TERTIARY AND VOCATIONAL EDUCATION COMMISSION

COMMON WRITTEN EXAMINATION – 2020/ 2021

Diploma in Construction Technology
NVQ Level 05 – Semester I

Structural Mechanics	F45C001M03	Three Hours

Answer any 05 questions only

01. (a) Determine the resultant of the system of concurrent coplanar forces shown in Figure 01 (a)
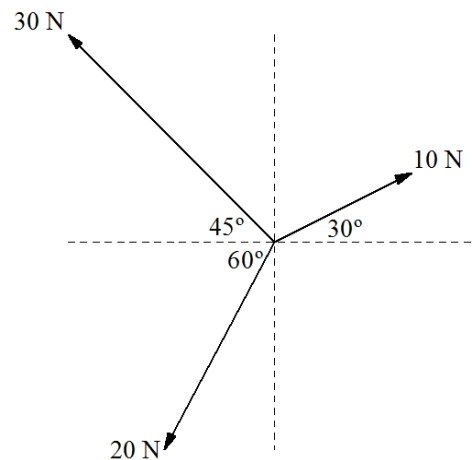

Figure 01(a)　　　　　　　　**(10 Marks)**

(b) A rigid rod, of negligible mass, supporting a load of 250 N is held at an angle of 30° to the vertical by a tie rope at 75° to the vertical, as shown in Figure 01 (b).
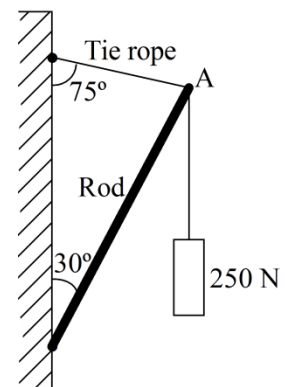

Figure 01(b)

(i) Draw a free body diagram for point A. **(02 Marks)**

(ii) Determine the tension in the rope and the compression in the rod. **(08 Marks)**

02. (a) Explain the difference between a concentrated load and a distributed load applied on a beam. **(04 Marks)**

(b) A uniform beam of length 3 m is simply supported at A and B as show in the figure 02 (b). Suppose a concentrated load P = 150 N acts at a distance d = 1 m from the left end.
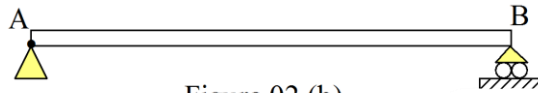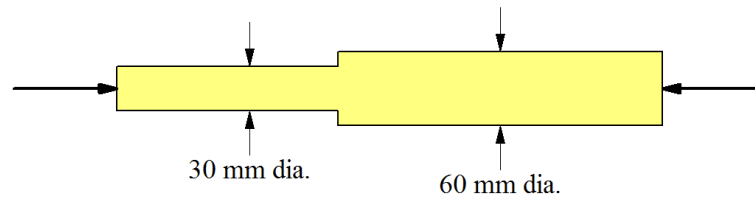

Figure 02 (b)

(i) State whether this beam is statically determinate or statically indeterminate. Explain your answer. **(04 Marks)**

(ii) Draw a free body diagram and find the support reactions. **(06 Marks)**

(iii) Suppose a uniformly distributed vertical load q = 100 N/m acts over the entire length of the beam, in addition to the concentrated load mentioned above. Find new support reactions. **(06 Marks)**

03. (a) A square section reinforced concrete column has a cross section 450 mm by 450 mm and contains four steel reinforcing bars, each of diameter 25 mm. The steel has a modulus of elasticity of 200 GPa and the concrete has a modulus of elasticity of 14 GPa. A total load of 1.5 MN is applied on the column.

(i) Determine the stresses in the steel bars and the concrete. **(10 Marks)**

(ii) Calculate the percentage increase of the stress in concrete, if the number of steel reinforcing bars has been reduced to three. **(06 Marks)**

(b) A rod is formed with one part of it having a diameter of 60 mm and the other part a diameter of 30 mm and is subject to an axial force of 20 kN as shown in figure 03 (b). What will be the stresses in the two parts of the rod?

