UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA ENGINEERING: MECHANICAL
SUBJECT	:	**STRENGTH OF MATERIALS 2**
CODE	:	**SOM 2111**
DATE	:	NOVEMBER EXAMINATION 12 NOVEMBER 2014
DURATION	:	(SESSION 2) 12:30 - 15:30
WEIGHT	:	40: 60
TOTAL MARKS	:	100

ASSESSOR	:	DR L MTHEMBU
MODERATOR	:	MR P STACHELHAUS 2246
NUMBER OF PAGES	:	3 PAGES + 1 ANNEXTURE

INSTRUCTIONS :

- ANSWER ALL QUESTIONS.
- A STUDENT IS EXPECTED TO MAKE REASONABLE ASSUMPTIONS FOR DATA NOT SUPPLIED.
- NUMBER YOUR QUESTIONS CLEARLY AND UNDERLINE THE FINAL ANSWER.
- ANSWERS WITHOUT UNITS WILL BE IGNORED.
- ALL DIMENSIONS ON DIAGRAMS ARE IN mm UNLESS OTHERWISE SPECIFIED.

QUESTION 1

Figure 1 shows member AE which is subjected to a number of axial loads. Assuming the member is in static equilibrium and the Young's modulus of the member is of 210 GPa;

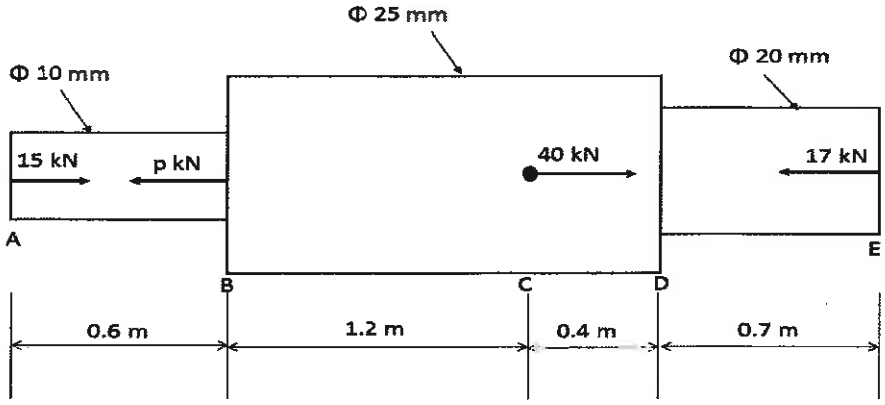


FIGURE 1

1.1 Calculate the unknown load, P. (2)
1.2 Calculate the change in length in section AB. (3)
1.3 Calculate the change in length in section BC. (5)
1.4 Calculate the total change in length of the whole member. (14)
[24]

QUESTION 2

A hollow shaft having a diameter ratio of 2:1 transmits 620 kW at 120 r/min. The maximum torque exceeds the mean torque by 20 %.

Determine the inside and outside diameters of the shaft, if the shaft is not to twist more than 1.5° over a length of 4 m and the torsional shear stress is not to exceed 45 MPa. Assume material G = 80 GPa.

[15]

QUESTION 3

A thin steel cylinder 500 mm in diameter has closed ends and is rotated at a speed of 3000 r/min about its longitudinal axis. It is simultaneously subjected to an internal pressure of 3 MPa.

3.1 Determine the required wall thickness of the cylinder when the maximum tensile stress in the steel is limited to 120 MPa and the density of steel is 7850 kg/m^3. (8)

3.2 List three assumptions made when deriving formulae for the stresses induced in a thin walled cyclinder subjected to an internal pressure. (3)
[11]

QUESTION 4

A 16 m long simply supported beam carries a uniform distributed load of 400 N/m for the left half of the beam span. The beam also carries a concentrated load of 6 kN at midpoint.

2.1 Draw the beam and the loads it carries. (2)

2.2 Calculate the reactions at both ends. (3)

2.3 Show the calculations for the shear force before midpoint and immediately after midpoint. (4)

2.4 Draw and label the shear force diagram. (8)

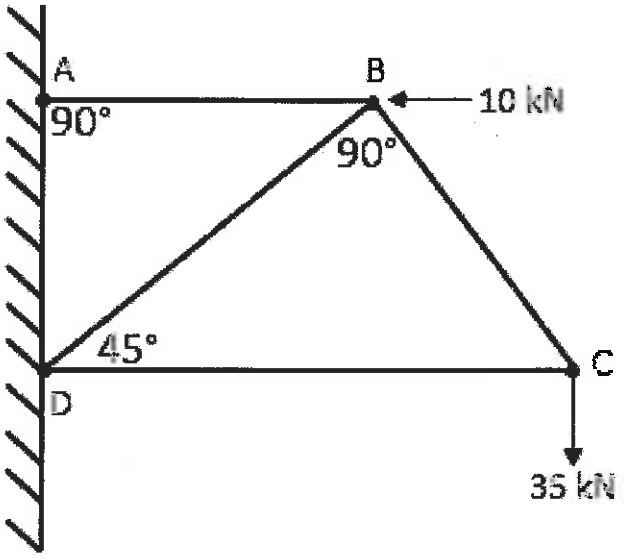
2.5 Show the calculations for the bending moment at 4 m, 8 m, 12 m and 16 m. (8)

2.6 Draw and label the Bending moment diagram. (5)

[30]

QUESTION 5 (TRUSSES)

Determine the magnitude and nature of the forces in all the members of the simple truss shown in the diagram below. The distance AD is 1 m long. Use the method of sections to solve this problem.



[20]

TOTAL = 100

ANNEXURE

Formula Sheet

$$\sigma = \frac{F}{A} \quad [\text{Pa}]$$

$$\varepsilon = \frac{\Delta l}{l}$$

$$E = \frac{\sigma}{\varepsilon} \quad [\text{Pa}]$$

$$\Delta A = \frac{D_2^2 - D_1^2}{D_1^2} \times 100$$

$$\Delta l = \frac{l_2^2 - l_1^2}{l_1^2} \times 100$$

$$\tau = \frac{V}{A} \quad [\text{Pa}]$$

$$G = \frac{\tau}{\gamma} \quad [\text{Pa}]$$

$$\sigma_C = \frac{Pd}{2t} \quad [\text{Pa}]$$

$$\sigma_l = \frac{Pd}{4t} \quad [\text{Pa}]$$

$$\sigma = \rho v^2 \quad [\text{Pa}]$$

$$J = \frac{\pi D^4}{32} \quad [\text{m}^4]$$

$$J = \frac{\pi (D^4 - d^4)}{32} \quad [\text{m}^4]$$

$$\frac{T}{J} = \frac{G\theta}{l} = \frac{\tau}{R}$$

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

$$I_{XX} = \frac{BD^3}{12} \quad [\text{m}^4]$$

$$I_{YY} = \frac{DB^3}{12} \quad [\text{m}^4]$$

$$I_{YY} = I_{XX} = \frac{\pi D^4}{64} \quad [\text{m}^4]$$

$$I_{NA} = I_{XX} + Ah^2 \quad [\text{m}^4]$$