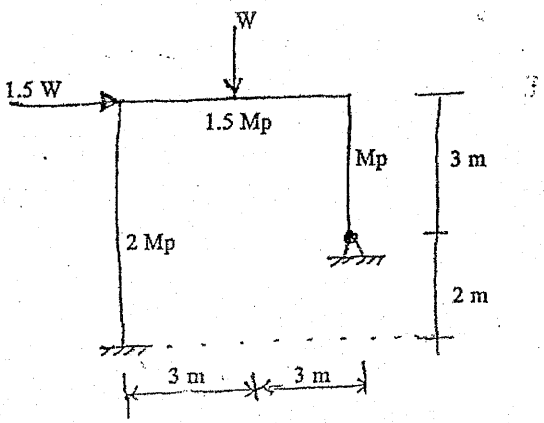
b) Determine end moments and draw bending moment diagram by using slope deflection method. [10]



5. a) Draw ILD for the support moment at A by computing the ordinates at 3 meter intervals. [6]



b) Determine collapse load in the portal frame shown in figure below. [10]



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

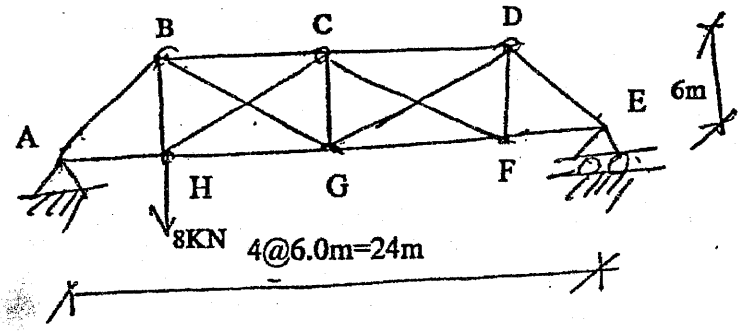
Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structure II *(CE 601)*

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

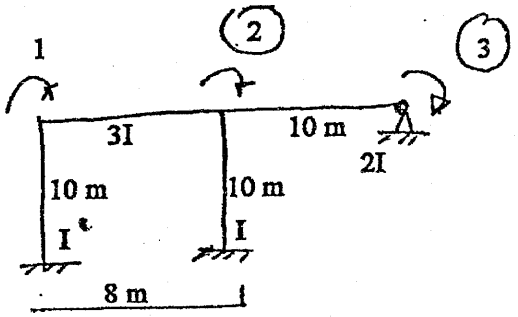
1. a) Enunciate Betti's law and Maxwell's Reciprocal theorem and explain their uses. [6]

   b) Compute the bar forces in the members BG, HC, and CF of the following loaded truss structures as shown. AE = constant. [10]



2. a) Determine end moments in a fixed beam of span L when one of the supports settles down by Δ units. Take EI as the cross sectional stiffness of the beam. [6]

   b) Generate stiffness matrix of the structural system. [10]

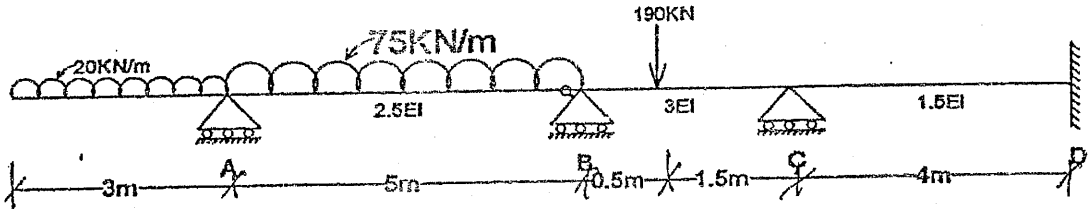


3. a) Derive slope deflection equations for a beam of span L and cross sectional stiffness EI. Assume other data, if required. [6]

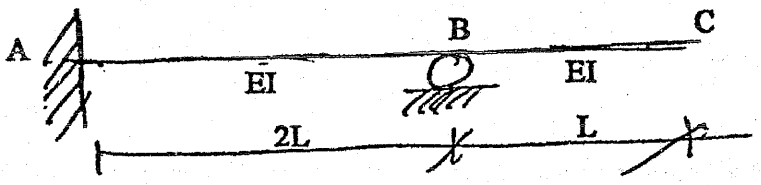
   b) Determine moment at fixed support and rotation at roller support of a propped cantilever beam of span 10m and loaded with uniformly distributed load 30kN/m on its whole span and a point load of 50 KN at the centre using castigliano's theorem. [10]

4. a) Write down the compatibility equation for two hinged parabolic arch due to external loads, variation in temperature, Rib shortening and yielding of supports. [6]

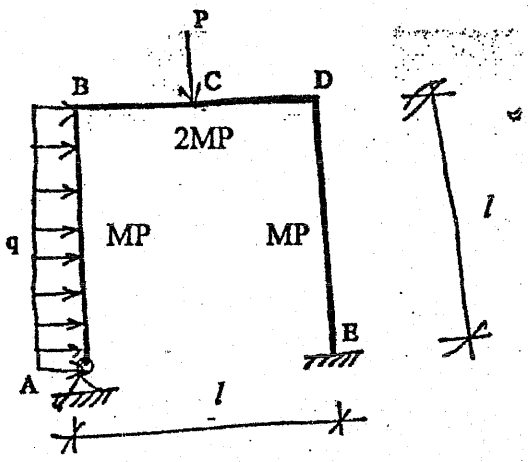
   b) Draw BMD using slope deflection method. [10]



5. a) Draw Influence Line diagram for moment at support B of a propped cantilever beam as shown. Plot ordinates at 0.50 times span length. [6]



b) Evaluate the collapse load for the given portal frame. Assume P=2ql. [10]



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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

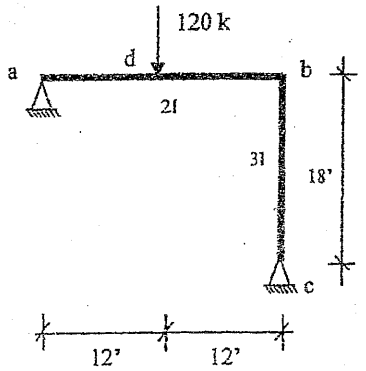
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structures II *(CE601)*

- ✓ 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.*

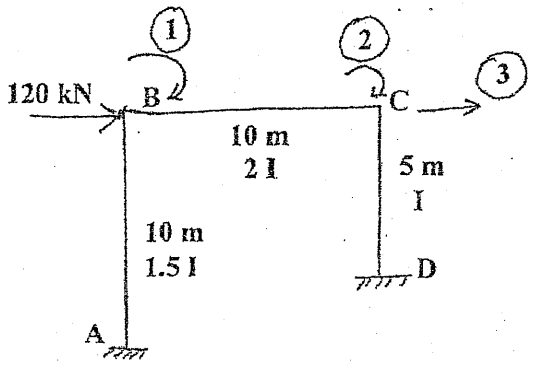
1. a) Define degree of static and kinematic indeterminacies. Give examples for each. [6]

   b) Analyze the structure given below using Force method. Draw Shear force and Bending Moment diagrams. [10]

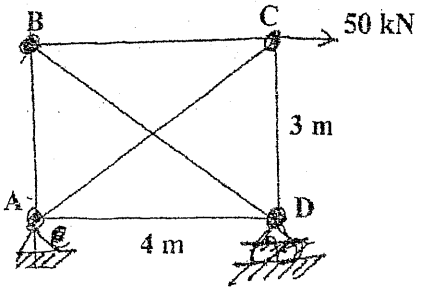


2. a) Derive the three moment equation and use it to solve single span fixed beam with uniform distributed load throughout the span. [6]

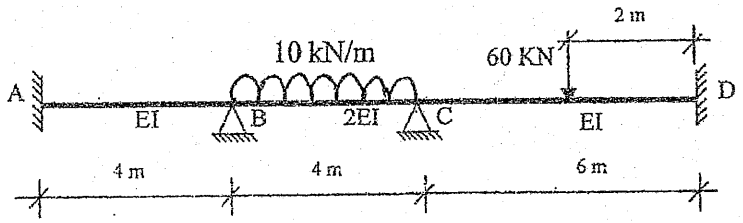
   b) Generate stiffness matrix for the frame shown in below figure and determine the end moments and horizontal reactions at supports due to the load given. [10]



3. a) Determine forces in all members of the truss shown in figure below using force method. AE for all members is constant. [10]

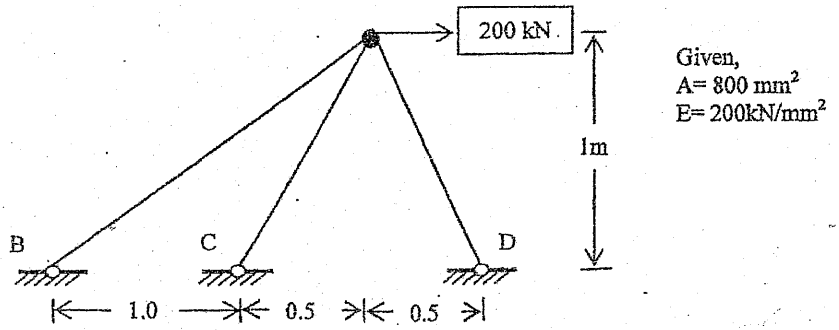


b) Analyze the continuous beam shown in figure below by slope deflection method. Given I = 4*10^7 mm^4, and E = 200 kN/mm^2 Draw Bending Moment diagram. [8]

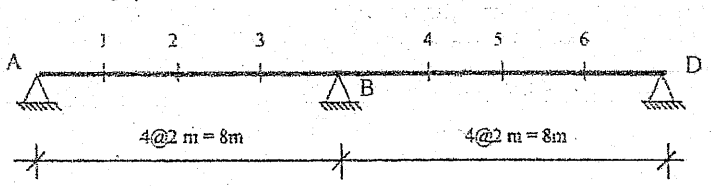


4. a) Explain with example how bending moment diagram is drawn for a statically indeterminate portal frame which undergoes settlement of one support. [4]

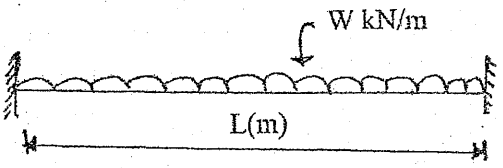
b) Analyze the truss shown in figure below by the stiffness matrix method and find the vertical and horizontal displacement at node A. [8]



5. a) Draw the influence line for bending moment at Section 5 of a two span continuous beam as shown in figure below. Given ordinate at 2m interval. [10]



b) Determine collapse load for the following beam. [4]



c) Calculate the reaction at the prop of a propped cantilever with uniform distributed load throughout the span using Castigliano's theorem. [4]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

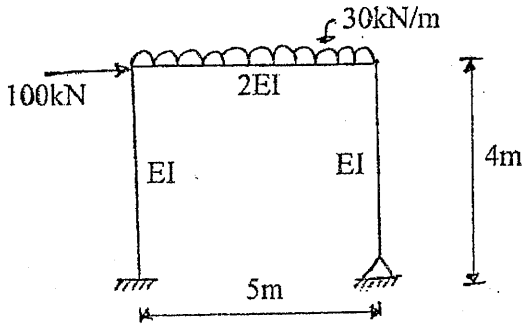
Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structures II *(CE601)*

- ✓ 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.*

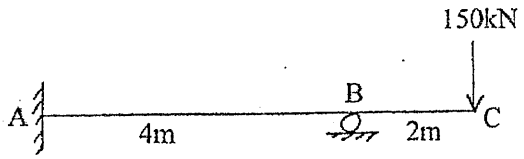
1. a) What is structural idealization? Explain the steps involve during identification and formulation of problems in theory of structure. [3+3]

   b) Determine the horizontal and vertical reaction at hinged support and also draw BMD using Force method. [10]



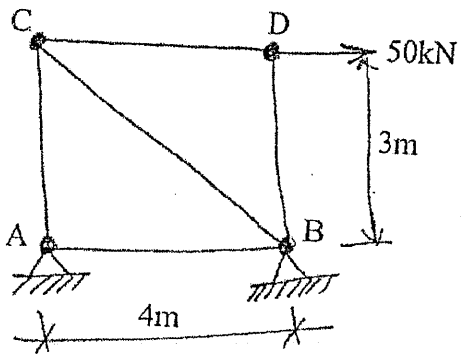
2. a) "Displacement method is unique in comparison to force method". Justify the statement giving suitable example. [4]

   b) Determine reaction at support B of the beam shown in figure below by castigliano's method. [6]

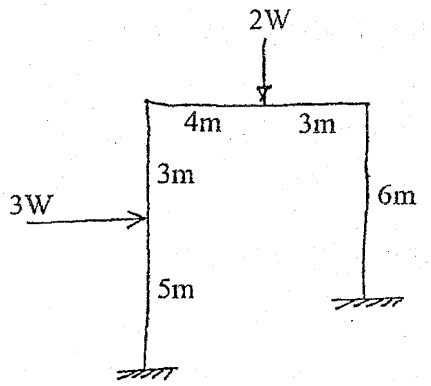


   c) A portal frame of span 6m and height 5m is hinged supported at both ends. The beam of the frame carries a uniformly distributed gravity load of intensity 50 kN/m. Use force method to solve the frame considering the flexural stiffness EI to be constant. Determine the reactions at both supports. [6]

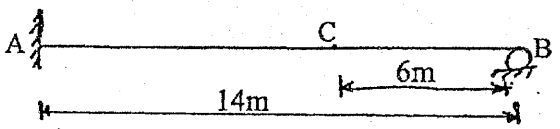
3. a) Determine the forces in all members of the truss shown below, using force method. Take EA = 10^5kN. [8]



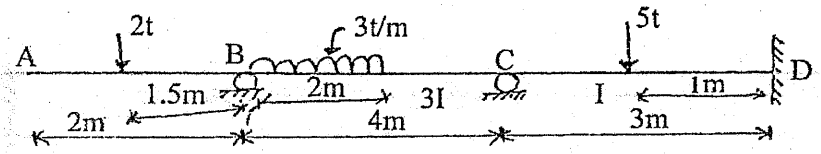
b) Determine the collapse load Wc for the rectangular portal frame shown in figure below. [8]



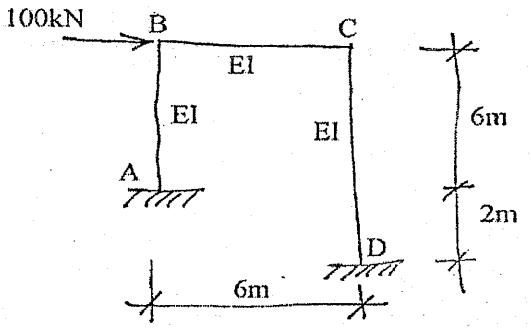
4. a) Draw ILD for S.F. at point C of the propped cantilever beam shown in figure below. [6]



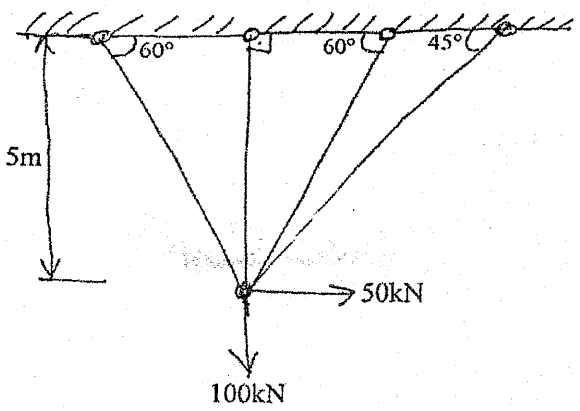
b) Analysis the continuous beam loaded as shown in figure below using slope deflection method considering settlement of support C by 4mm downward. Take $EI = 1\times10^9$ t mm^2. [10]



5. a) Generate stiffness matrix for the frame shown and determine the end reactions at the support. [8]



b) Analyse the truss by displacement method. Take $E = 2\times10^5$ MPa, $A = 8$ cm^2 [8]



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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

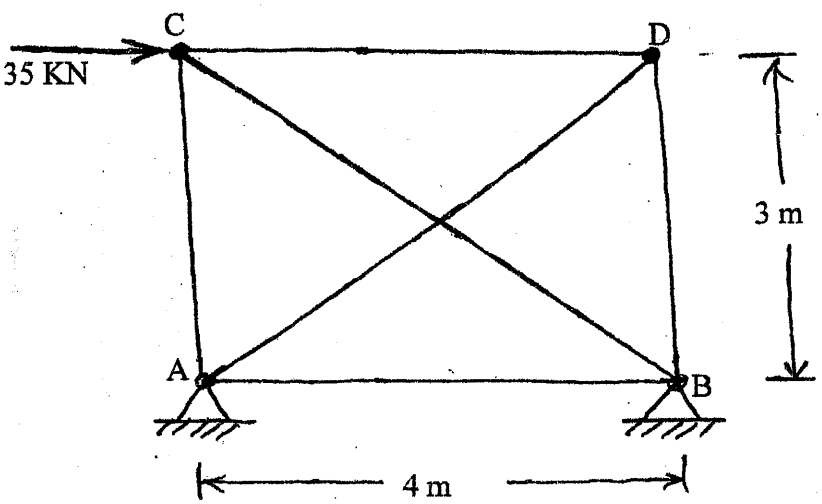
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structure II *(CE601)*

- ✓ 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.*

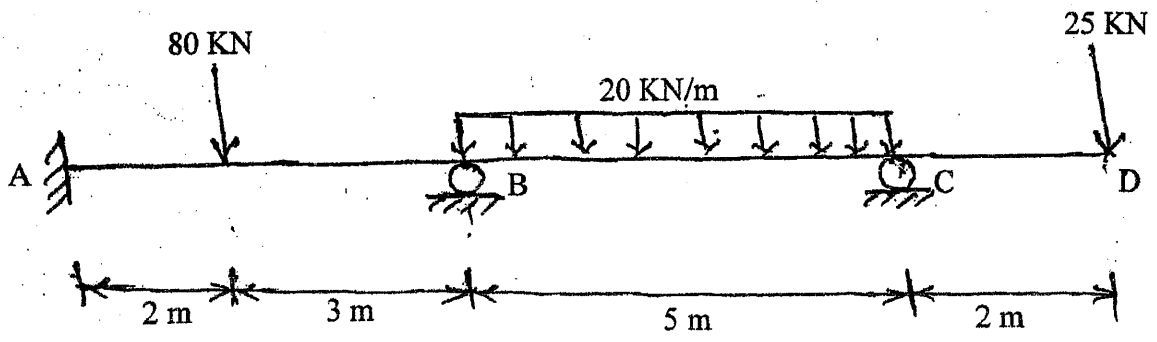
1. a) Define static and kinetic indeterminacies of a structural system. Explain with an example for each of indeterminacy what they are used for. [6]

   b) Calculate the force in the members of the truss loaded shown in figure below using "Force Method". Take the cross-sectional stiffness EA of the members to be constant. [10]



2. a) Derive moment expressions of slope-deflection method and explain whether the method used is force or displacement. Define with an example what is fixed end moment? [6]

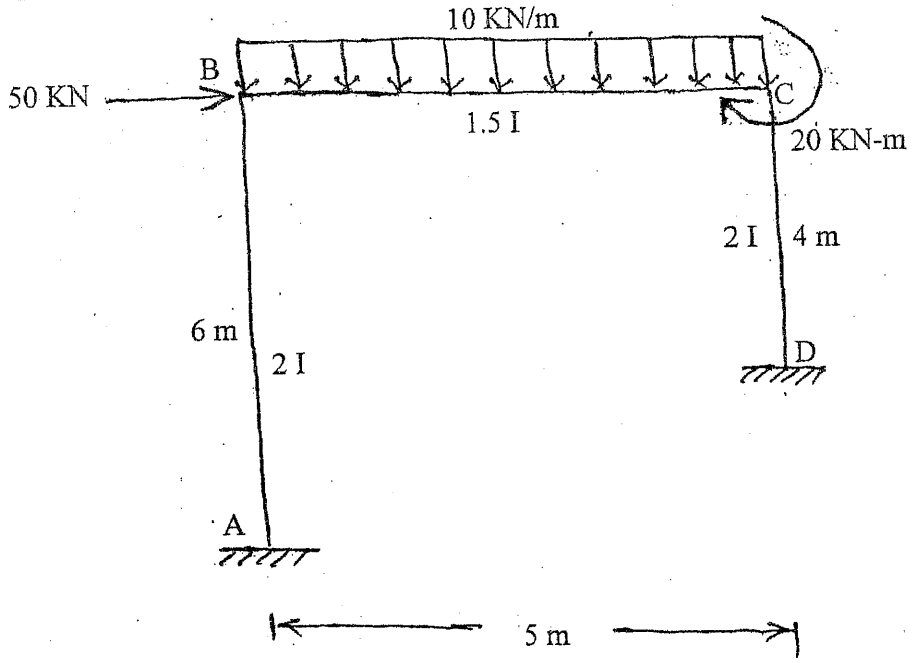
   b) Analyse the beam shown in figure below by Moment Distribution Method. Also draw BMD indicating the salient points. Supports B sinks by 15 mm. [10]



Take EI = 10000 KN-m^2, and is constant throughout.

