# NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
# FACULTY OF INDUSTRIAL TECHNOLOGY
# DEPARTMENT OF CIVIL AND WATER ENGINEERING
# BACHELOR OF ENGINEERING (HONOURS) DEGREE
# PART II SUPPLEMENTARY EXAMINATION – MAY 2011
# THEORY OF STRUCTURES – TCW 2203

**INSTRUCTIONS**

Answer all questions. Each question carries 25 marks

Time: 3 Hours
Total Marks 100

**Q1**

(a) A simple supported beam is subjected to the loading shown in Fig 1.1. Calculate the deflection at the section D and displacement at E. Take E = 90 $GN/m^2$ and I = 264 x $10^6$ $mm^4$. Use the double integration method. [11]

(b) Determine the displacement at the support B and the deflection at point C of the beam shown in Fig 1.2 EI is constant. Use the moment area theorems. [14]

**Q2**

(a)State the differences between least work method and the virtual work method. [2]

(b) Outline the differences between the conjugate beam method and the moment area theorems for calculating deflections in beams. [3]

(c) Determine the displacement of the joint C on the frame shown in Fig 2.1. The cross sectional area is rectangular. Include the internal strain energy due to the axial load and shear. Take E = 210GPa, G = 90GPa , I = 22 x $10^{-6}$ $m^4$ and A = 150$mm^2$. Use the method of virtual energy. [20]

**Q4**

(a)State the difference between bending moment diagram and an influence line diagram. [2]

(b) Where can the approximate methods of analysis be used in design and analysis of structures. [3]

(c) Use the portal method to determine approximately the reactions at A, B, C and D of the frame in Fig 3.1. Draw approximately the moment diagram for the frame. [20]

**Q5**

(a) Calculate the displacement at D of the beam shown in Fig 5.1. Take E = 200GPa and I = 90 x $10^6$$mm^4$. Use the method of virtual work. [7]

(b) Determine the vertical displacement at joint I for the truss in Fig 5.2. Each member has a cross section of 30$mm^2$ and E = 200GPa. Use the Castligliano's second theorem.[14]

(c) Derive an expression that shows the relationship between shear force and the bending moment for a beam under the action of lateral loads. [4]

