First Semester Examination
2020/2021 Academic Session

February 2021

EAS253 – Theory of Structures

Duration : 2 hours

Please check that this examination paper consists of **SEVEN (7)** pages of printed material before you begin the examination.

Instructions: This paper contains **THREE (3)** questions. Anwser **ALL** questions.

All questions **MUST BE** answered on a new page.

1. (a). **Figure 1** shows a continuous beam with a hinge joint at B. Check statical determinacy of the beam. Suggest a way with proof to reduce the degree of statical indeterminacy of the beam by ONE (1), without changing the support conditions.

[7 marks]

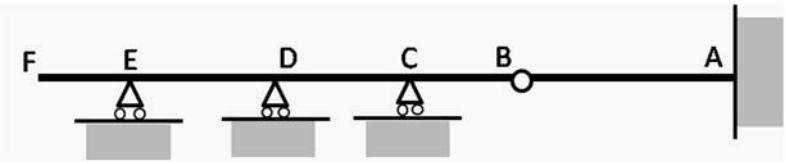

Figure 1

(b). Verify with proof if the following statement is true:
"Degree of statical in indeterminacy of the frame shown in **Figure 2** is FOUR (4)".

[8 marks]

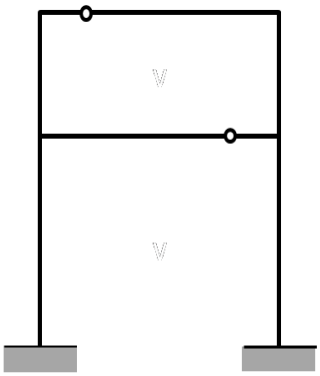

Figure 2

(c). **Figure 3** shows a frame which is pin-supported at A and E. Joint C is a hinge joint. Vertical uniformly distributed loads of 6 kN/m and 8 kN/m act along inclined member AB and horizontal member BD, respectively. Joint D is subjected to a horizontal concentrated load of 45 kN.

(i). Determine the distribution of axial force in inclined member AB.

(ii). Determine shear force on section just to the left of joint D.

(iii). Draw bending moment diagram for the frame.

(iv). Sketch the qualitative deflected shape.

[20 marks]

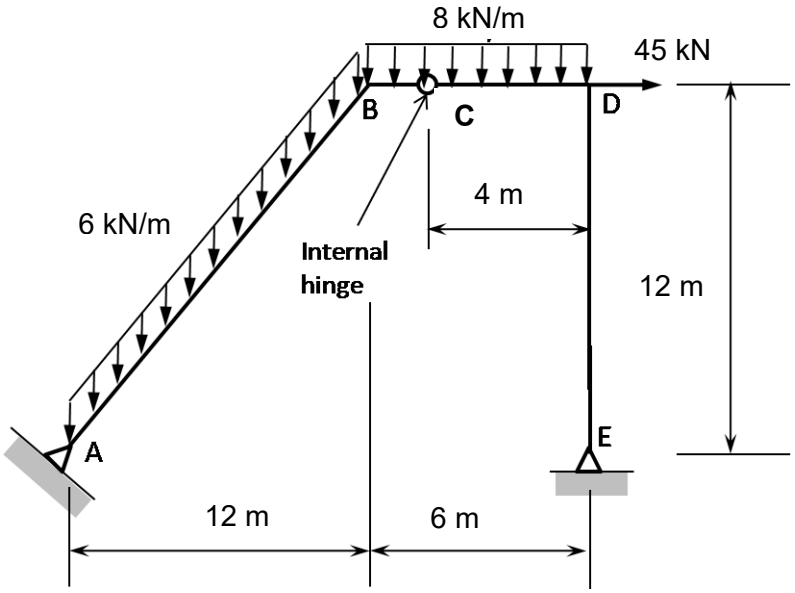

Figure 3

2. (a). **Figure 4** shows a plane truss of a slanting roof for an airport. Check the statical determinacy of the truss. Support A is pinned and support F is roller. All member connections are pinned. Find the reactions at both supports and identify zero force members, if any. Determine forces in members BD, DC and CE by using section method and members DF, DE and EF by using joint method. Classify whether they are in tension or compression.

[20 marks]

(b). If one member DE is removed from the truss shown in **Figure 4**, determine what will happen to the overall stability of the truss. Will there be any changes of the forces in members DF and EF?

[5 marks]

(c). If the 100 kN and 80 kN loads in the truss shown in **Figure 4** are reduced by 50%, respectively, what will happen to the value of the reactions and the forces in members DC and CE?

[5 marks]

(d). If the length of all the members in the truss shown in **Figure 4** are doubled, explain the changes of the forces in members DE and EF.