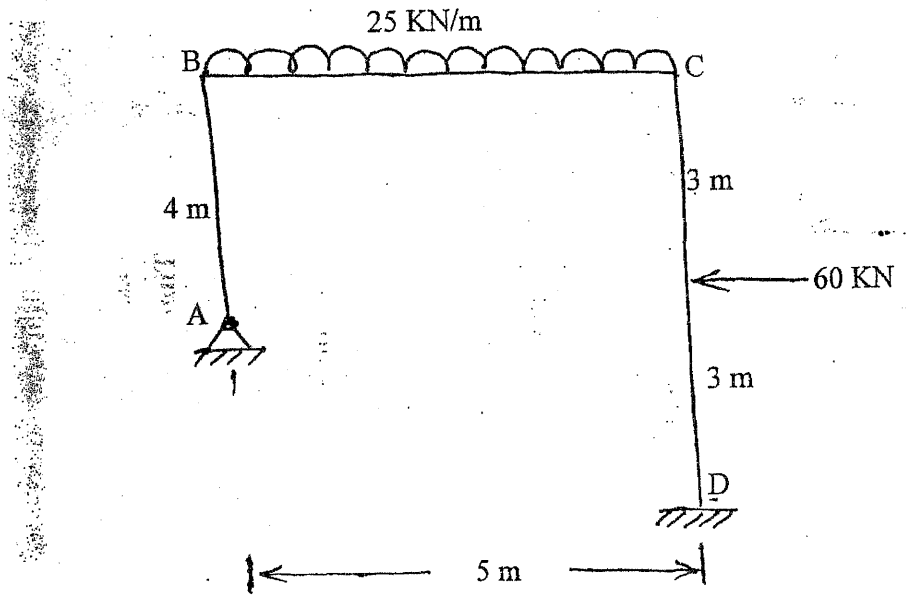
3. a) Differentiate between stiffness and flexibility. Also explain their relationships. [4]

b) Generate stiffness matrix and solve for the final end moments and reactions for the following frame loaded as shown in figure below. Also draw the bending moment diagram. [6+4+2]



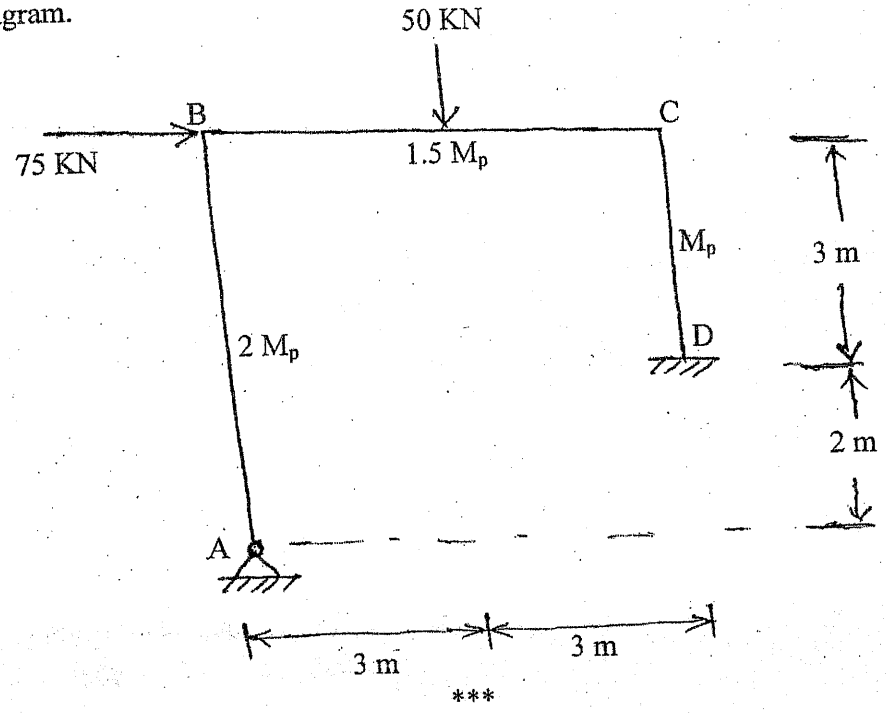
4. a) Draw influence line diagram for the moment at the fixed support a propped cantilever beam of span L. Find and plot the ordinate at 0.2L interval. Use Mueller-Breslau principle. [6]

b) Analyse the frame loaded shown in figure below using the method of consistent deformation. Draw BMD and SFD. Consider EI to the constant throughout the frame. [10]



5. a) Derive three moment equation and explain its physical meaning. Explain with an example how the theorem can be used for a continuous beam with a clamed support at the end. [6]

b) The portal frame shown in figure below is subjected to the factored loads. Determine the plastic moment of resistance. Also draw the statically admissible bending moment diagram. [10]



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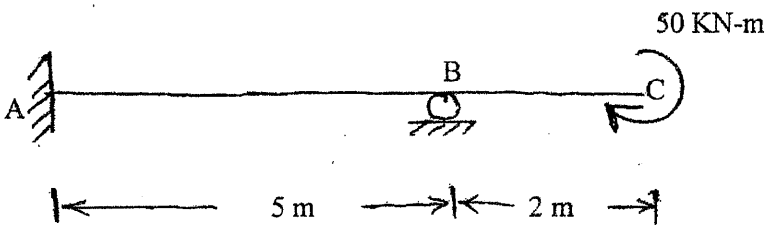
Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structure II *(CE601)*

- ✓ 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 degree of static indeterminacy and the degree of kinematic indeterminacy of a structural system with suitable expressions and examples. [5]

   b) Determine the moment at the fixed support of the following loaded beam using Castigliano's theorem. Take EI constant. [6]

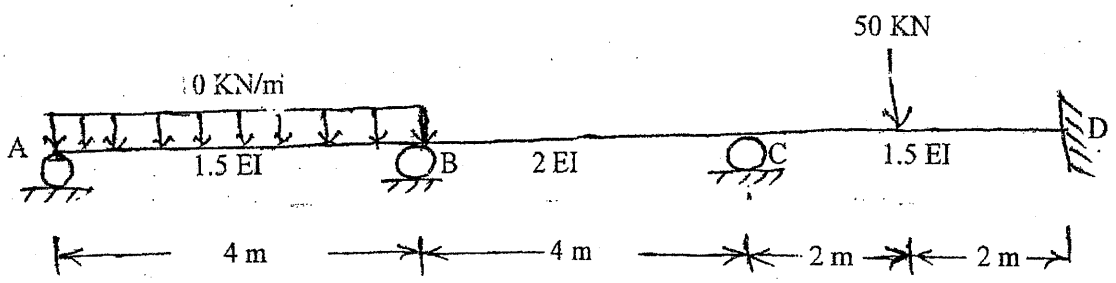


   c) Enuciate Mueller-Breslau principle of influence line and prove it with an example of a continuous beam. [5]

2. a) Explain the principle of moment distribution method with a simple example. [6]

   b) A portal frame of span 4 m and height 4 m is fixed at both supports. The beam of the frame carries a uniform distributed gravity load of intensity 30 KN/m. Use Force method to solve the frame considering the cross-sectional stiffness (EI) to be constant. Draw bending moment, shear force and normal thrust diagrams for the frame. [10]

3. a) Analyse the continuous beam loaded as shown in figure below and draw the bending moment diagrams using slope-deflection method. Support B sinks by 19 mm. [12]

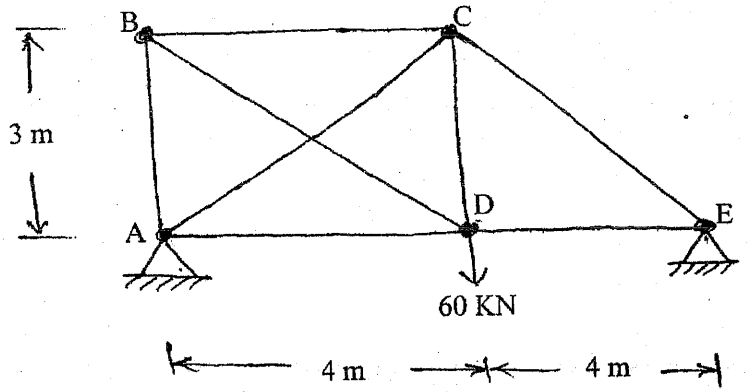


   Take EI = 10,000 KN-m^2

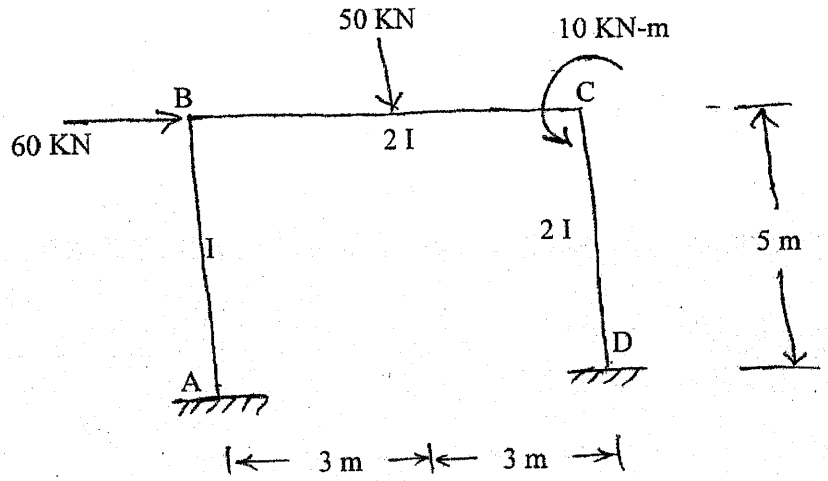
   b) Define plastic hinge. Also compare plastic and elastic hinges of a structural system. [4]

4. a) Define the term left and right focal point ratios. Also write their expressions. [4]

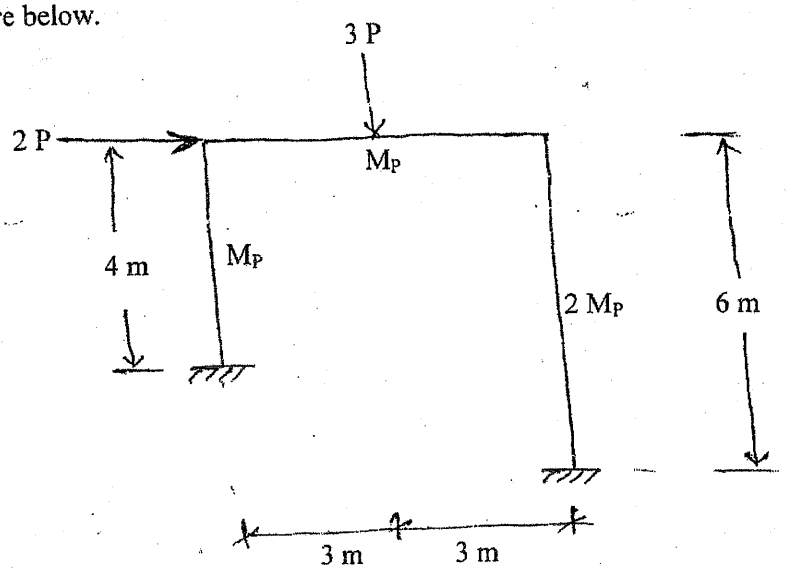
b) Analyse the truss shown in figure below using "Force Method". Take the cross-sectional stiffness EA of the members to be constant. [12]



5. a) Generate stiffness matrix the frame loaded as shown in figure below. Also determine the end moments considering stiffness equations of each member. [10]



b) Determine the collapse load, W_p, for the rectangular portal frame loaded as shown in figure below. [6]



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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

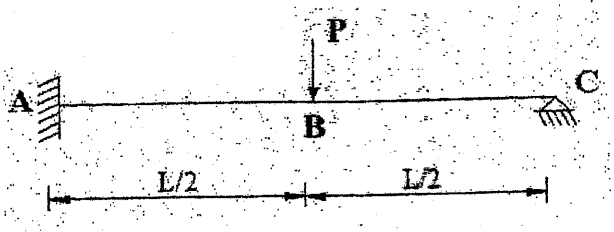
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structure II *(CE601)*

- ✓ 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.*

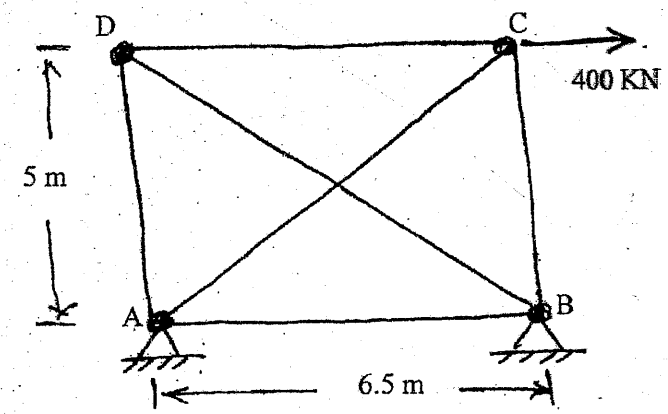
1. a) Draw influence diagram for vertical reaction at fixed support of a propped cantilever beam. Plot ordinates at 0.25 times span length. [4]

   b) Using Castigliano's theorem, find the deflection at point B of the beam shown in figure below. Take constant EI through the length. [12]



2. a) State and proof Maxwell's Reciprocal theorem. [4]

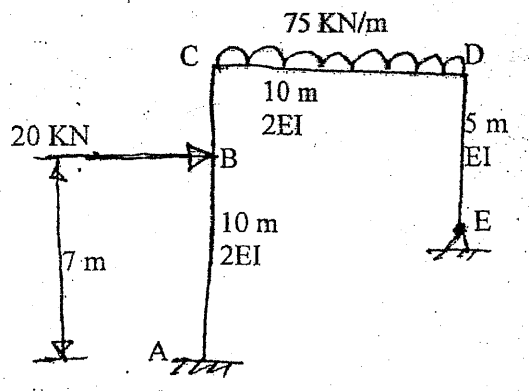
   b) Determine the bar forces and reactions that develop in the statically inderminate truss shown in figure below. [12]



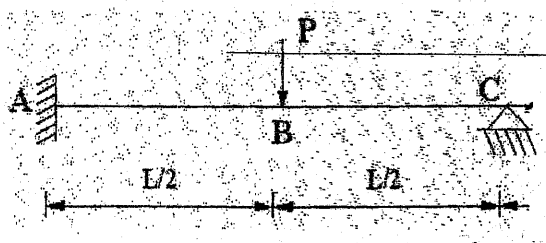
-Cross sectional Area:
Member BD = 20 cm^2
Other members = 15 cm^2
-Young's modulus = 240×10^6 KN/m^2

3. a) Define plastic moment and shape factor. [3]

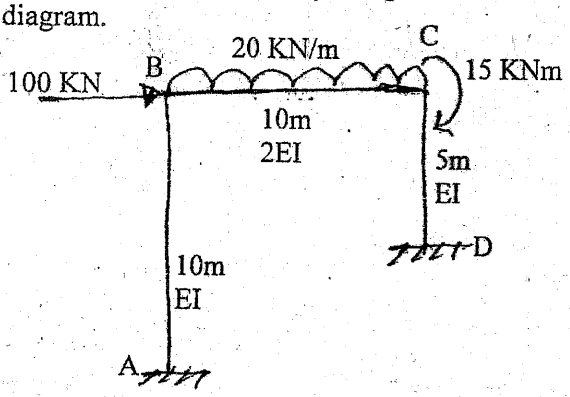
   b) Determine the reactions at support E and A and draw bending moment diagram of the frame shown in figure below by using flexibility matrix method (force method) [13]



4. a) A propped cantilever beam of uniform Mp is loaded as shown in the figure below. Find the collapse load. [4]

