

Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway
SECOND SEMESTER EXAMINATIONS, 2000

Third Civil Engineering Examination

Mechanics of Solids

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Time allowed: *Three* hours

Attempt *Five* Questions

1. The stresses at a point in a biaxial state of stress are: $\sigma_{xx} = 108 \text{ MPa}$, $\sigma_{yy} = 40 \text{ MPa}$ and $\tau_{xy} = -60 \text{ MPa}$. Find the magnitudes and directions of the principal stresses.
2. Find the shear centre of the channel section shown in figure Q2. The thickness of the flanges and the web are all 10mm.

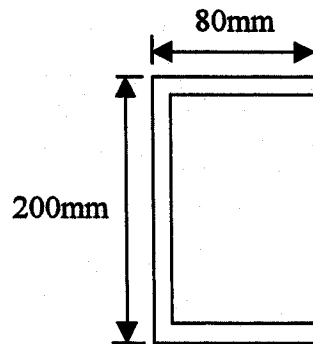
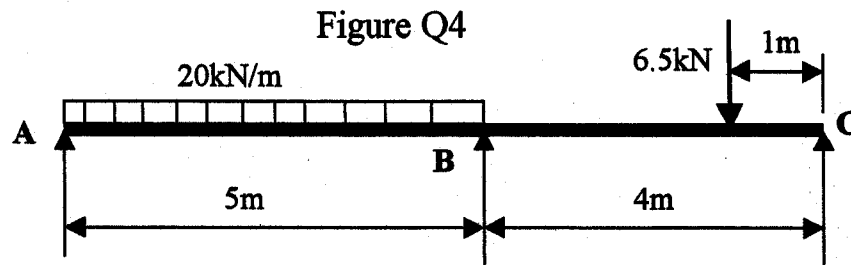


Figure Q2

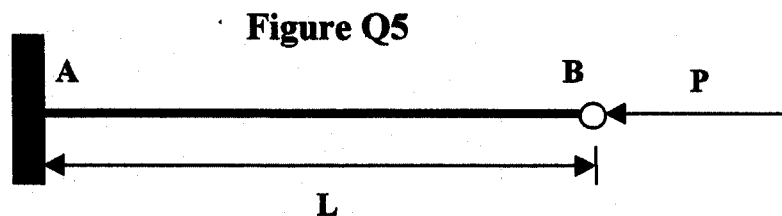
3. A solid steel shaft 50mm diameter is twisted until only a 20mm diameter core remains elastic. The steel may be assumed to behave in an ideal elastic-plastic manner with a yield stress in shear of 150MPa. Find the torque applied.

PTO

4. a) Using the Moment Area method derive the Three Moment Theorem, (Clapeyrons Theorem). Assume that the supports are rigid, the second moment of area is constant within a span and Young's Modulus is constant throughout.
- b) Using the Three Moment Theorem or otherwise find the bending moment at B for the beam shown in figure Q4. E and I are constant throughout both spans.



5. The long column shown is fixed at A and pinned at B. EI is constant throughout. Find the Euler buckling load.



6. a) Prove Castigliano's Theorem: $\delta U / \delta w_i = \Delta_i$ where U is the strain energy, w_i is the i^{th} load and Δ_i is the deflection at w_i and in the direction of w_i .
- b) Use Castigliano's theorem to find the rotation at the free end of a cantilever beam of span L with a concentrated lateral load W at the free end. EI is constant throughout.

End