Ollscoil na hÉireann, Gaillimh GX 2042
National University of Ireland, Galway
Semester I Examinations 2005-2006

Exam Code	2BI
Exam	Second Industrial Engineering
Module Code	CE215
Module	Introduction to Strength of Materials
External Examiner	Professor M O'Mahony
Internal Examiners	Prof. P. O Donoghue Dr. A.M. Harte

Instructions:

Answer 3 questions
All questions carry equal marks

Duration:	2 hours
No. of Answer books	1

Requirements:
Graph Paper
Log Tables

No. of Pages 2 + 1

Department Civil Engineering

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SEMESTER I EXAMINATIONS 2005

SECOND ENGINEERING EXAMINATION

CE215 Introduction to Strength of Materials

Professor M. O'Mahony
Professor P.E. O'Donoghue
Dr. A.M. Harte

Time allowed: *Two* hours
Answer *three* questions
All questions carry equal marks

1. Explain briefly the meaning of the following terms: *Normal stress, Young's modulus, Poisson's ratio, and coefficient of thermal expansion.*

A short tubular column is 900mm long and is subjected to an axial compressive force of 250kN. The section has an inside diameter of 140mm and a wall thickness of 10mm. Calculate the changes in the length and diameter of the column due to this load. If the temperature of the column is then raised by 25°C, determine the final column length and diameter. The column is made from an aluminium alloy having the following properties: E= 70GPa, υ =0.3 and $\alpha = 23 \times 10^{-6}$ /°C.

2. Stating your assumptions clearly and defining the symbols used, derive the torsion formula for circular shafts

$$\frac{T}{J} = \frac{\tau}{c} = \frac{G\theta}{L}$$

A rotor shaft is required to transmit 500 kW of power at 1200 rpm. Determine a suitable shaft diameter if the maximum torsional shear stress in the shaft is 75MPa.

3. Stating your assumptions clearly and defining all the symbols used, derive the following expression for the volumetric strain in a thin walled spherical pressure vessel.

$$\frac{\Delta V}{V} = \frac{3pr}{2tE}(1-2\nu)$$

A 3m diameter spherical pressure vessel is used to store gas at a pressure of 300kPa. Determine the required wall thickness if the maximum allowable normal stress is 100MPa. Using this thickness, what is the increase in volume of the vessel? Assume that E=200GPa and $\nu = 0.3$.

4. A complex stress system, comprising direct stresses together with a set of complementary shear stresses, exists at a point in a linearly elastic, isotropic solid as shown in Figure 1. Use Mohr's circle to determine the principal stresses, the principal planes and the maximum shear stress at the point.

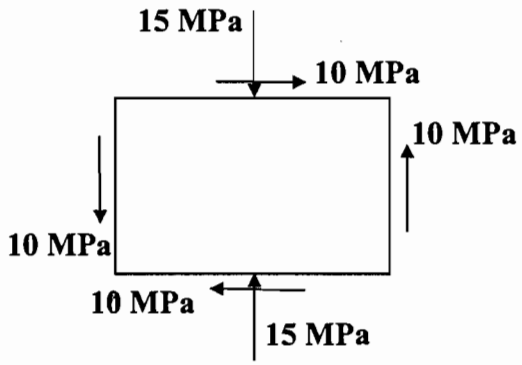

FIGURE 1