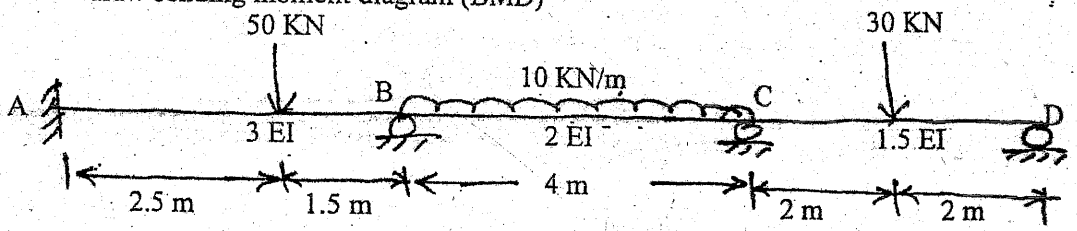


b) Analyse the frame shown in figure below by using stiffness matrix method and draw bending moment diagram. [12]



5. a) Define plastic hinge and explain how its length is determined. [4]

b) Analysis the beam loaded shown in the figure below by slope deflection method. Also draw bending moment diagram (BMD) [12]



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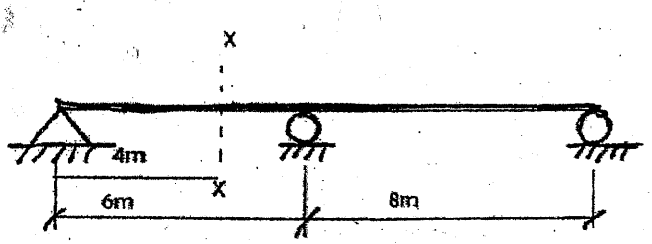
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

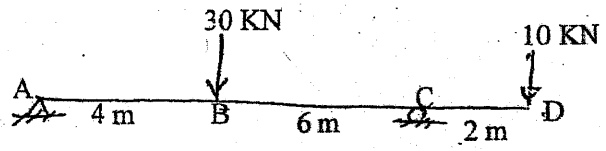
Subject: - Theory of Structure II *(CE601)*

- ✓ 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) Draw influence line diagram for moment at section x-x of the continuous beam shown in figure below. Find the ordinates at 2 m intervals. [5]

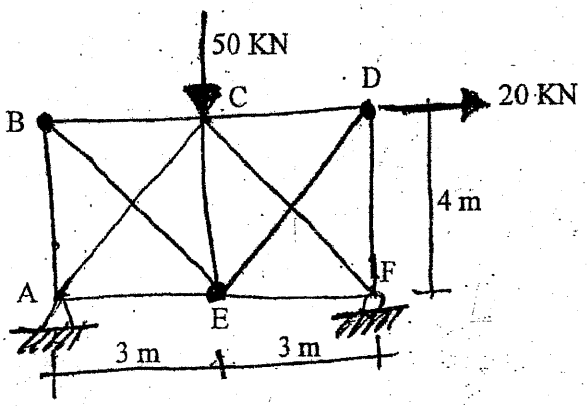


b) Determine slope at A and deflections at D of the beam shown in figure below using castigliano's theorem. [10]



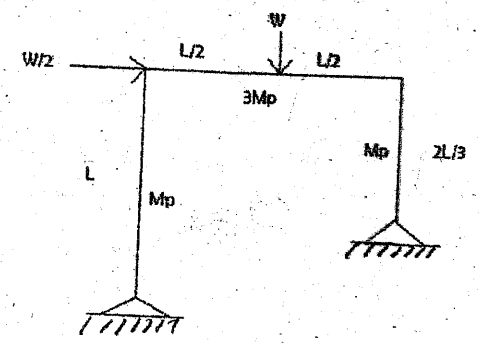
2. a) Define and explain the following terms: [5]
   i) Primary structure
   ii) Redundant force
   iii) Flexibility coefficient
   iv) Stiffness coefficient
   v) Kinematic indeterminacy

b) Determine the forces in all members of the truss shown in figure below using force method. [12]



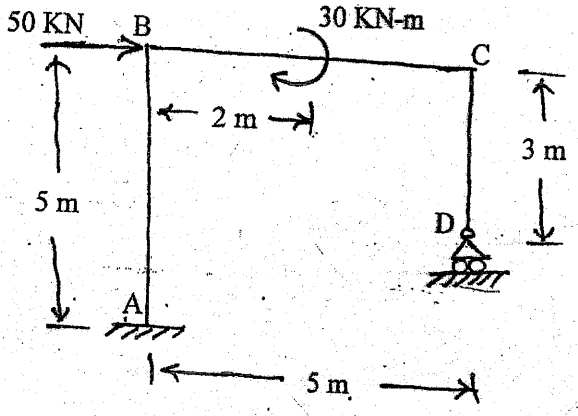
AE is constant for all members

3. a) Find the collapse load for portal frame shown in figure below. [10]

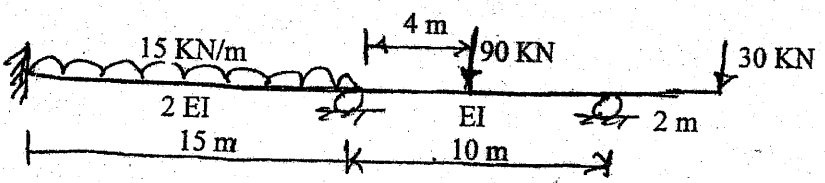


b) Derive the expression of three moment theorem for continuous beam and explain its physical meaning. [6]

4. a) Using flexibility matrix method, determine the reactions at support D of the frame loaded as shown in figure below. Also draw SFD and BMD. Take EI = constant. [7]

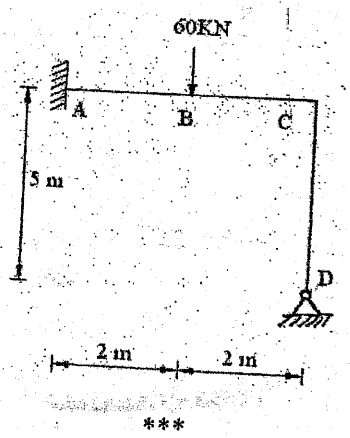


b) Analyse the continuous beam shown in figure below using slope deflection method. [10]



5. a) Derive the slope deflection equations. [5]

b) Using stiffness matrix method, draw bending moment diagram for the frame shown in figure below. Take constant EI. [10]



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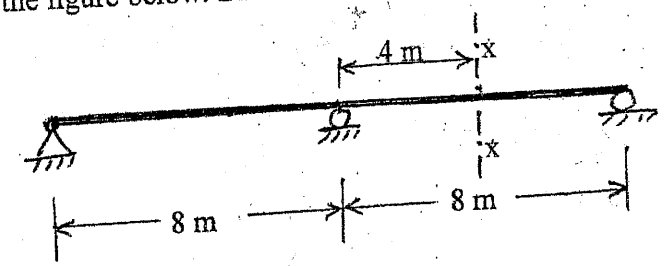
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

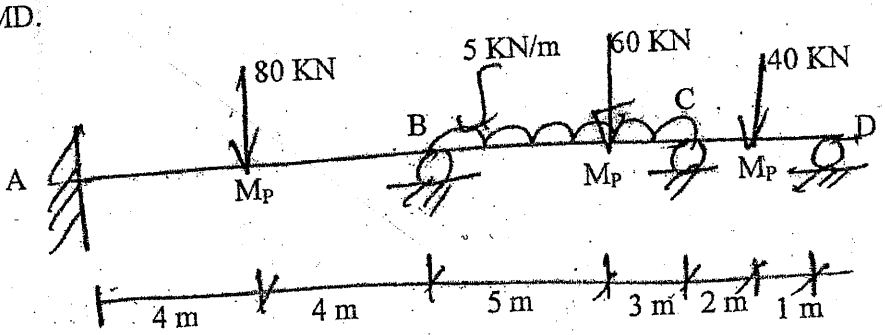
Subject: - Theory of Structure II *(CE601)*

- ✓ 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.*

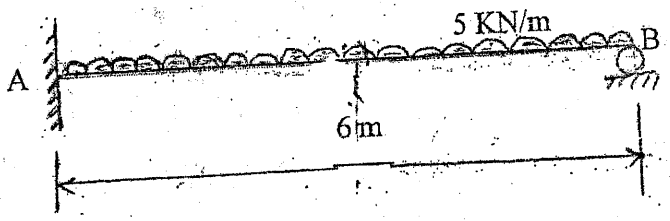
1. a) Draw influence line diagram for shear at the section x-x for the two-span continuous beam shown in the figure below. Draw the ordinate at 2 m interval. [6]



b) A prismatic continuous beam ABCD is fixed at A and simply supported at B, C and D. It is subjected to factored loads as shown. Find the collapse mechanisms and draw BMD. [10]

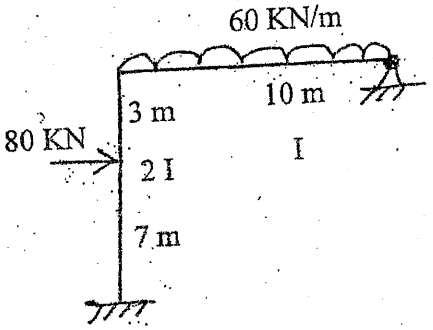


2. a) Using Castigliano's theorem, determine the moment at the fixed support A of the propped cantilever beam loaded as shown in figure below. [6]

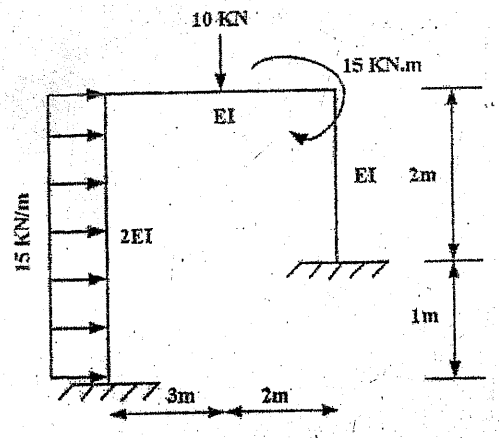


$E = 232\ kN/mm^2$
$I = 112.5 \times 10^6\ mm^4$

b) Analyse the frame shown in figure below by using force method and draw bending moment diagram. [10]

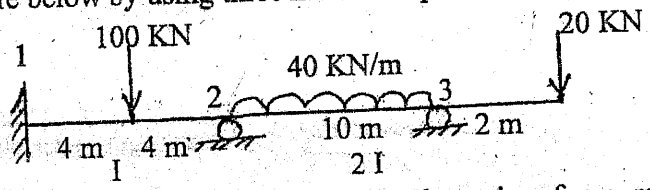


3. a) Analyse the frame shown in figure using stiffness matrix method. Consider only flexural deformations. [10]

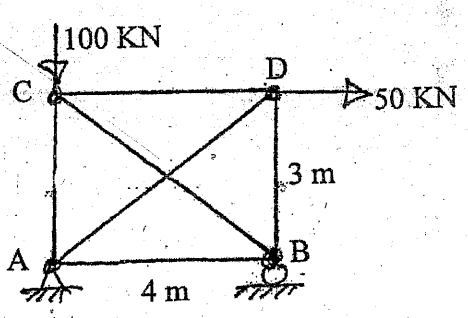


b) List the differences between force and displacement methods. Draw a neat sketch of a system and explain. [6]

4. a) Determine the support moments and draw bending moment diagram of the continuous beam shown in figure below by using three moment equation. [7]

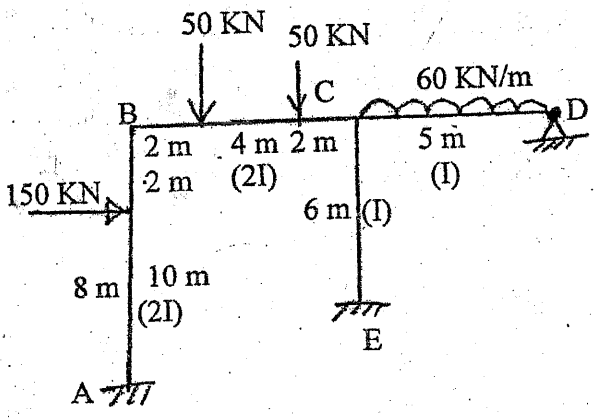


c) Determine the forces in all members of the truss by using force method. AE is constant for all members. [7]



b) Write down the boundary conditions for a single span beam fixed at both ends. [2]

5. Analyse the frame shown in figure below by using moment distribution method. [15]



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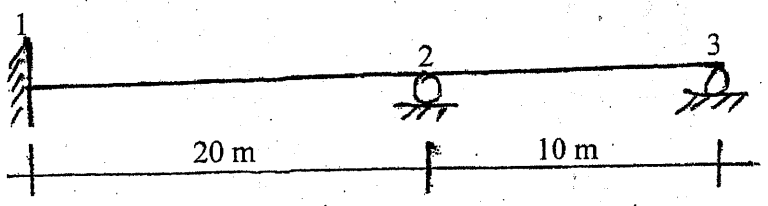
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

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

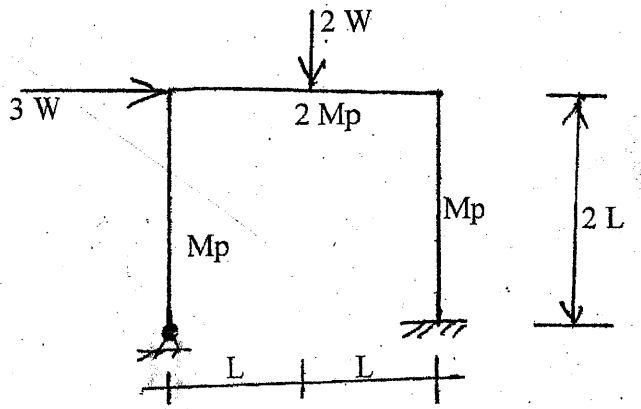
Subject: - Theory of Structure II *(CE601)*

- ✓ 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.*

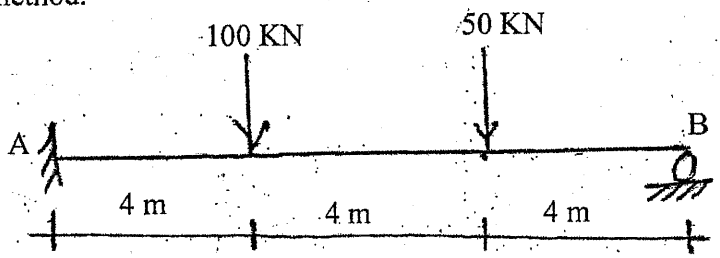
1. a) Draw influence line diagram for moment at support 2 of the continuous beam shown in figure below by using focal point method. Find ordinates at 4 m interval, in span 1-2 and at 2m interval on span 2-3 [6]



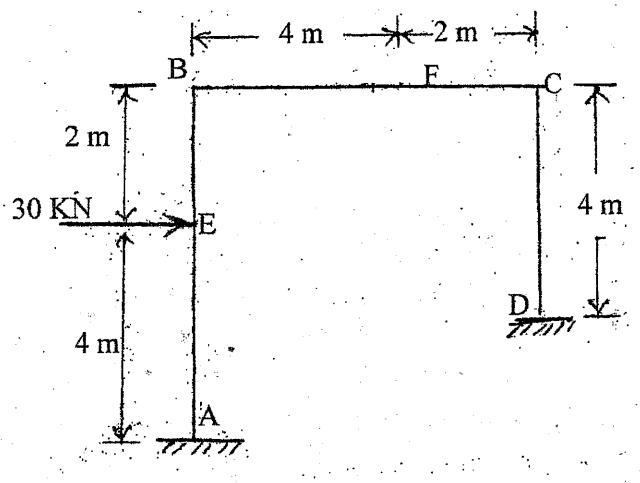
b) Find the collapse load for portal frame shown in figure below. [10]



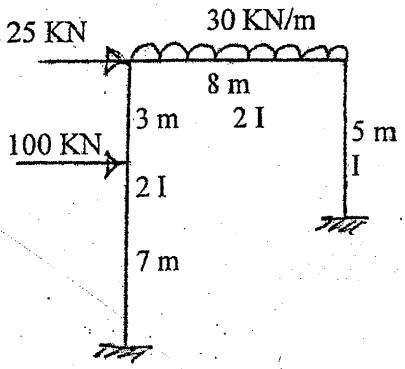
2. a) Determine the moment at fixed support of the propped cantilever beam using Castigliano's method. [6]



b) Generate flexibility matrix to determine the reactions at support D for the frame loaded shown in the figure below. Also determine the reactions at support D and draw bending moment diagram. Show all the steps. [10]

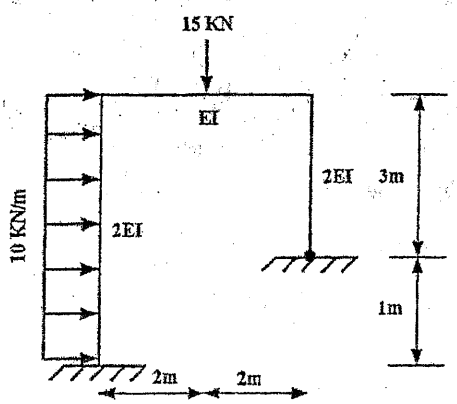


3. a) Analyse the frame shown in figure below by using stiffness matrix method and draw bending moment diagram. [10]



b) List the properties of stiffness and flexibility matrices for a given system. Draw a neat sketch of a system and explain. [6]

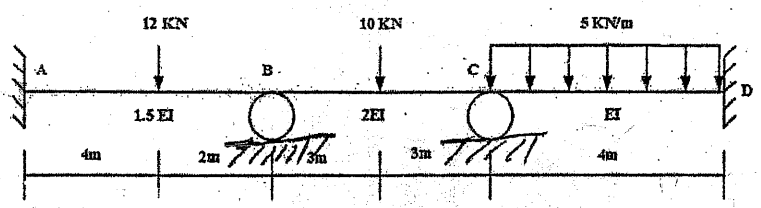
4. a) Using the consistent deformation method analyse the frame shown in figure and draw bending moment, shear force and normal thrust diagram. [15]



b) Draw a propped cantilever and write down its boundary conditions. [2]

5. A continuous beam is shown in figure support 'B' sinks by 10mm down and 'C' rises by 20 mm up during loads. Analyse the given beam using slope deflection method and also draw bending moment diagram and show deflected shape. [15]