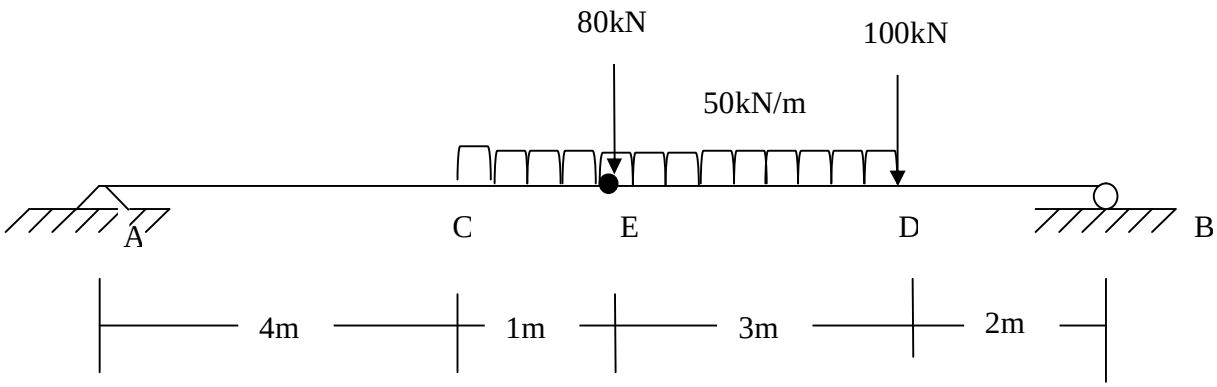


**Fig 1.1**

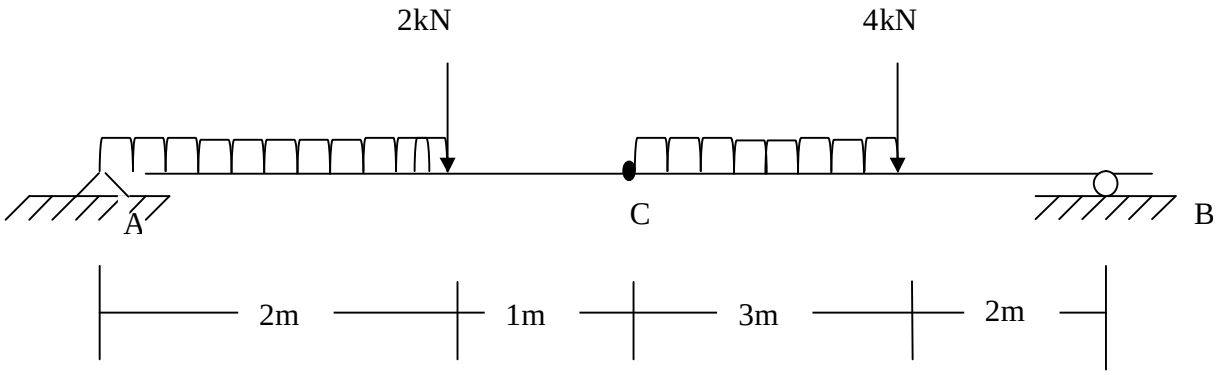


**Fig 1.2**

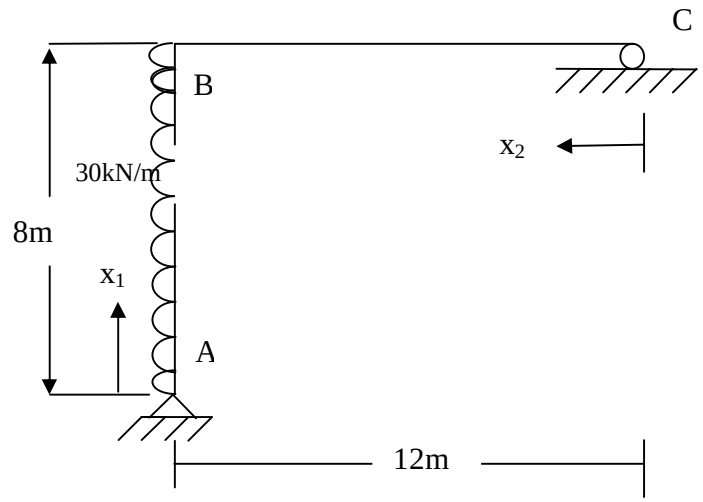
C
B
30kN/m
$x_2$
8m
$x_1$
A
12m

**Fig 2.1**

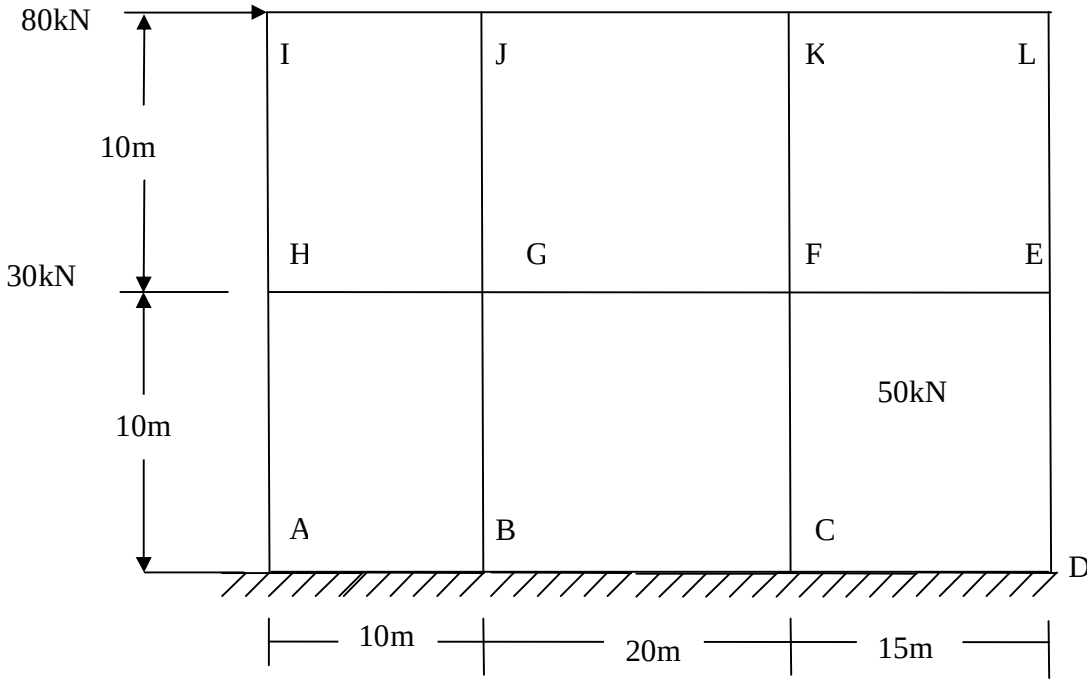
80kN
I
J
K
L
10m
H
G
F
E
30kN
50kN
10m
A
B
C
D
10m
20m
15m