[5 marks]

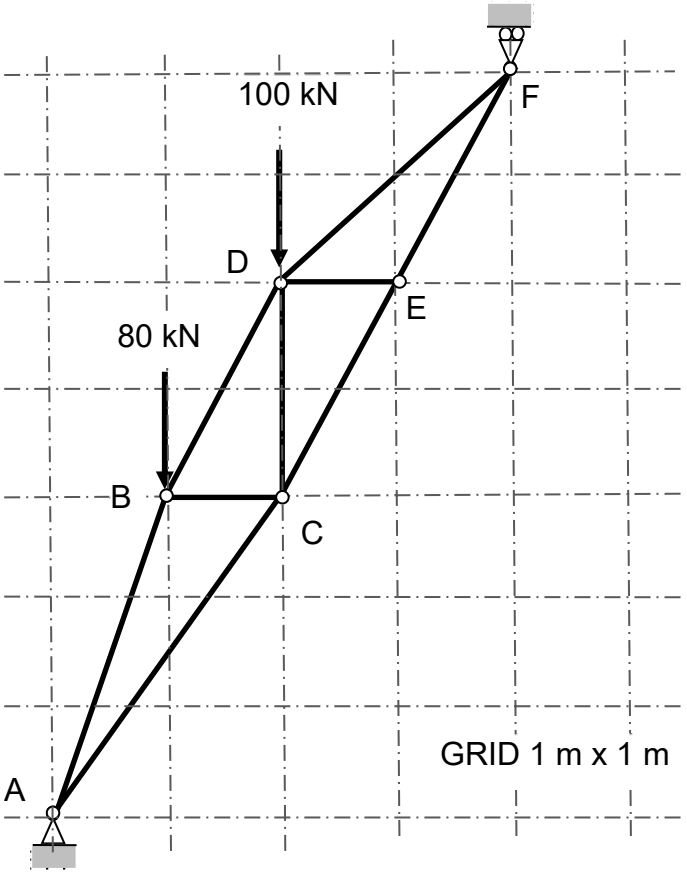

Figure 4

3. (a). **Figure 5** shows a simple beam subjected to a uniformly distributed load of w kN/m acting at the first *L1* m from the left support. Flexural rigidity of the beam is 2*EI*. Given *E* = 210 GPa and *I* = 125(10^6) mm^4, calculate the slope and deflection of the beam at *a* point *b* m from the right support of the beam. **The values of *w, L1* and *L2* are given in Table 1 according to your matriculation number.** Use either moment-area method or conjugate-beam method.

[15 marks]

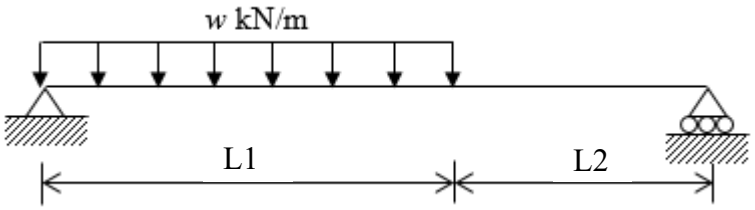

Figure 5

(b). If an additional concentrated moment of *M* kNm acts at the right support of the beam as shown in **Figure 6**, calculate the slope and deflection at point *L2* m from the right support of the beam. **The value *M* is given in Table 1 according to your matriculation number**. Use either moment-area method or conjugate-beam method.

[15 marks]

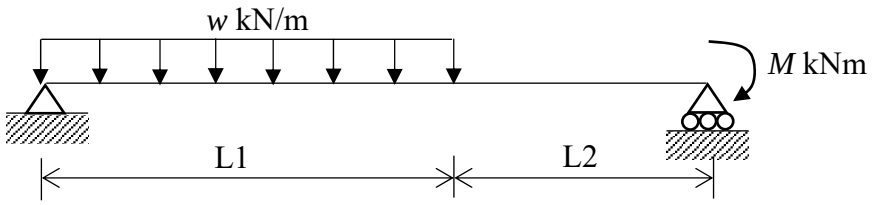

Figure 6

Table 1: Values of *w, M, L1* and *L2*

Last digit of matriculation number	*w* (kN/m)	*M* (kNm)	Second last digit of matriculation number	*a* (m)	*b* (m)
0	3	25	0	3	2
1	3.5	22.5	1	3.5	2.5
2	4	20	2	4	3
3	4.5	17.5	3	4.5	3.5
4	5	15	4	5	4
5	5.5	12.5	5	4	5
6	6	10	6	3.5	4.5
7	6.5	7.5	7	3	4
8	7	5	8	2.5	3.5
9	7.5	2.5	9	2	3

Note: If your matriculation number is 15628, use w = 7 kN/m, M = 5 kNm, L1 = 3 m and L2 = 4 m.

-oooOOOooo-