$E = 200 * 10^6 \, KN/m^2$ and $I = 80 * 10^{-6} \, m^4$



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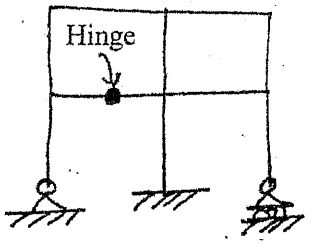
01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

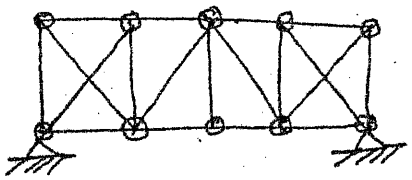
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structure II *(CE601)*

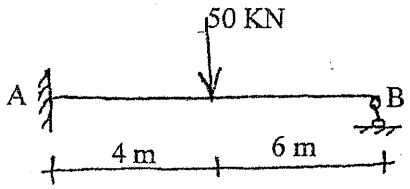
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Obtain the degree of static and kinematic indeterminacies for the given structures. [3+2]

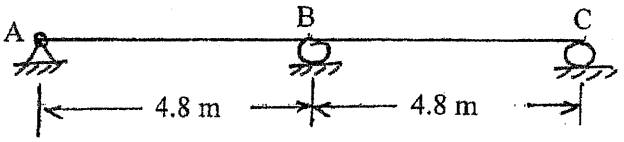




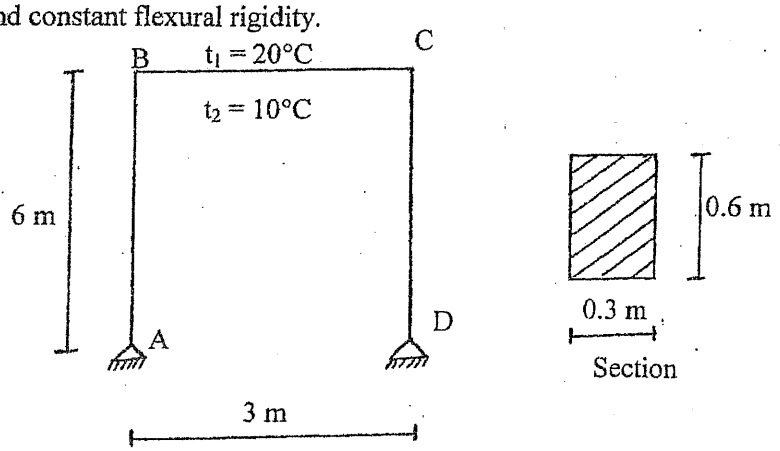
b) Determine reaction at B of the propped cantilever beam shown in figure below using Castigliano's theorem. Also draw bending moment diagram. [10]



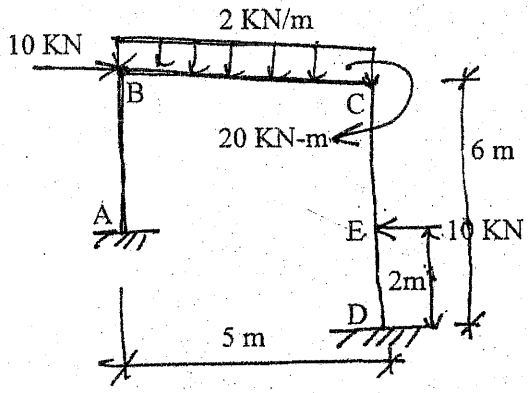
2. a) Explain why flexibility method is called a Force Method. using Force method determine the reactions in the continuous beam shown in figure below, if support B settles 18 mm and support C settles 12 mm. Given EI is constant. E = 232 KN/mm^2, and I = 112.5×10^{6}mm^4. [3+7]



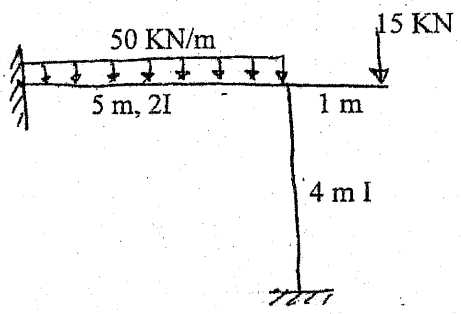
b) Explain the physical meaning of compatibility condition and derive the equation for it. A portal frame with hinged supports is subjected to a temperature variation as shown in figure below. Determine flexibility coefficients and calculate redundant force with the help of compatibility equation. Take $\alpha = 11\times 10^{-6}/°C$, $E = 5000\sqrt{f_{ck}}$, $f_{ck} = 20$ MPa and constant flexural rigidity. [15]



3. a) Generate stiffness matrix for the frame given below. Use the stiffness matrix generated to draw bending moment diagram. Take EI as constant for all members. [15]

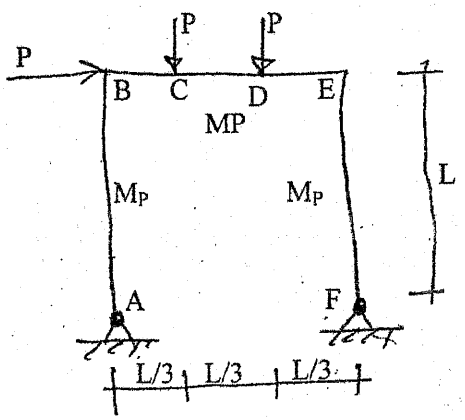


b) Analyse the frame shown in figure below by using moment distribution method. Draw bending moment diagram. [10]



4. a) Explain influence line diagram as system specific diagram. Derive the expression of recurrent formula for focal point ratio considering two consecutive spans for loading on right spans. [5]

b) For the given portal frame with same plastic moment capacity Mp for all members calculate the value of P at collapse. [10]



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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

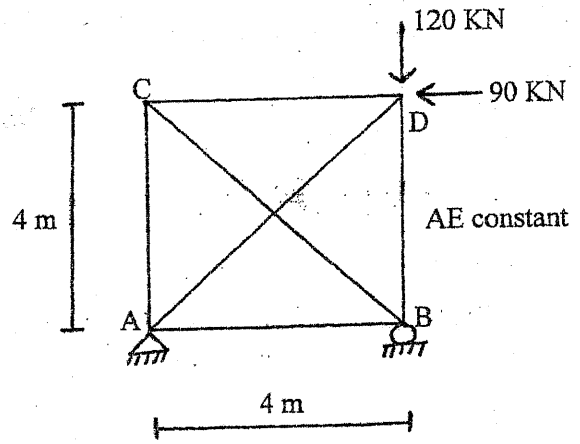
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structure II *(CE601)*

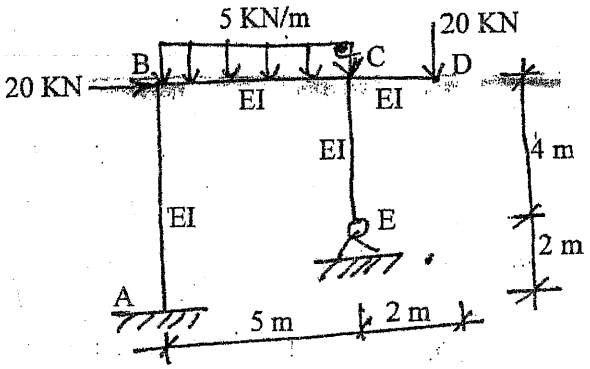
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Describe different types of indeterminacies of the structural system and their physical meanings. [5]

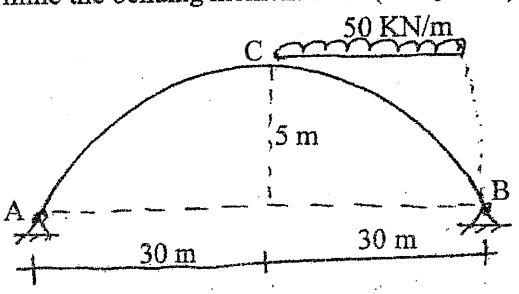
   b) Use castigliano's theorem to determine forces induced in each members of the square truss loaded as shown below. [10]



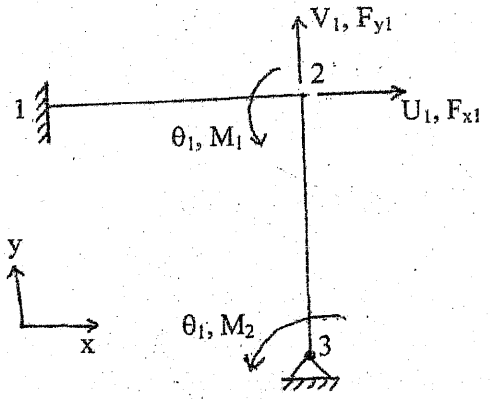
2. a) Draw shear force and bending moment diagrams for the frame given below. Use force method. [15]



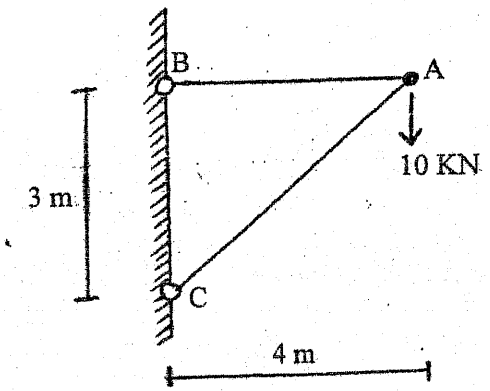
   b) Determine the horizontal reaction in the two hinged parabolic arch shown figure below. Also determine the bending moment at C. ($I = I_c \sec\theta$) [10]



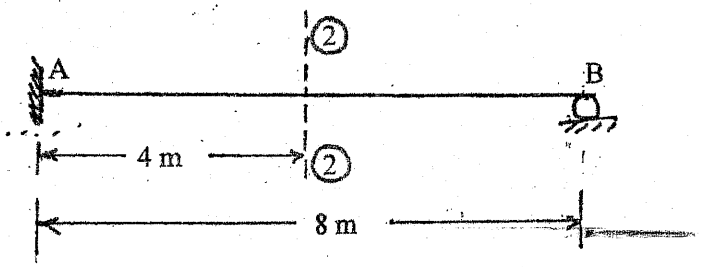
3. a) Describe with example the principle of moment distribution. For the frame shown in figure below generate stiffness matrix that operates on displacements u_1, v_1, $\theta_1$and θ_2. Both members are slender and have the same E, I, A and L. Express matrix coefficients in terms of L, a = AE/L and b = EI/L^3 [5+10]



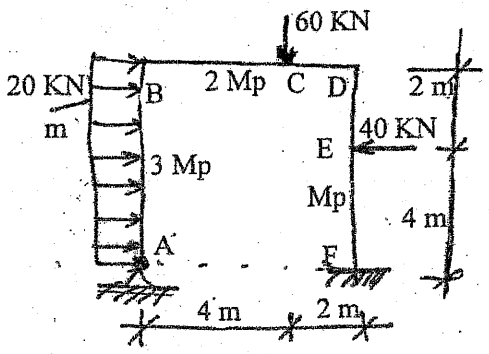
b) A jib-crane is carrying vertical load of 10KN at A as shown in figure below. Determine by matrix displacement method, the displacement of joint A and hence calculate the forces in members AB and AC. Take cross-sectional area of members AB and AC as 10000mm^2 and 20000mm^2 respectively and E = 200KN/mm^2. [10]



4. a) Draw influence line diagram for the shear at section 2-2 of the propped cantilever beam shown in figure below. Find the ordinates at 2 m interval. [5]



b) Find the plastic moment capacity of the frame shown figure below during collapse. [10]



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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2069 Chaitra

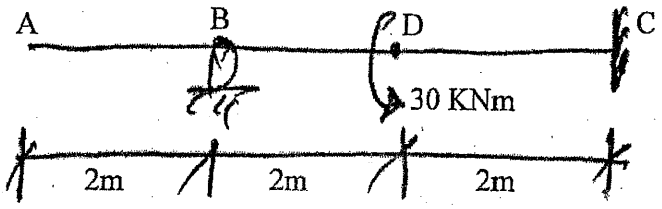
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structures II *(CE601)*

- ✓ 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.*

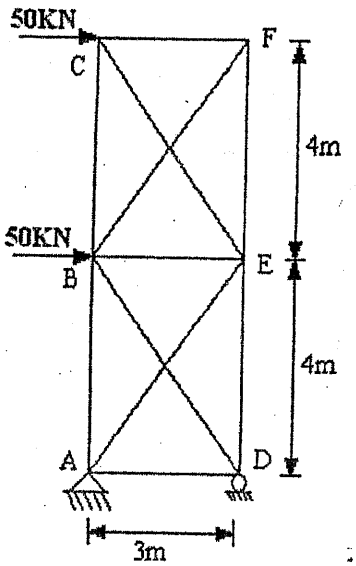
1. a) What is structural idealization? Explain necessary and sufficient condition for stability of a truss. [5]

   b) Use Castigliano's theorem to find moment at point C of the propped cantilever beam loaded as shown in the figure below. Take EI to be constant. [10]



2. a) Derive expressions for support moments of a single span fixed beam when one end of the beam rotates by an angle θ. Also determine the expressions for support moments of the same beam when one end of the beam settles down by Δ. Assume EI as the cross sectional stiffness and L the span. [7]

   b) Find out member forces in the truss shown in figure below using force method. The axial rigidity of all vertical and horizontal members in EA and that for all inclined member is 2EA. [18]



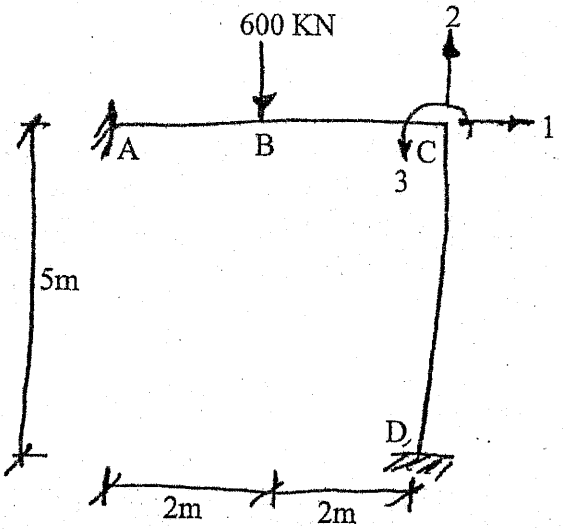
3. a) Derive three moment theorem for a continuous beam and explain its physical meaning. [7]

   b) Determine element stiffness matrices, deformations at joints and member forces. Also draw bending moment diagram, using stiffness matrix method. [18]

$E = 2\times10^5$ MPA

$A = 200$ cm^2

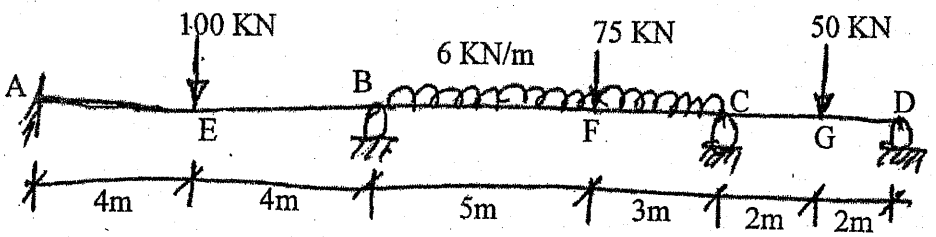
$I = 2.5\times10^5$ mm^4



4. Define and explain what is neutral point in an unloaded span of a continuous beam. Derive recurrent formula for its determination. [5]

5. a) Enunciate the two basic theorems on methods of limit in plastic analysis. [4]

   b) A prismatic continuous beam ABCD is fixed at A and simply supported at B, C and D. It is subjected to factored loads as shown in figure below. Find collapse mechanism and draw BM diagram. [6]



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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

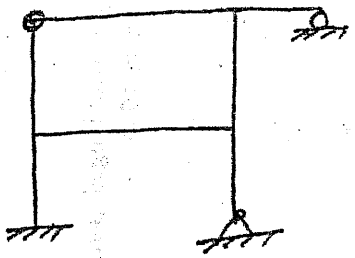
Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structures II *(CE601)*

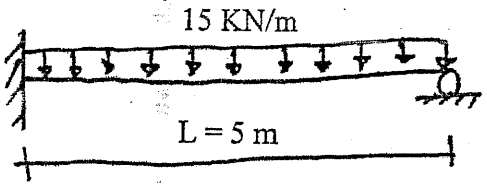
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Define degree of static and degree of kinematic indeterminacies with suitable examples. [4]

   b) Determine the external and internal degrees of static indeterminacy of the structure shown in figure below. Also determine the kinematic indeterminacy. [3+3]

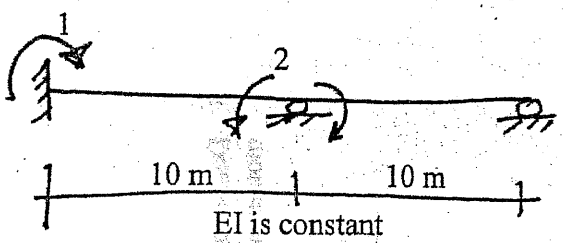


   c) Determine the moment at the fixed end of a propped cantilever beam shown in figure below using Castigliane's theorem. [5]

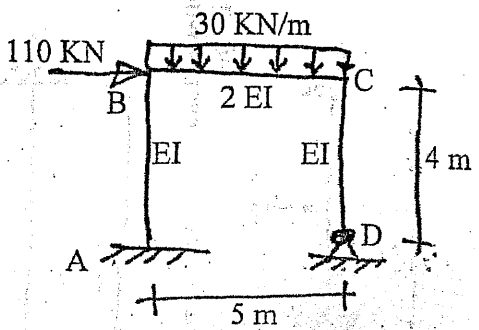


2. a) Define force method and primary structure. [4]

   b) Generate flexibility matrix for the coordinates shown in figure below. [6]

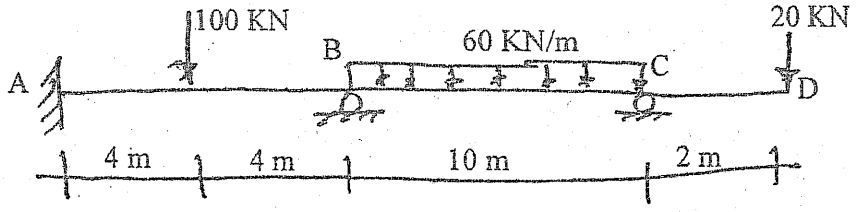


   c) Determine horizontal and vertical reactions at support D of the frame shown in figure below using force method. [10]



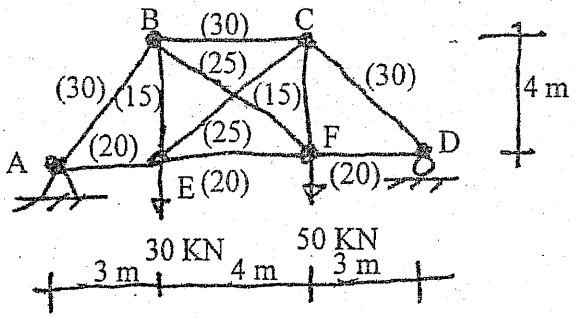
OR

Analyse the continuous beam shown in figure below by using three moment theorem.