**Fig 3.1**

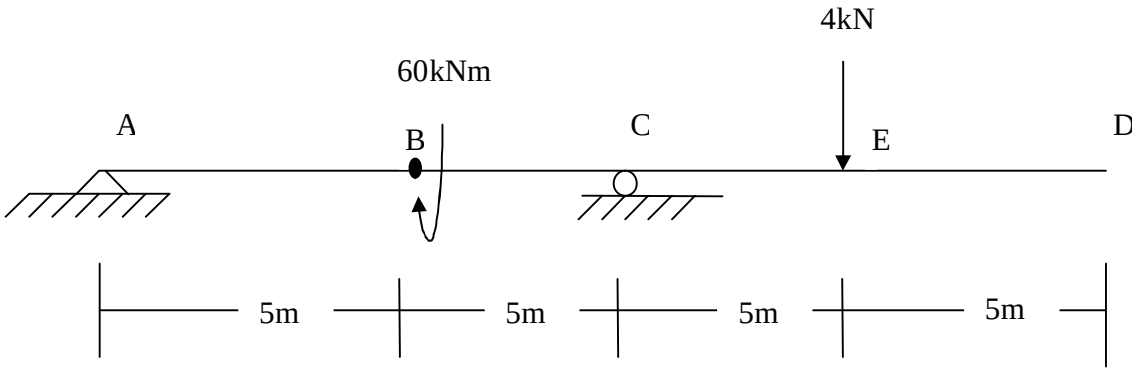
4kN
60kNm
A
B
C
E
D
5m
5m
5m
5m

**Fig 4.1**

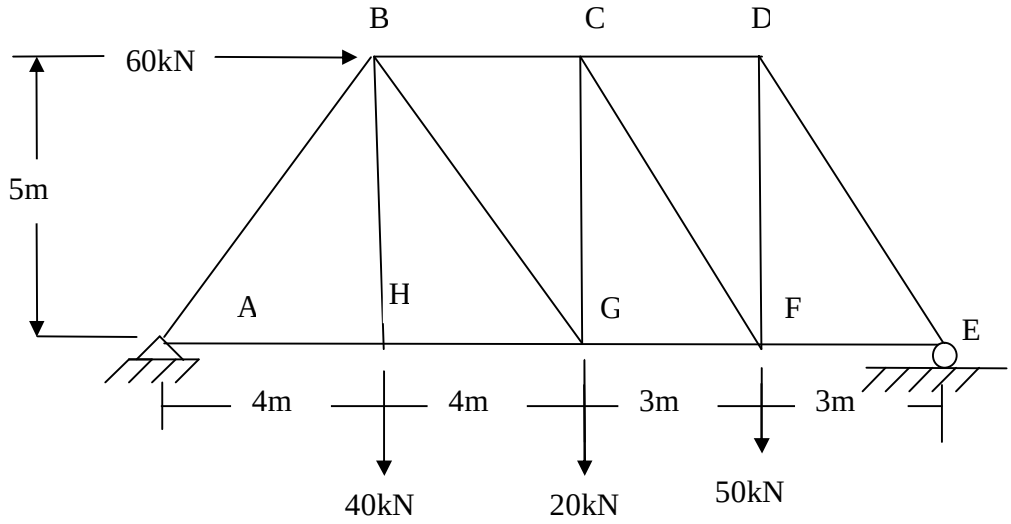
B
C
D
60kN
5m
A
H
G
F
E
4m
4m
3m
3m
40kN
20kN
50kN

**Fig 4.2**