(04 Marks)

30 mm dia. 60 mm dia.

Figure 03 (b)

04. A cantilever beam AB has a length of 3 m and carries a point load of 3 kN at a distance of 2 m from the fixed end and a uniformly distributed load of 2 kN/m over a 2 m length from the fixed end as shown.
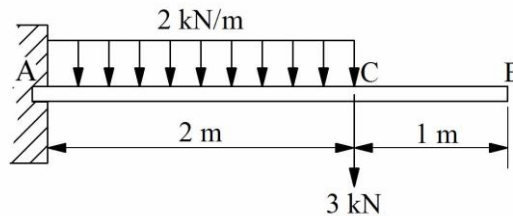

Figure 04

(i)   Draw a free body diagram and find the reactions at A.   **(04 Marks)**

(ii) Draw the shear force and bending moment diagrams for the beam.   **(16 Marks)**

05. A steel beam of length 12 m has the uniform section as shown in the figure 05 and rests on supports at each end.
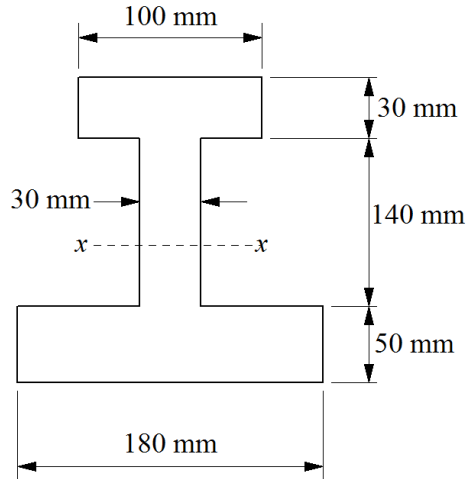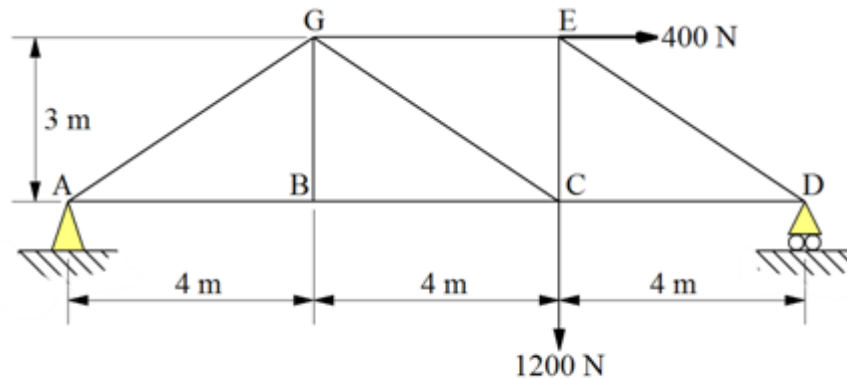

Figure 05

(i) Determine the position of the neutral axis *x-x* shown (06 Marks)

(ii) Calculate second moment of area I_{xx} about the neutral axis. (06 Marks)

(iii) Determine the maximum stress in the beam under its own weight if the steel has a density of 7900 kg/m^3. Assume that the maximum bending moment occurs in the cross section at the middle of the beam. (08 Marks)

06. (a) Explain the importance of method of sections over method of joints in the analysis of trusses. (04 Marks)

(b) Using the method of sections, determine the force in members GE , GC , and BC of the truss shown in figure 06. Indicate whether the members are in tension or compression.

(16 Marks)

Figure 6

07. (a) Explain the material properties "ductility" and "Brittleness". Give examples for ductile materials and for brittle materials. **(04 Marks)**

(b) Explain why steel reinforcing bars are embedded in concrete structures. **(04 Marks)**

(c) Describe at least three different advantages of using steel-based structures in construction. **(06 Marks)**

(d) How do you bring "sustainability" into construction field when it comes to construction of steel-based or concrete-based structures? **(06 Marks)**