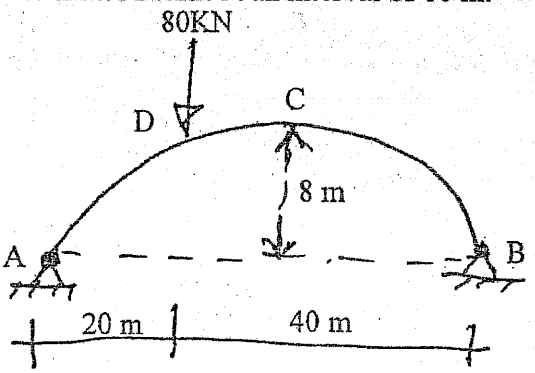
Draw shear force and bending moment diagram.

d) Determine the force in member BF of the redundant truss shown in figure below. Cross section areas of each member in cm^2 are given in figure within brackets. [5]

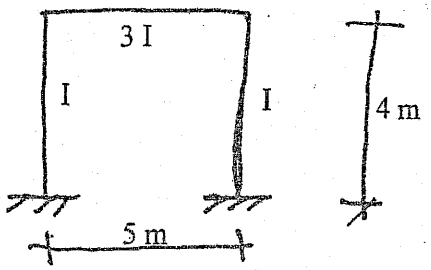


OR

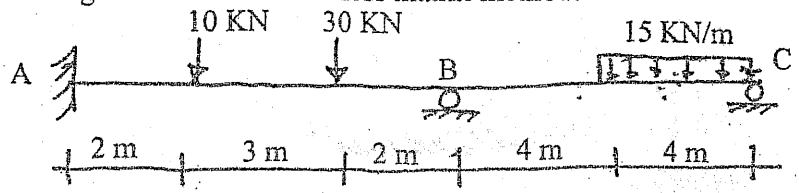
Draw bending moment (BM) diagram for the two hinged parabolic arch shown $I = I_C \text{Sec}\theta$. Calculate the BM value at an interval of 10 m.



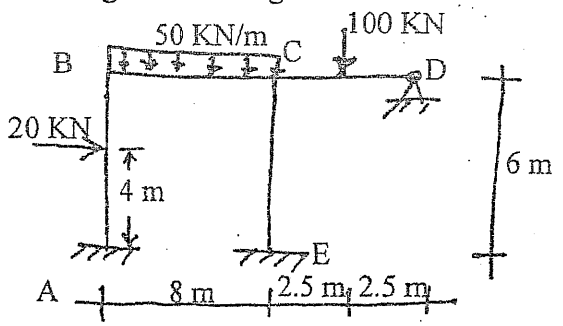
3. a) Generate stiffness matrix for the frame shown in figure below. [5]



b) Analyse the continuous beam and draw bending moment diagram which is loaded as shown in figure below. Use stiffness matrix method. [10]



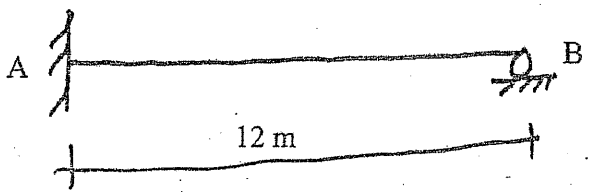
c) Use moment distribution method to analyse the frame loaded as shown in figure below. Also draw bending moment diagram. [10]



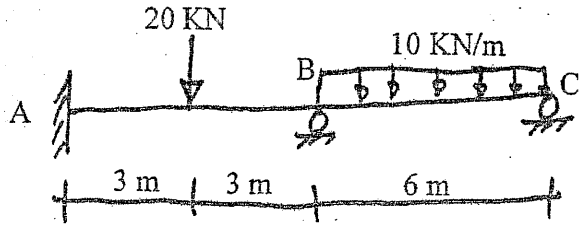
4. Define focal point ratio and derive expression to determine left focal point ratio. [7]

OR

Draw influence line diagram for reaction at support B of the propped cantilever beam shown in figure below. Determine ordinates at 3 m interval.



5. Determine the collapse load for the two span beam shown in figure below if the plastic moment capacity is MP. [8]



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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

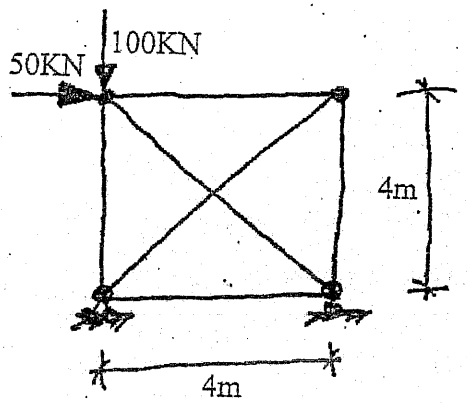
Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structure II *(CE 601)*

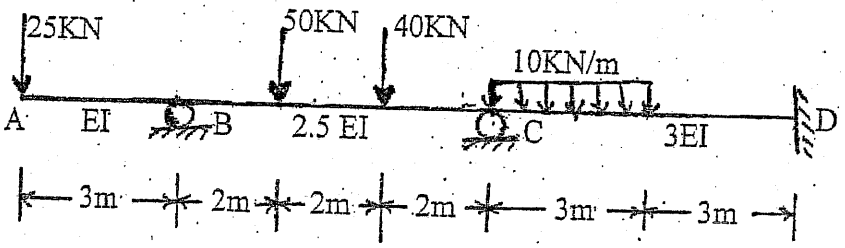
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Five questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Explain with a simple example the steps to follow in solving a frame using displacement method. [8]

   b) Use force method (flexibility matrix) to solve the truss as shown in figure below. [8]

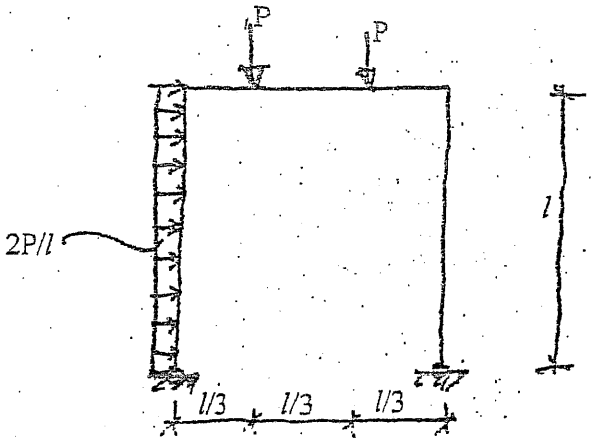


2. Analyse the beam shown in figure below by slope deflection method. Draw BM diagram considering given external loading and rotation of support D by (1/10) clockwise, support C settles down by 4mm. [16]

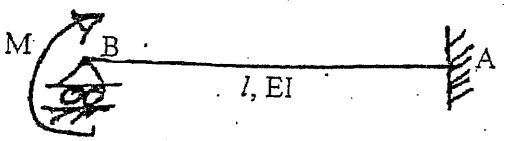


3. a) What is Muceller Breslau principle and how it is used to determine the shape of an influence line diagram of a structural quantity in a statically indeterminate beam? Shown in a simple example. [8]

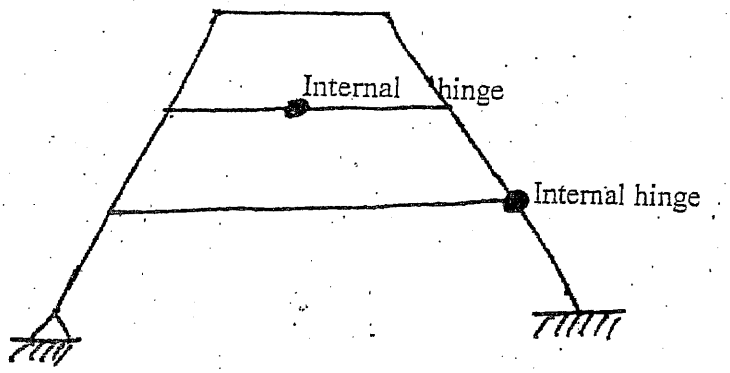
b) For the given portal frame with same plastic moment of resistance M_P for all the members, calculate the value of p at collapse. [8]



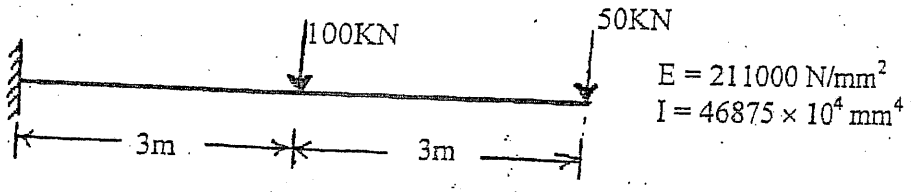
4. a) For the beam as shown, determine the slope at support B. Use Castiglano's second theorem. Take EI = constant. [5]



b) Determine the Static indeterminacy (eternal/internal) and kinematiz indeterminacy for the structure as shown. [3]

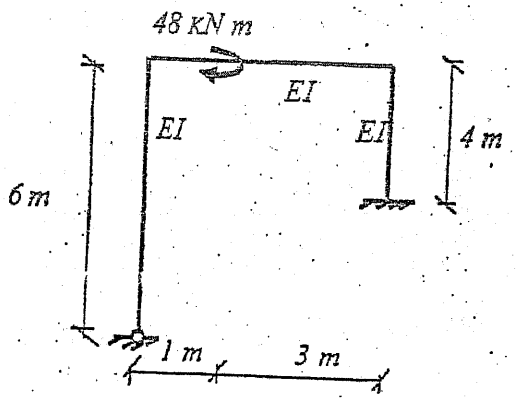


c) Using Castigliano's second theorem, determine the vertical deflection at the 50 KN load in the beam shown in figure below. [8]

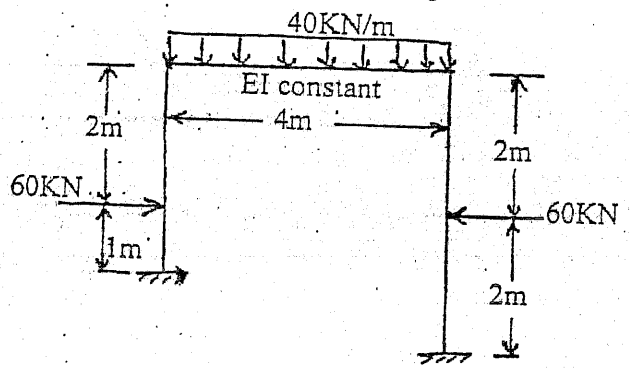


5. a) Enunciate and explain with its uses the two basic theorems on methods of limit analysis in plastic analysis for bending. [8]

b) Use force method (flexibility matrix) to solve the frame as shown in figure below. [8]



6. a) Determine Stiffness matrix for the frame shown in figure below. [8]



b) Draw ILD at 1m interval for support reaction at fixed end of propped cantilever beam of span 5m. Take EI is constant. [8]

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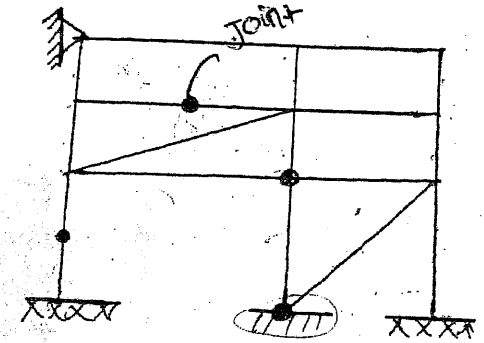
06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Baishakh

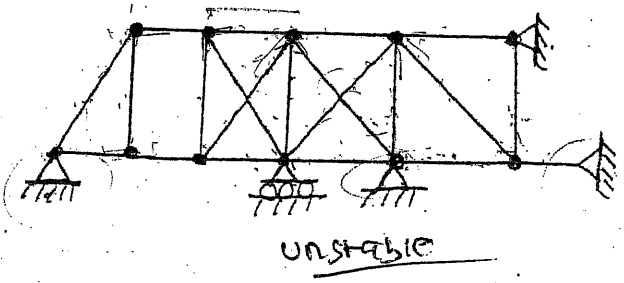
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structures II

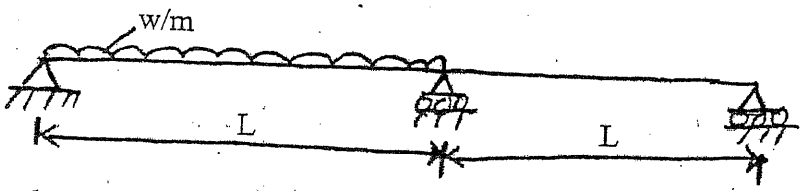
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Four** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Determine the external/internal static indeterminacy and kinematic indeterminacy of the structures shown in the figure below. Are they geometrically stable? [10]

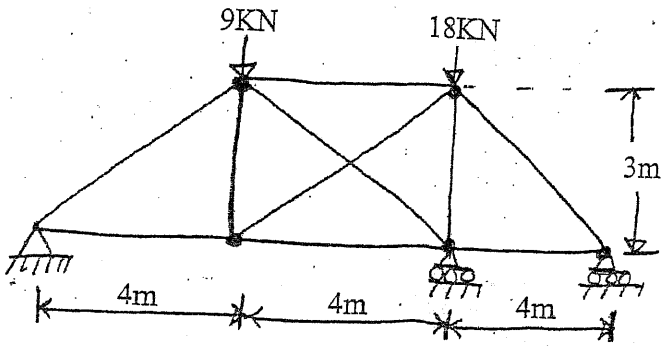




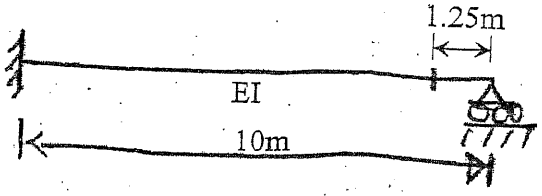
b) Find support reactions of the given loaded beam using Castigliano's theorem. [10]



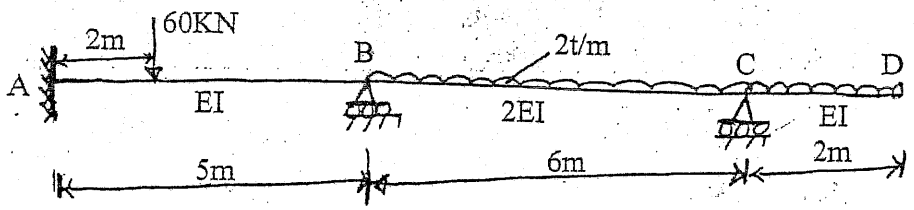
2. Compute the bar forces in all members due to: (i) Given load and (ii) temperature rise by 30°C in the upper chord. Take $E = 2 \times 10^5$ N/mm^2, $\propto = 10.8 \times 10^{-6}$/°C. Take area of all members to be 30cm^2. [12+8]



3. a) Draw influence line diagram for bending moment at fixed support of the beam and obtain ordinates at each 1.25m interval. [10]



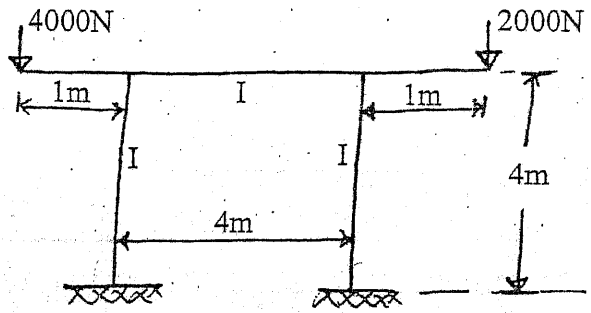
b) Using slope and deflection method, find support moments and draw bending moment diagram for the given beam. [10]



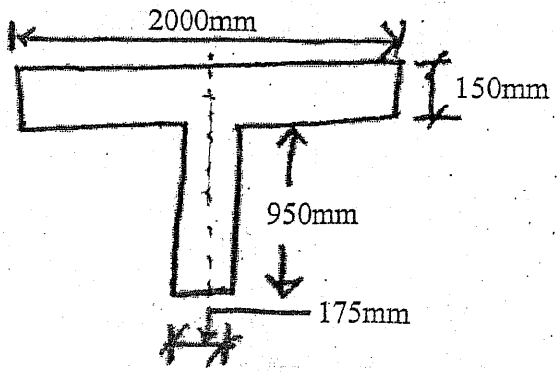
Support A sinks by 1cm
Support C sinks by 1.5cm

Take, $E = 2 \times 10^5$ MPa, $I = 10{,}000$ cm^4.

