TERTIARY AND VOCATIONAL EDUCATION COMMISSION
COMMON WRITTEN EXAMINATION – 2020/ 2021

Higher National Diploma in Construction Technology
NVQ Level 06 – Semester I

Structural Analysis & Fundamentals of Structural Design	**F45C001M14**	**Three Hours**

Answer any five (05) questions.

Q-01:

a) Explain, how do you control the deflection of a simply supported reinforced cement concrete (RCC) beam? (02 Marks)

b) Give two reasons for undesirability of **excessive deflection** in beams. (02 Marks)

c) Sketch a simply supported reinforced concrete beam and label the followings;

I. Tensile reinforcement,
II. Compressive reinforcement,
III. Hanger bars,
IV. Shear links and
V. Nominal links (05Marks)

d) What do you mean by **under reinforced section** and **over reinforced section** with respect to reinforced concrete beams? Which would you recommend for design purposes and explain? (04 Marks)

e) What is the camber and why it is important for steel trusses? (03 Marks)

f) Explain, which structures are statically determinate and which structures are statically indeterminate. (04 Marks)

Q-02:

a) Explain the reason for limiting the depth of the neutral axis of a reinforced concrete beam section to 0.5*d*, according to the BS 8110. Let consider the "*d*" as the effective depth of the section. (04 Marks)

b) A simply supported rectangular beam of 6m span carries a characteristic dead load (g_k) including self-weight of the beam and imposed load (q_k) of 8 kN/m and 6 kN/m respectively. Calculate the **area of reinforcements** required by assuming f_{cu} = 30 N/mm^2 and f_y = 460 N/mm^2 and beam dimensions as breadth (b) = 225 mm and effective depth (d) = 425 mm. (08 marks)

c) A reinforced concrete beam has a rectangular section of breadth (b) = 250 mm and effective depth (d) = 500 mm. It has to carry a design moment of 305 kNm and f_{cu}=25 N/mm^2 and f_y=460 N/mm^2. **Prove that the compression reinforcements are required or not**. If required, find out the **number of 16mm diameter steel bars that will be required** as compression reinforcements. The distance of the center of the compression reinforcements from the compression concrete surface may take as 50 mm. (08 Marks)

Q-03:

A pad foundation is required to support a single square column transferring an axial loads only. Using the data provided:

I. Determine a suitable base size, (08 Marks)

II. Check the base with respect to: bending and designing suitable reinforcement where necessary. (12 Marks)

Design Data:

- Characteristic dead load on column ; 800 kN
- Characteristic imposed load on column ; 300 kN
- Characteristic concrete strength, f_{cu} ; 40 N/mm^2
- Characteristic strength of reinforcement, fy ; 460 N/mm^2
- Net permissible ground bearing pressure, p_g ; 200 kN/m^2
- Column dimensions ; 375 mm × 375 mm
- Exposure condition ; severe

Q-04:

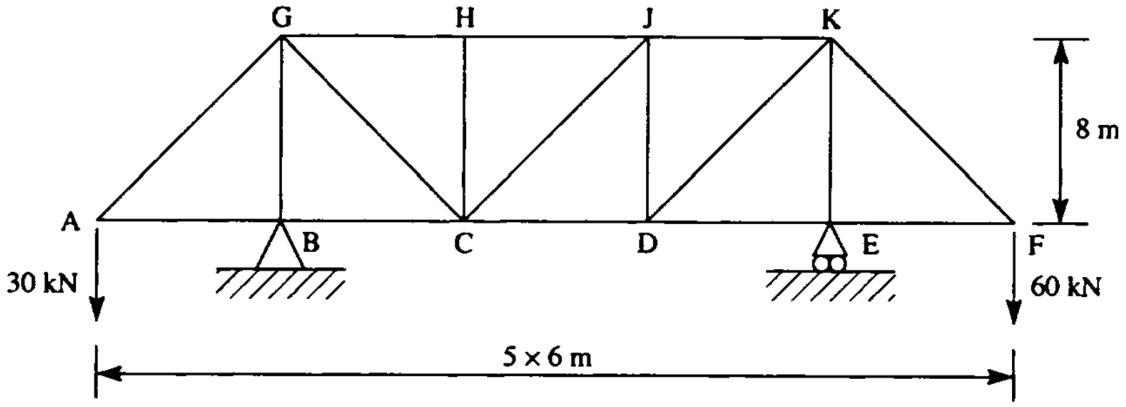
a) A rectangular beam 100 mm wide and 250 mm deep is subjected to a maximum shear force of 50 kN. Determine;

I. Average shear stress

II. Maximum shear stress, and

III. Shear stress at a distance of 25 mm above the neutral axis. (10 Marks)

b) Determine the forces in the members JK, JD, and DE of the truss shown in the figure using the method of sections. (10 Marks)



Q-05:

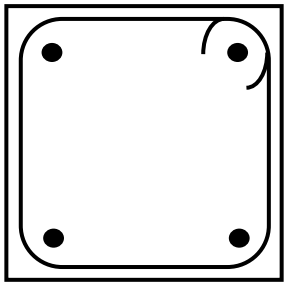
a) What is Macaulay's method of beam deflection analysis? What are its advantages over the direct integration method? (10 Marks)

b) A cantilever of 3 m span carries a uniformly distributed load of 5 kN per meter length over the entire span. Determine the deflection at the free end. E = 200 GPa and I = 80 x 10^6 mm^4. (04 Marks)

c) A cantilever beam is 4 m long and carries a point load of 5 kN at the free end. The flexural stiffness is 53.3 MNm^2. Determine the slope and deflection at the free end. (06 Marks)

Q-06:

a) A 50 cm x 50 cm uniform square shaped concrete column reinforced with 2.5 cm diameter four steel rods embedded in the concrete column. Estimate the compressive stresses in the steel and concrete when the total thrust on the column is 1 MN. Let's consider the Young's modulus for steel is 200 GN/m^2 and that for concrete is 14 GN/m^2. (10 Marks)



b) A piece of material is subjected to two perpendicular tensile stresses of 100MPa and 60MPa. Draw the **Mohr's stress circle** and determine the plane on which the resultant stress has maximum obliquity with the normal. Also, find the **resultant stress** on this plane. (10 Marks)