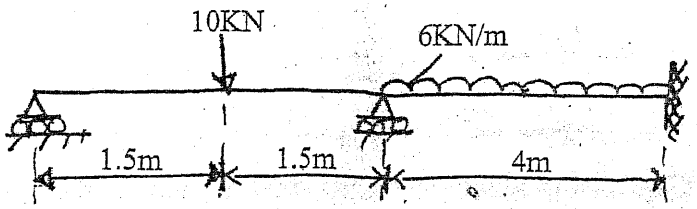
4. Draw axial force, shear force and bending moment diagram for the given loaded frame. Use moment distribution method. [20]



5. a) Define shape factor and write properties of plastic hinge. Find shape factor of the given T - beam section. [10]



b) Using stiffness matrix method, find support reactions and draw bending moment diagram for the given loaded continuous beam. [10]



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06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

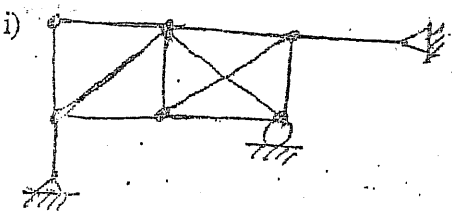
Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Theory of Structure II

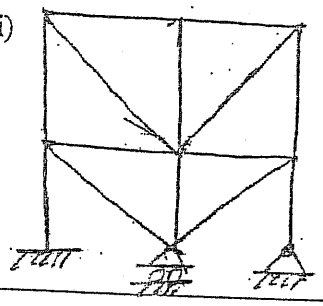
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Four questions.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Determine the external/internal static indeterminacy and kinematic indeterminacy of the structures shown in figure below. Are they stable or unstable? [5]

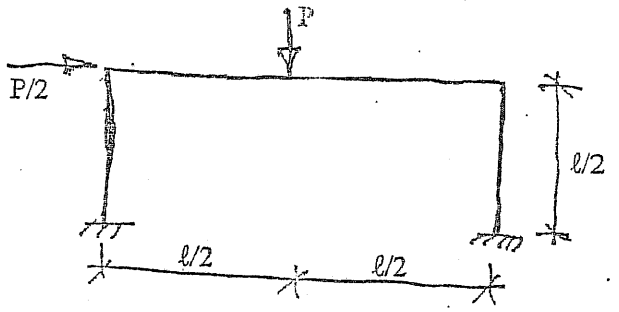
i)



ii)

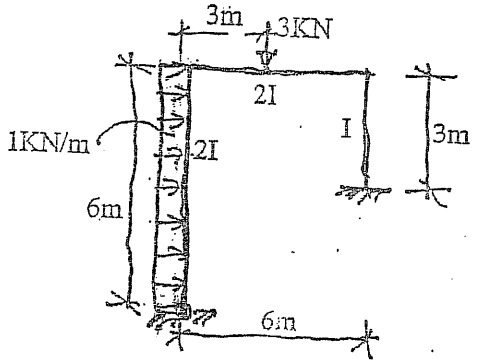


b) For the frame shown calculate collapse value of 'P' assuming M_P as the plastic moment of resistance for all the member. [15]



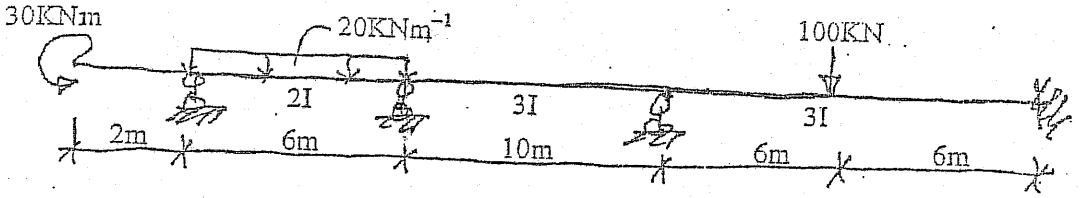
2. a) Explain Cartigliano's theorem for determination of displacement in a structural system and prove it. [5]

b) Use consistent deformation method to solve the frame and draw bending moment, shear force and normal thrust diagrams. [15]



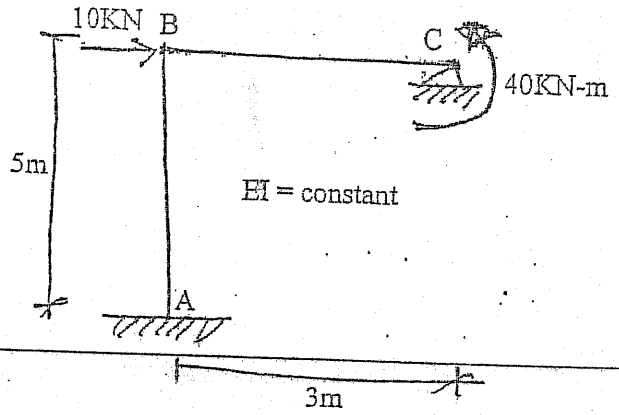
3. a) What is the consistent deformation method? Derive the formula. [5]

b) Use slope deflection method to draw bending moment and shear force diagrams of the beam. [15]



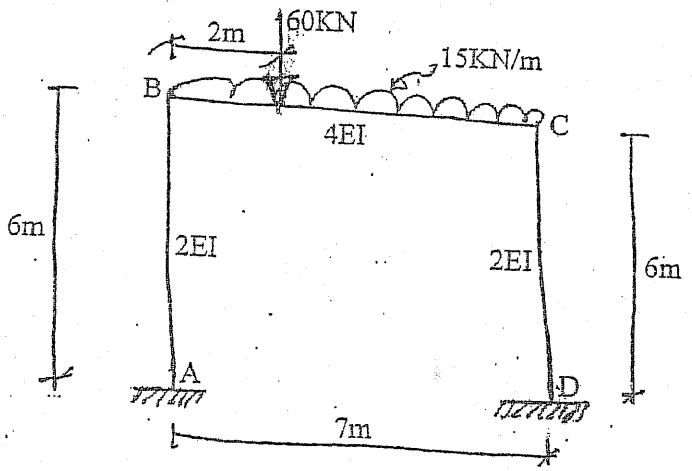
4. a) Explain about cases of symmetry and anti symmetry. [5]

b) Analyze the frame shown in figure using stiffness method (displacement method). Consider only flenural deformations and take EI as constant throughout. [15]



5. a) Explain Muller Breslau principle for influence line diagram and show in an example how it is applied. [5]

b) Analyze the frames shown in figure by moment distribution method. Also draw AFD, SFD, and BMD for the structure. [15]



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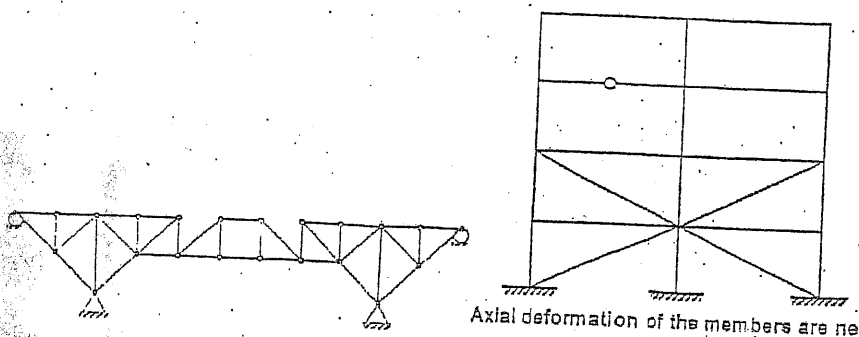
06 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Bhadra

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

Subject: - Theory of Structures II

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

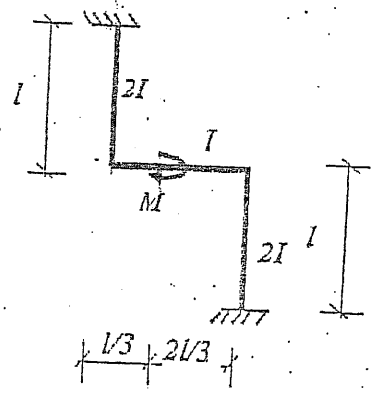
1. a) Compute Static Indeterminacy, Kinematic Indeterminacy and Stability of the structures shown in figure given below. [10]



Axial deformation of the members are neglected.

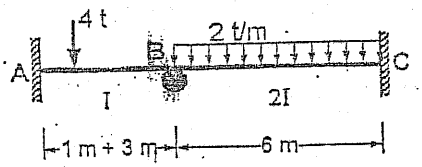
b) Compute the maximum central vertical deflection for a simply supported beam of span L loaded with a uniformly distributed load of w/unit length, EI is constant. Use Castigliano's theorem. [10]

2. a) Use consistent deformation method to draw bending moment diagram of the chair-frame loaded with a couple as shown. Take $E = 2 \times 10^4$ MPa, $\ell = 3$m, M = 50 kNm and $I = 4.5 \times 10^8 mm^4$. Also draw shear force and normal thrust diagrams corresponding to the bending moment diagram. [10]

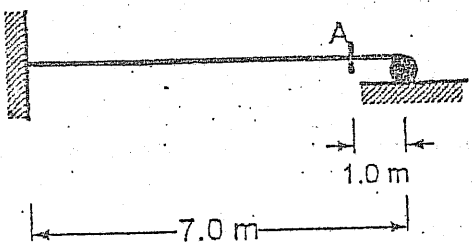


b) A rectangular horizontal truss of span 12m and height 9m is with two diagonals and is supported by two hinges fixed at the base. A horizontal force of magnitude 100 kN is acting toward the truss at the left top joint. The diagonal connecting the loaded joint was manufactured 2cm shorter than the assigned length. Calculate the forces induced in every member assuming Young's modulus and cross-sectional areas of the every member to be 2×10^5 MPa and $1000 mm^2$ respectively. [10]

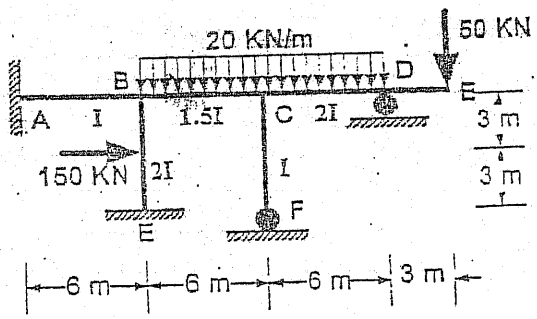
3. a) Determine the member end moments using slope deflection method and draw BMD and SFD for the beam loaded as shown in figure given below. Support B settles down by 5mm and Support C rotates clockwise by 0.02 radian and EI is 20 t/mm^2. [10]



b) Draw Influence Line Diagram for Shear Force at A of the propped cantilever beam shown below. Calculate ordinates at 1.0m interval. [10]

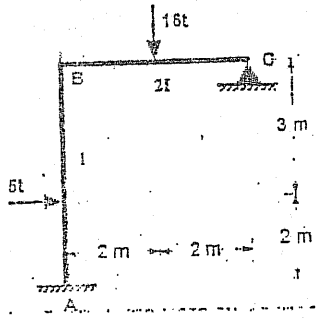


4. Analyze the frame loaded as shown in figure given below. Use Moment Distribution Method. Draw BMD and SFD. [20]



5. a) A single spanned fixed beam of length 9m has two concentrated forces applied vertically downwards at 3m distance from each ends. The left and right forces are 60kN and 120kN respectively. Calculate the section modulus required to render system into collapse condition, if the yield stress and load factor for the materials used are 250 MPa and 1.15 respectively. [10]

b) Analyze the frame given below with inextensible members using stiffness method. [10]



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BAM, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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. What are the importances of Numerical Methods in the field of science and engineering? [4]
2. Write an algorithm to find a real root of a non-linear equation using Bisection method. [6]
3. What are the limitations of Newton- Raphson method? Using this method, find the real root of the equation $\cos x - 3x + 1 = 0$, correct to four decimal places. [6]
4. Solve the following system of equations by LU factorization method. [8]

$$2x_1 + x_2 + 5x_3 = 25$$
$$x_1 - x_2 + 3x_3 = 13$$
$$x_2 - 2x_1 + 4x_3 = 13$$

5. Find the largest eigenvalue and corresponding eigen vector of the matrix $A = \begin{bmatrix} 2 & -2 & 4 \\ 2 & 3 & 2 \\ -1 & 1 & 1 \end{bmatrix}$ using power method. [8]
6. Fit a curve $y = ax^b$ to the following data: [8]

x	1	2	3	4	5
y	0.5	2	4.5	8	12.5

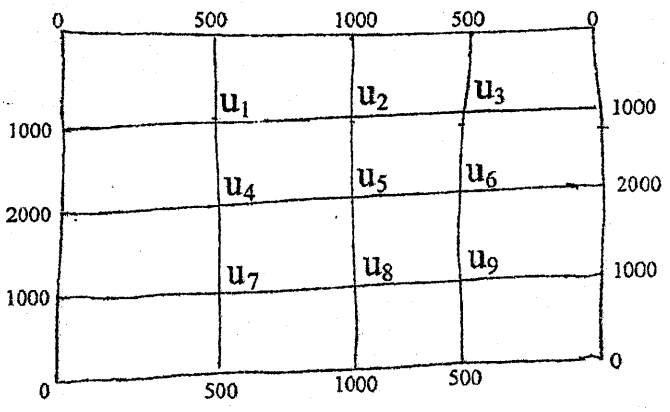
7. Estimate y(4) using cubic spline interpolation technique from the following data. [8]

x	3	5	7	9	11
y	6	9	12	9	6

8. Evaluate $\int_{-1}^{2} e^{-x^2} dx$ using Gaussion 3 – point formula. [4]
9. Derive the general Newton-cotes quadrature formula and use it to obtain simpson's 1/3 formula. [6]
10. Write a pseudo – code to solve first order differential equation using RK-4 method. [4]
11. Solve the following boundary value problem using finite difference method by dividing the interval into four sub intervals. [8]

$$y'' + 3y' - y = \cos x \quad y(0) = 2 \text{ and } y(2) = 3$$

12. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with the boundary values as shown. [10]



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BAM, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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. Discuss the advantages and limitations in solving mathematical problems by numerical techniques rather than analytically. [4]

2. Find a negative real root of the following equation correctto three decimals using Bisection Mehod. [6]

$$\frac{1-(x+1)^4}{x}-1=0$$

3. What are limitations of Newton-Raphson method? Using Newton-Raphson method, find a root of the equation xsinx – cosx = 0 correct to four decimal places. [2+4]

4. Solve the following system of linear equation, using Gauss-Elimination method with partial pivoting technique. [8]
$x_1-3x_2+8x_3=3$
$5x_1+x_2+2x_3=9$
$x_1+7x_2-x_3=14$

5. Obtain the dominant eigen value and its corresponding eigen vector of the following matrix using Power method. [8]

$$\begin{bmatrix} 1 & 4 & 4 \\ 4 & 1 & 8 \\ 4 & 8 & 1 \end{bmatrix}$$

6. Using the Method of Least Squares, fit the following set of data to a curve of the form $y = a \log_e x + b$. [8]

x	0.5	1.0	1.5	2	2.5	3
y	3.7	5.3	5.8	6.6	6.9	7.5

7. Using the cubic spline technique, estimate f(4) from the following data: [8]

x	1	3	5	7	9
f(x)	1.5	-0.4	-6.9	6.1	6.4

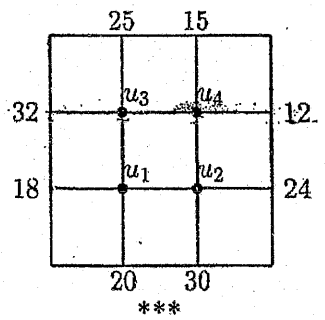
8. Derive composite Simpson's 3/8 formula for integration. [4]

9. Use Romberg's method to compute $\int_0^1 \frac{1}{1+x^2}dx$ correct to three decimal places. [6]

10. Using Euler's method, solve $\frac{dy}{dx}=\frac{y+x}{y-x}$, with y=1 at x=0, for x=0.1, h=0.02. [6]

11. Solve the following boundary value problem using Finite Difference Method taking a step-size of 0.5. $y''+2y'+y=3x^2$ subject to boundary conditions $y(0) = 5$ and $y(2)=4$. [8]

12. Solve the Laplace equation $u_{xx}+ u_{yy}=0$ for the square mesh with boundary conditions as shown in the figure attached. [8]



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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BAM, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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. Using finite difference table, show that the following data satisfies a cubic polynomial. [4]

x	0	1	2	3	4
y	-8	0	26	88	204

2. Write an algorithm/pseudo-code to find a real root of a non-linear equation using Bisection method. [6]
3. Find a real root of the equation $3x+\sin(x)-e^x=0$ correct to 3 decimals using False Position (Regular-Falsi) method. [6]
4. Compute the inverse of the following matrix using the Gauss-Jordan Method. [8]
$$\begin{bmatrix} 9 & 9 & 8 \\ 7 & 8 & 7 \\ 6 & 8 & 8 \end{bmatrix}$$
5. Find the largest Eigen value and corresponding Eigen vector of the matrix $\begin{bmatrix} 1 & 4 & 4 \\ 4 & 1 & 8 \\ 4 & 8 & 1 \end{bmatrix}$ using power method. [8]
6. Using the Least Squares Method, fit a second-order polynomial $y = ax^2 + bx + c$ to the following set of data: [8]

x	1.0	1.50	2.0	2.5
y	0.75	1.25	1.45	1.25

7. Interpolate y(24) from the following data using natural cubic spline. [8]

x	10	15	20	25	30
y	22	31	28	25	26

8. Using Gauss-Legendre 3-point formula, evaluate: $\int_1^3 (x\sin x + \log_e x)dx$ [6]
9. A rod is rotating in a plane. The following table gives the angle θ (radian) through which the rod has turned for various of time t seconds. [4]

t	1.0	1.2	1.4	1.6	1.8	1.9	2.0
θ	2.10	2.31	2.52	2.85	3.24	3.95	4.31

Calculate the angular velocity of the rod when t=1.1 sec.

10. Write the pseudo-code for solving a 1st order ordinary differential equation using Runge-Kutta 4th order method. [6]
11. Solve the differential equation $y'' + xy' - y = x$; $y(0) = 1$; $y(1) = 0$ using finite difference method by dividing four sub-intervals. [8]
12. Solve $U_{xx}+U_{yy}=0$ for the square mesh bounded by $0 \le x \le 4$; $0 \le y \le 4$ and the boundary conditions $u(0,y)=150$, $u(4,y) = 150$, $u(x,0) = 100$, $u(x,4) = 100$; $0 < x < 4$; $0 \le y \le 4$. Find the values of u(i,j), i= 1, 2, 3 correct to 3 places of decimals. [8]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BAME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Define error and write its different types with examples. If x = 1.350253 is rounded off to Four significant digits, find absolute and relative errors. [4]
2. Write an algorithm to find a real root of a non linear equation using secant method. [6]
3. What are limitations of Newton-Raphson method? Using Newton-Raphson method, find a root of equation
   $x\sin x + \cos x = 0$ which is near to $x = \pi$. [2+4]
4. Solve the following system of linear equation using Gauss-Seidal method, correct to 3 decimal places. [8]

$$2x_1 + 6x_3 - 3x_4 = 31$$
$$6x_1 + 2x_4 = 14$$
$$-3x_1 + 5x_2 = 9$$
$$2x_1 + x_2 - 5x_3 + 9x_4 = -9$$

5. Obtain the dominant eigen value and its corresponding eigen vector of following matrix using Power Method. [8]

$$\begin{bmatrix} 1 & 4 & 4 \\ 4 & 1 & 8 \\ 4 & 8 & 1 \end{bmatrix}$$

6. Fit the curve of the form $y = a \log_e x + b$ to the following data sets. [8]

x	2	3	4	5	6	7
y	5.45	6.26	6.84	7.29	7.66	7.96

7. Approximate y(2) and y(10) using appropriate interpolation formula from the following data: [8]

x	3	4	5	6	7	8	9
y	4.8	8.4	14.5	23.6	36.2	52.8	73.9

8. Derive Newton-Cotes general quadrature formula for integration and use it to obtain Simpson's $\frac{1}{3}$ rule of integration. [6]
9. Evaluate $\int_0^1 \frac{\tan^{-1} x}{x}$ using Gaussian 3 point formula. [4]
10. Solve the following boundary value problem using shooting method [10]
    $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = e^x$, with y(1) = 1 and y(2) = 5; Taking h = 0.25
11. Write a pseudo-code to solve an initial value problem of first order using Runge - Kutta 4 method. [4]
12. Derive recurrence formula for solving one dimensional heat equation $U_t = c^2 U_{xx}$. Using it solve the heat equation $U_t = 0.5\ U_{xx}$, $0 \le x \le 5$, $0 \le t \le 4$ with boundary conditions $U(x, 0) = xe^x (5 - x)$, $U(0, t) = 0$ and $U(5, t) = 0$; taking h = 1. [4+4]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2075 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BAME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Explain the importance of Numerical Methods in the field of Science and Engineering. [4]
2. Write a pseudo-code to find a real root of a non-linear equation using False Position method. [6]
3. Find a positive root of the equation $x^2 \sin x - e^x + 2 = 0$ correct to 3 decimals using Bisection method. [6]
4. Using L-U method solve, the following system of equations [8]

$$2x + 3y + z = 1$$
$$6x - 3y + 4z = 17$$
$$5x + 7y + 6z = 10$$

5. Determine the dominant eigen value and corresponding vector of the following matrix using the power method: [8]

$$\begin{bmatrix} 2 & 6 & 3 \\ 6 & 5 & 4 \\ 3 & 4 & 9 \end{bmatrix}$$

6. Fit the following set of data to a curve of the form $y = ae^{bx}$. [8]

x	2	3	4	5	6	7
y	15.1	10.2	7.8	5.5	3.8	1.7

7. Using the Cubic Spline interpolation technique, estimate the value of y(4) from the following data: [8]

x	1	3	5	7
y	1.56	-0.43	-16.90	6.10

8. Derive an expression to evaluate first derivative from Newton's backward interpolation formula and evaluate $\frac{dy}{dx}$ at x = 8 from the following table. [3+3]

x	0	2	4	6	8
y	0	-0.7553	-11.2151	34.2867	-8.3226

9. Use Simpson's $\frac{1}{3}$ – rule to evaluate $\int_0^6 \frac{2x^2+5}{1+x} dx$, taking n = 6 and also find the absolute error with exact value. [3+1]

10. Write a pseudo-code to solve an initial value problem of first order differential equation using Runge-Kutta 2 method. [4]

11. Using Fourth-order Runge Kutta method, solve the following differential equation for y at x = 0.2 and r = 0.4;

$$y'' - xy'^2 + y^2 = 0, \quad y(0) = 1, \quad y'(0) = 0$$ [8]

12. Solve Poisson's equation $Uxx + Uyy = 243(x^3 + y^3)$ over the square domain $0 \le x \le 1$, $0 \le y \le 1$ with step size $h = 1/3$ with u = 100 on the boundary. [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. What are the applications of Numerical methods in the field of science and engineering? Discuss briefly. [4]
2. Find a real root of $e^x - \cos x = 3$ correct to three places of decimal using the Bisection method. [6]
3. What are the drawbacks of Newton-Raphson method? Discuss. [6]
4. Solve the following system of linear equations using LU factorization method. [8]

$$x_1 + 2x_2 - x_3 = 2$$
$$x_1 - 3x_2 + 2x_3 = 1$$
$$2x_1 + 4x_2 + 3x_3 = 19$$

5. Apply power method to find the largest eigen value of the following matrix. [8]

$$\begin{bmatrix} 4 & -1 & 1 \\ -1 & 3 & -2 \\ 1 & -2 & 3 \end{bmatrix}$$

6. Write the pseudo-code to fit a polynomial to a given set of data by Lagrange's interpolation method. [8]
7. Estimate y(3) from the following data using cubic spline interpolation technique. [8]

x	2	4	6	8	10
y	2	3	6	3	2

8. Derive Newton-cotes quadrature formula for integration. [4]
9. Evaluate $\int_{-1}^{2} e^{-x^2} dx$ using 3-point Gaussion Quadrature formula. [6]
10. Solve $y' = 2x + \sin y$ for y(0.2) subject to the condition y(0) = 1 using Modified Euler's method. [4]
11. Solve the following boundary value problem using finite difference method by dividing the interval into four sub intervals. [8]

$y'' + 3y' - y = \cos x, \quad y(0) = 2$ and $y(2) = 3$

12. Solve Poision's equation $u_{xx} + u_{yy} = 729x^2y^2$ on a square grid with $0 \le x \le 1, 0 \le y \le 1$ with u = 0 on the boundary. Take step size $n = \frac{1}{3}$ [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Discuss the significance of Numerical Methods in the field of science and engineering. [4]
2. Find a real root of the equation $\cos x - xe^x = 0$, correct to four decimal places, using Regula-falsi method. [6]
3. Write pseudo-code for finding a real root of a non-linear equation using the Secant Method. [6]
4. Solve the following system of linear equations using the Gauss-Elimination Method. [8]

$$3x_1 - 2x_2 + 3x_3 + 2x_4 = 16$$
$$2x_1 - 3x_2 + 2x_3 + 3x_4 = 9$$
$$5x_1 + 3x_2 - 5x_3 + 4x_4 = 7$$
$$4x_1 + 2x_2 + 2x_3 - 3x_4 = 16$$

5. Find the dominant Eigen value and corresponding vector of the following matrix using the Power Method. [8]

$$\begin{bmatrix} 5 & 2 & 3 \\ 2 & 4 & 2 \\ 3 & 2 & 5 \end{bmatrix}$$

6. Write the pseudocode to fix a given set of data to a second degree polynomial $(y = a + bx + cx^2)$ using the Least Square Method. [8]
7. Fit the following data to the curve $y = ax^b$ using least square method. [8]

x	350	400	500	600
y	61	26	7	2.6

8. Evaluate $\int_0^2 (\sin x + \cos x)dx$ using Gaussian 3-point formula. [6]
9. Derive the formula for computing first and second derivative using Newton's forward difference interpolation formula. [6]
10. Solve the following boundary value problem using Shooting Method employing Euler's formula taking a step-size of 0.25. [10]

    $y'' = x - y + y'$ subject to boundary conditions $y(0) = 2$ and $y(1) = 3$

11. Solve the elliptic equation (Laplace) $\mu_{xx} + \mu_{yy} = 0$ for the square mesh $0 \le x \le 1, 0 \le y \le 1$ where h = Δx=0.25 and k = Δy = 0.25 with the following boundary conditions: [10]

$u(0,0) = 0$ $u(0,0.25) = 1000$ $u(0,0.50) = 2000$ $u(0,0.75) = 1000$ $u(0,1) = 0$	$u(0.25,0) = 500$ $u(0.25,1) = 500$	$u(0.5,0) = 1000$ $u(0.5,1) = 1000$	$u(0.75,0) = 500$ $u(0.75,1) = 500$	$u(1,0) = 0$ $u(1,0.25) = 1000$ $u(1,0.50) = 2000$ $u(1,0.75) = 1000$ $u(1,1) = 0$

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Shrawan

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

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Construct Divided Difference table from the following data: [4]

x	1	2	4	5	6
y	14	15	5	6	19

2. Find an approximation of the root of the equation $x^3 - x - 11 = 0$ by using Bisection method correct to three decimal places. [6]
3. Write an algorithm for finding a real root of non-linear equation using Newton Raphson method. [6]
4. Solve the following system of linear equations using Gauss-Seidal iteration method. [8]

$$6x_1 + x_2 - x_3 + 2x_4 = 4$$
$$2x_1 + 5x_2 - 4x_3 + 6x_4 = -5$$
$$x_1 + 4x_2 + 3x_3 - x_4 = 2$$
$$x_1 + x_2 + 2x_3 + x_4 = 5$$

5. Find the largest Eigenvalue and corresponding Eigenvector of the following matrix using power method. [8]

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

6. Evaluate y(10) by using Lagrange's interpolation formula from the following data: [8]

x	5	6	9	11
y	12	13	14	16

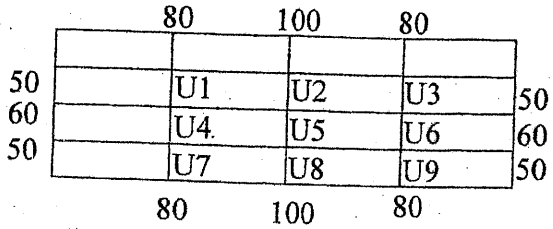
7. Using least square method, fit a curve $y = ae^{bx}$ to the following data: [8]

x	4	5.5	7	8	10
y	18.47	39.11	82.79	136.5	371.03

8. Find the value of cos(1.74) from the following table. [4]

x	1.7	1.74	1.78	1.82	1.86
sinx	0.9916	0.9857	0.9781	0.9691	0.9584

9. Derive composite simpson's three-eight formula for the integration. [6]
10. Write Psudocode to solve a first order differential equation using R-K 4 method. [6]
11. Solve the boundary value problem $y''+xy'+y = 3x^2 + 2, y(0) = 0, y(1) = 1$ [6]
12. Solve the laplace equation $U_{xx} + U_{yy} = 0$ over the square grid with boundary condition as shown in figure. [10]



05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Write an algorithm to solve a non-linear equation using secant method. [6]
2. Find the positive root of equation $\cos x - 1.3x = 0$, correct to six decimal places using Newton Raphson Method. [6]
3. Discuss the limitations of fixed point iteration methods graphically. [4]
4. Using Factorisation method, solve the given system of linear equations. [8]

$$2x - 5y + z = 12$$
$$-x + 3y - z = -8$$
$$3x - 4y + 2z = 16$$

5. Find the largest eigen value and corresponding eigen vector of the matrix: [8]

$$\begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$$

6. using least square method, fit a curve $y = ax^2 + bx + c$ to the following data: [8]

x	20	40	60	80	100	120
y	5.5	9.1	14.9	22.8	33.3	46.0

7. Use cubic spline interpolation to estimate f(2.5) from given table. [8]

x	1	2	3	4
f(x)	0.5	0.3333	0.25	0.20

8. Derive Newton-cotes quadrature formula for integration and use it to obtain the trapezoidal rule of integration. [6]
9. The following table gives distance (s) of a particle at time (t): [4]

t	0.2	0.4	0.6	0.8	1.0	1.2
s	0.12	0.49	1.12	2.02	3.20	4.67

Calculate the velocity at time t = 0.3

10. Write Pseudocode to solve a first order differential equation using Euler's method. [4]
11. Using Fourth order Runge-Kutta method, solve the following differential equation for y at x = 0.2 and x = 0.4: [8]

$$y'' - xy'^2 + y^2 = 0,\ y(0) = 1,\ y'(0) = 0$$

12. Solve Poisson's equation $u_{xx} + u_{yy} = 729x^2y^2$ over the square domain $0 \le x \le 1, 0 \le y \le 1$ with step size h = 1/3 with u = 0 on the boundary. [10]

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01/06

05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Calculate a real root of $x^7 + \sin x - \cos x = 0$ accurate up to 3 decimal places using Bisection Method. [6]
2. Write pseudo-code to find a real root of a given non linear equation using False Position Method. [6]
3. Discuss the limitations of Newton-Raphson Method in finding a real-root of a non-linear equation. [4]
4. Use Gauss Jordan method to find the inverse of following matrix A. [8]

$$A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$$

5. Compute the dominant Eigen value of the following matrix using Power Method. [8]

$$\begin{bmatrix} 3 & 4 & 5 \\ 4 & 3 & 6 \\ 5 & 6 & 5 \end{bmatrix}$$

6. From the following table estimate f(1.6) using Newton's forward interpolation method. [8]

x	1	1.4	1.8	2.2
f(x)	3.49	4.82	5.96	6.5

7. Estimate y(5) from the following data using Cubic Spline Interpolation technique. [8]

x	2	4	6	8
y	4	5	7	6

OR

Write a high-level language (C/C++/FORTRAN) program to complete Largrange's interpolation.

8. Find approximate values of y'(3) and y''(3) from the following function: [4]

x	2	2.5	3	3.5	4
y	5.53	5.74	4.62	2.96	2.89

9. Evaluate $\int_0^1 \frac{\tan^{-1} x}{x} dx$ using Romberg method correct up to 3 decimal places. [6]
10. Solve $y''+3y'-y = 2x$ subject to the boundary conditions $y(0) = 3$ and $y(2) = 4$ in the range $0 \le x \le 2$ by dividing the interval into four sub-intervals using the finite difference method. [8]
11. Write pseudo-code to solve an initial value problem (first order ordinary differential equation) using the Runge- Kutta fourth order method. [4]
12. Solve the equation $\nabla^2 u = -10(x^2 + y^2 + 10)$ over the square with sides $x = 0 = y$, $x = 3 = y$ with $u = 0$ on the boundary and mesh length = 1 [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Kartik

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

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Show that the following data pairs satisfy a cubic polynomial by constructing a divided difference table. [4]

x	1	2	4	5	7	8
y	8.8	5.5	3.7	4.0	4.0	2.5

2. Find a positive real root of the equation $xe^x + \sin x = 0.5$ with an accuracy of 6 decimal places using Newton-Raphson Method. [6]
3. Write pseudo-code to find a real root of a given non-linear equation using Secant Method. [6]
4. Solve the following system of linear equations using Factorization Method. [8]

$$9x_1 + 5x_2 - 8x_3 = 19$$
$$5x_1 - 3x_2 + 8x_3 = 19$$
$$7x_1 + 4x_2 - 5x_3 = 19$$

OR

Write a high-level language (C/C++/FORTRAN) program to compute the inverse of a non-singular square matrix using Gauss Jordan Method.

5. Find the largest Eigen value and corresponding vector of the following matrix using Power Method. [8]

$$\begin{bmatrix} 1.4 & 1.3 & 2.2 \\ 1.3 & 3.5 & 1.5 \\ 2.2 & 1.5 & 3.2 \end{bmatrix}$$

6. Fit the following set of data to a curve of the form $y = a\log_e x + b$ [8]

x	2	4	6	8	10	12	14
y	4.7	7.2	8.3	9.6	10.4	10.7	10.9

7. Evaluate y (1.6), y (7.8) and y (4.2) from the following data using appropriate polynomial interpolation technique used for equally spaced intervals. [8]

x	1	2	3	4	5	6	7	8
y	2.3	1.8	2.0	3.0	4.4	5.0	3.9	1.7

8. Derive formula for first derivative using Newton forward interpolation formula. [5]
9. Evaluate $\int_0^{\pi} x\sin x dx$ using 3-point Gauss Legendre formula. [5]
10. Solve $y' = \sin x + \cos y, y(0) = \pi$ in the range $0 \le x \le 2$ by dividing the interval into 5 sub-intervals using Euler's method. [4]
11. Apply Runge-Kutta method of fourth order to find y(0.5) and y(1) from following equation $\frac{dy}{dx} = \frac{y^2 + x^2}{x + y}$ with $y(0) = 1$. [8]
12. Solve the Poisson's equation $\nabla^2 u = x^3 + y^3$ over the square region $0 \le x \le 3$ and $0 \le y \le 3$ subject to $u(x,0) = 0, u(0,y) = 0, u(3,0)$ and $u(0,3) = 0$ taking $\Delta x = \Delta y = 1$. [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2071 Shawan

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

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Find a real root of the following equation, correct to four decimals, using the False Position method. [6]

$$x^3 - 5x - \sin(x) - 6 = 0$$

2. Derive analytically the iteration formula for Newton-Raphson method to find a real root of a non-linear equation. [4]
3. Write an algorithm to find a real root of a non-linear equation using the Bisection Method. [6]
4. Solve the following system of linear equations using the Gauss-Seidal Iteration Method. [8]

$$9x_1 + 2x_2 - 3x_3 = 10$$
$$5x_1 + 11x_3 + 2x_4 = 30$$
$$x_2 + 3x_3 + 7x_4 = 25$$
$$2x_1 + 8x_2 - 2x_4 = 15$$

OR

Write pseudo-code for solving a system of linear equations using the Gauss Elimination Meythod.

5. Find the dominant Eigen value and corresponding vector of the following matrix using the Power method. [8]

$$\begin{bmatrix} 1 & 4 & 3 \\ 4 & 2 & 7 \\ 2 & 6 & 5 \end{bmatrix}$$

6. Evaluate f(2.5) from the following data using Newton's Divided difference interpolation formula: [8]

x	1	2	3	4	5	6
$f(x)$	8.9	9.2	16.3	35.6	72.5	132.4

7. Fit the following data to an exponential curve of the form $y = ab^x$. [8]

x	2	4	6	8	10
y	2	6	25	115	300

8. Find y'(0.2) and y''(0.2) from the following data: [5]

x	0.1	0.2	0.3	0.4	0.5
y	2.6	8.2	15.4	25.6	37.8

9. Evaluate the following using Gaussian three point formula: [5]

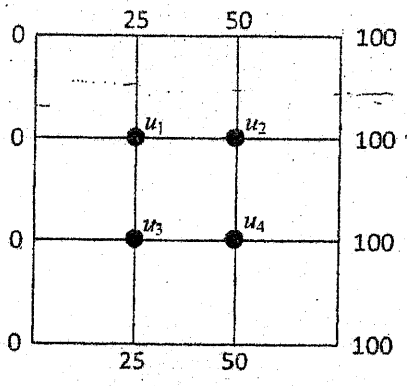
$$\int_0^2 x \sin(\cos x) + 2 \, dx$$

10. Solve the following initial value problem using the Modified Euler's method for $0 \le x \le 0.6$ with an interval of 0.2 [6]

$$\frac{dy}{dx} = \sin x + \cos y; \quad y(0) = 3$$

11. Explain the technique of solving a two-point boundary value problem using the shooting method. [6]

12. Solve $u_{xx}+u_{yy}= 0$ for the following square mesh with boundary conditions as shown in the figure. [10]



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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE,BME,BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. How do we obtain a real root of a non-linear equation using Secant method? Explain graphically and hence deduce the iteration formula. [4]
2. Write an algorithm to find a real root of a non-linear equation using Bisection method. [4]
3. Find a positive real root of $\sin(x) + \cos(x) + e^x - 8 = 0$ correct up to 4 decimal places using Newton-Raphson method. [6]
4. Solve the following system of equations using the LU Factorization method. [8]
   $4x + 3y + z = 33$
   $2x + 5y + 3z = 41$
   $2x + y + 5z = 47$
5. Obtain the numerically dominant Eight value and corresponding eigen vector of the following matrix, using power method. [8]

$$\begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$$

6. From the following data, find the cubic polynomial between x = 3 and x = 4 using the natural cubic Spline interpolation technique. [8]

x	2	3	4	5	6
y	5	6	4	3	2

OR

Write a program in C to numerically interpolate a value from a given data set using Lagrange's interpolation formula.

7. Fit the following set of data to a curve of the form $y = a e^{bx}$ [8]

x	1	2	3	4	5	6	7	8
y	2	3	4	5	7	10	15	30

8. A slider in a machine moves along a fixed straight rod. Its displacement x cm. along the rod is given below at different instant of time t seconds. Find the velocity of the slider and its acceleration when t = 0.2 seconds. [4]

t	0.0	0.1	0.2	0.3	0.4
x	30.13	31.62	32.87	33.64	33.95

9. Evaluate the following integral correct to three decimals using Romberg's method. [6]

$$\int_2^4 \left(4 + \frac{\cos(X)}{e^{\sin x}}\right) dx$$

10. Using the finite difference approximation, solve the following boundary value problem for three interior points. [8]

$y''+4y'-3y = \sin(x)$; with boundary conditions $y(2) = 3$ and $y(4) = 4$

11. Write pseudo-code to solve an initial value problem (first order ordinary differential equation) using the Runge-Kutta fourth order method. [6]

12. Solve the Poisson's partial differential equation $u_{xx} + y_{yy} = -10(x^2 + y^2 + 10)$ over the region $0 \le x \le 3$ and $0 \le y \le 3$ with boundary conditions: [10]

$u(0,y) = 0, u(3,y) = 0, u(x,0) = 0$ and $u(x,3) = 0$ Assume mess length = 1

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2069 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH603)*

- ✓ 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. Using the divided different table, show that the following data satisfies a cubic polynomial. [4]

x	1	3	4	5	7	9
y	2.9	2.3	14.6	41.5	166.7	418.1

2. Write an algorithm to find a real root of a non-linear equation using Bisection Method. [6]
3. Find a real root of the following equation correct to three decimals using the Secant method. $e^{\cos x} = \sin x$ [6]
4. Solve the following system of linear equations using Gauss-Seidel's method [8]

$-x_1 - x_2 - 2x_3 + 10x_4 = -9$
$10x_1 - 2x_2 - x_3 - x_4 = 3$
$-2x_1 + 10x_2 - x_3 - x_4 = 15$
$-x_1 - x_2 + 10x_3 - 2x_4 = 27$

Your answer must be correct to three decimal places.

OR

Write pseudo-code to solve a system of linear equations of 'N' unknowns using the Gauss-elimination method.

5. Obtain the numerically dominant Eigen value and corresponding eigenvector of the following matrix using Power Method. $\begin{bmatrix} 15 & -4 & -3 \\ 10 & 12 & -6 \\ -20 & 4 & -2 \end{bmatrix}$ [8]
6. Using the Cubic Spline interpolation technique, estimate the value of y(9) from the following data: [8]

x	4	6	8	10
y	2	5	8	6

7. Fit the following set of data to a curve of the form $y = a\,e^{bx}$. [8]

x	2	3	4	5	6	7
y	15.1	10.2	7.8	5.5	3.8	1.7

8. A rod is rotating in a plane. The following table gives the angle θ (radians) through which the rod is turned for various values of the time t second: [4]

t	0.0	0.2	0.4	0.6	0.8	1.0	1.2
θ	0	0.12	0.49	1.12	2.02	3.20	4.67

Calculate the angular velocity and the angular acceleration of the rod, when t = 0.2 and 1.0 second.

9. Derive simpson's 1/3 rule for integration. Evaluate the following integral using Simpson's 1/3 rule, taking h = 0.25 $\int_0^1 \frac{e^x}{x+1} dx$ [4+2]

10. Solve the following boundary value problem using the finite difference method by dividing the interval into four sub-intervals. $\frac{d^2y}{dx^2} = \sin x + y;\ y(0) = 3;\ y(1) = 4$ [8]

11. Write pseudo-code to solve an initial value problem (first order ordinary differential equation) using Euler's method. [4]

12. Solve the Poisson's equation $u_{xx} + u_{yy} = -81xy$, $0 < x < 1$, $0 < y < 1$ with boundary condition: $u(0,y) = u(x,0) = 0$ and $u(1,y) = u(x,1) = 100$; taking $h = 1/3$. [10]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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

Subject: - Numerical Methods *(SH603)*

- ✓ 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. What is error? Explain absolute, relative and percentage error, with example. [4]
2. Write an algorithm to find a real root of a non linear equation using secant method. [6]
3. Find the cube root of 30, correct to 3 decimal places using Newton-Raphson method. [6]
4. Solve the following system of linear equations using factorization method. [8]

$$4x_1 + 4x_2 + 5x_3 = 31$$
$$2x_1 + 6x_2 + 2x_3 = 23$$
$$3x_1 + 2x_2 + 2x_3 = 15$$

OR

Write pseudo-code for solving a system of linear algebraic equations using the Gauss-Jordan Method.

5. Determine the dominant Eigen value and corresponding vector of the following matrix using the power method. [8]

$$\begin{bmatrix} 2 & 6 & 3 \\ 6 & 5 & 4 \\ 3 & 4 & 9 \end{bmatrix}$$

6. Develop pseudocode to interpolate the given sets of data using Lagrange interpolation method. [6]
7. Using the cubic spline interpolation technique, find the cubic polynomial between x = 2 and x = 3 from the following data and also evaluate y (2.5): [10]

x	0	1	2	3	4
y	2	-6	-8	2	4

8. The distance y covered in time t by an object moving in a straight line is given below; approximate the velocity at t = 1 second and acceleration at t = 5 seconds. [4]

t(in seconds)	0	1	2	3	4	5
y(in meters)	0	15	71	143	245	367

9. Compute $\int_1^2 \frac{dx}{x}$ using Romberg method correct upto 3 decimal places. [6]
10. Solve the equation y'' = x+y with the boundary conditions y(0) = y(1) = 0, using finite difference method, taking four sub intervals. [10]
11. Derive Schmidt recurrence formula to solve one dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ [4]
12. Solve the Poisson's equation $\nabla^2 u = 8x^2y^2$ for the square mesh $0 \le x \le 3$, $0 \le y \le 3$ with u = 0 on the boundary and mesh length = 1. [8]

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05 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2068 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BME, BIE	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods *(SH 603)*

- ✓ 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. Generate the forward difference table from the following data: [4]

x	0	1	2	3	4	5	6
f(x)	0	2.2	4.7	8.5	14.3	20.7	30.1

2. Derive iterative formula for Newton-Raphson method using Taylor-series. [4]
3. Find a root of the equation $x^3-4x-9=0$, using bisection method, correct upto three decimal places. [8]
4. Solve the following system of linear equations using the factorization method. [8]

$$2x+2y+3z = 17$$
$$3x+2y+z = 12$$
$$5x+2y+2z = 18$$

OR

Write the Pseudo-code for solving a system of linear equations using the Gauss Jordan Method.

5. Find the dominant Eigen value and corresponding Eigen vector of the following matrix using the Power method. [8]

$$\begin{bmatrix} 1 & -2 & 3 \\ -2 & 4 & 2 \\ 3 & 2 & 9 \end{bmatrix}$$

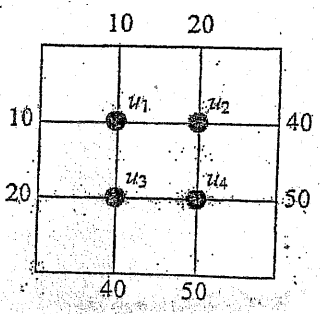
6. Using Lagrange interpolation formula, find the value of f(1.3) from following data [8]

X	1	3	4
Y	4.28	2.18	4.13

7. Estimate the co-efficients of $y = ax+b$ for the following data using least square method. [8]

X	−2.0	−1.0	0.5	2.0	3.0	5.5
Y	−0.4	1.2	3.5	6.0	7.4	11.0

8. Derive the expression for evaluating derivative by forward difference method. [4]
9. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ using Simpson's 1/3 rule taking unit interval size. [6]
10. Solve $\frac{dy}{dx} = y - \frac{3x}{y}, y(0) = 1.5$ in the range $0 \le x \le 0.4$ taking h = 0.2 using Modified Euler's method, performing iteration for an accuracy of four decimal places in each step. [10]
11. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary conditions as exhibited in the figure below. [12]



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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions. **Question No. 6 is compulsory.***
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. a) Find at least one root of $x^3 - 2x - 5 = 0$ with the accuracy of 0.08%, using Bisection method. [8]

   b) Find an approximate root of $x \log_{10} x - 1.2 = 0$ using secant method upto three decimal places of accuracy. [8]

2. a) Use a suitable method to fit an exponential curve $y = ae^{bx}$ for the following data: [8]

X	1	2	3	4	5
Y	1.65	2.7	4.5	7.35	12.2

   b) The followings are the measurement of t (time) made on a curve recorded by an oscillograph representing a change in the conditions of an electric current (I). [8]

t (time)	1.2	2.0	2.5	3.0
I	1.36	0.58	0.34	0.20

   Find the value of I when t = 1.6 with appropriate Newton's Gregory Interpolation method.

3. a) Evaluate $I = \int_0^2 \frac{(x^2+2x+1)}{1+(x+1)^4} dx$ using Gauss two point and three point formula. Also, compare results obtained from both the methods. [8]

   b) Find the largest Eigen value of the matrix $A = \begin{bmatrix} 2 & -2 & 4 \\ 2 & 3 & 2 \\ -1 & 1 & 1 \end{bmatrix}$ using power method. [8]

4. a) Solve the system of equations given using the Gauss elimination method with partial pivoting. [8]

$$2x_1 + x_2 + x_3 - 2x_4 = -10$$
$$4x_1 + 2x_3 + x_4 = 8$$
$$3x_1 + 2x_2 + 2x_3 = 7$$
$$x_1 + 3x_2 + 2x_3 - x_4 = -5$$

   b) Solve the following differential equation within $0 \le x \le 0.4$ using RK 4th order method. $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 3y = 6x$, with $y(0) = 0$ and $y'(0) = 1$. (take $h = 0.2$) [8]

5. a) A rod is rotating in a plane. The following table gives the angle θ(radian) through which the rod has turned for various values of the time t seconds. [8]

t	0	0.2	0.4	0.6	0.8	1.0	1.2
θ	0	0.12	0.49	1.12	2.02	3.20	4.67

   Calculate the angular velocity and angular acceleration of the rod, when t = 0.1 second.

   b) Solve the Poisson equation $\nabla^2 f = 2x^2y^2$, over the square domain of $0 \le x \le 3$ and $0 \le y \le 3$ with $h = k = 1$. Consider $f = 0$ at all its boundaries, $x = 0$, $y = 0$, $x = 3$ and $y = 3$. [8]

6. Develop algorithm, flowchart and program coding to interpolate at any points within a given set of data using Lagrange's interpolation method. [16]

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03 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2066 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any Five questions. Question No. 6 is compulsory.*
- ✓ *The figures in the margin indicate Full Marks.*
- ✓ *Assume suitable data if necessary.*

1. a) Find a real root of the equation $x^3 + x^2 - 1 = 0$ by the fixed point iteration method, correct to six decimal places. [8]

   b) Calculate a real root of non-linear equation $x \sin x + \cos x = 0$ using Newton Raphson Method. The absolute error of functional value at our calculated root should be less than 10^{-4}. [8]

2. a) Use appropriate method of interpolation to get f(0.675) from the given table. [8]

x	0.125	0.25	0.375	0.5	0.625	0.75
f(x)	0.7916	0.7733	0.7437	0.7041	0.6532	0.6022

   b) Use the suitable method to fit a quadratic curve $y = ax^2 + bx + C$ for the following data. [8]

x	−3	−2	−1	0	1	2	3
y	4.63	2.11	0.67	0.09	0.63	2.15	4.56

3. a) Evaluate the integral $I = \int_0^1 e^{-x^2} dx$ and compare the result in both conditions for Simpson's 1/3 rule and 3 point Gauss Legendre method. [10]

   b) The following data gives corresponding values of pressure (P) and specific volume (V) of superheated steam: [6]

V	2	4	6	8	10
P	105	42.7	25.3	16.7	13

   Find the rate of change of pressure with respect to volume when V = 2 and V = 8.

4. a) Using the power method, find the largest eigen value of the following matrix. [6]

$$A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$$

   b) Solve the following system of linear equations by Gauss-Elimination method. [10]

$$5x_1 + x_2 + x_3 + x_4 = 4$$
$$x_1 + 7x_2 + x_3 + 4x_4 = 6$$
$$x_1 + x_2 + 6x_3 + x_4 = -5$$
$$x_1 + x_2 + x_3 + x_4 = 0$$

5. a) Use second order Runge-Kutta method to solve $\frac{dy}{dx} + xz = 0$; $\frac{dy}{dx} - y^2 = 0$ at x = 0.2 and 0.4 given that y = 1, z = 1 at x = 0. [8]

   b) Apply Runge Kutta fourth order method to approximate the value of y when x = 0.2 and 0.4 given that $y' = x + y$, $y(0) = 1$. [8]

6. Write an algorithm, flowchart and program code in any high level language to solve a system of linear equations in 'n' unknowns using the Gauss Jordan Method. The program should display the augmented co-efficient matrix at each step of elimination. [5+5+6]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2065 Shrawan

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

Candidates are required to give their answers in their own words as far as practicable.
Attempt any Five questions. Question No. 6 is compulsory.
The figures in the margin indicate Full Marks.
Assume suitable data if necessary.

1. a) Find the point with accuracy 0.001, where the line $y = x - 3$ and $y = \ln x$ is intersecting, using bisection method. [8]

   b) Calculate the root of non-linear equation $f(x) = \sin x - 2x + 1$ using secant method. The absolute error of functional value at our calculated root should be less than 10^{-3}. [8]

2. a) Find the missing values of collected water level using Lagrange' interpolation. [8]

Time duration of rainfall (t) min	1	3	6.5	10
Collected Water level (h) mm	23	61	?	203

   b) Use the suitable method and determine the exponential fit of $y = Ce^{Ax}$ for the following data: [8]

X	0	1	2	3	4
Y	1.5	2.5	3.5	5.0	7.5

3. a) Evaluate the integral $I = \int_0^{1.5} \sin x\,dx$, compare the absolute error in both conditions for Simpson 1/3 rule and Simpson's 3/8 rule. [8]

   b) Use Romberg Integration find the integral of $e^x \sin x$ between the limits -1 and 1. [8]

4. a) Find the inverse of the matrix $A = \begin{bmatrix} 2 & -2 & 4 \\ 2 & 3 & 2 \\ -1 & 1 & 1 \end{bmatrix}$ using Gauss-Jordan method. [8]

   b) Solve the following by Gauss Elimination method with complete pivoting. [8]

   $2x + 3y + 2z = 2$
   $10x + 3y + 4z = 16$
   $3x + 6y + z = 6$

5. a) Solve the following differential equation within $0 \le x \le 1.0$ using RK 4th order method. [8]

   $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 4y = 3x$, with $y(0) = 0$ and $y'(0) = 1$. (take $h = 0.5$)

   b) Consider a sheet metal of size 30cm by 30cm. The two adjacent sides are maintained at temperature of 50°C and other two sides are held at 500°C. Calculate the steady state temperature at interior points assuming a grid size of 10cm by 10cm. [8]

6. Write algorithm flow chart and program code of any high level language to solve polynomial of n^{th} degree using Harner's rule. Your program should read the coefficients of polynomial and display all roots of that polynomial correct up to five decimal places. [5+5+6]

INSTITUTE OF ENGINEERING

Examination Control Division

2064 Falgun

Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	III / I	Time	3 hrs.

Subject: - Numerical Methods

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt any **Five** questions. **Question No. 6 is compulsory.***
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. Find at least one root of the equation $x^2 + \tan x + e^x = 0$ correct up to 3 significant digits using bisection method. Again, find out the root with secant method and compare the result. [16]

2. a) The temperature of metal strip was measured at various time intervals during heating and data tabulated below. [8]

Time, t (min)	1	2	3	4
Temp, T(°C)	70	83	100	124

Express the relationship as $T = be^{t/4} + a$ using least square method and estimate value at t = 6 min.

b) Using Newton's Dividend Difference Method interpolate the value at x = 1.75. [8]

Temp	1.1	2.0	3.5	5	7.1
Viscosity	0.6981	1.4715	2.1287	2.0521	1.4480

3. Use L-U decomposition method to solve the set of linear equation: [16]

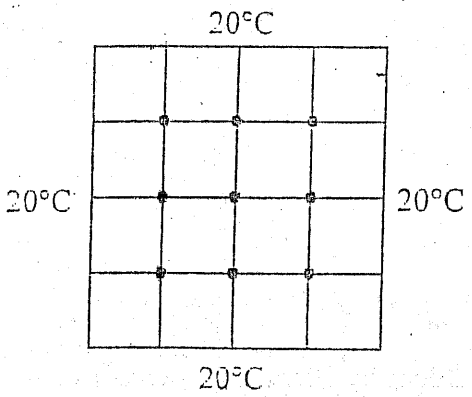
$x_1 + 2x_2 = 7$
$2x_1 - 3x_2 - x_3 = 9$
$4x_2 + 2x_3 + 3x_4 = 10$
$2x_3 - 4x_4 = 12$

4. a) Use Romberg integration method, evaluate [10]

$\int_0^1 e^{x^2} dx$ with starting step size h = (b – a) / 2.

b) Use central difference formula to evaluate the first and second derivative of $= x^* \log(1 + x^2)$ at x = 1.5 with h = 0.01. [6]

5. a) Consider a metal plate of size 40cm×40cm. the boundaries of which are held at 20°C. Calculate the temperature at interior points of the plate. Assume the grid size of 10cm×10cm. [10]



b) Use second order Runge-Kutta (RK-2) method to estimate y(2) for [6]
$y'(x) = 2y/x$ with y(1) = 2 with step size of 0.25.

6. Suppose you are required to find out all the possible roots of the equation $x^4 - 8x^2 + 16 = 0$. Write algorithm, flowchart and program in any one of the high level programming language known to solve n^{th} order polynomial using Newton Rapshon method. [4+4+8]

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