國立雲林科技大學 109 學年度 碩士班招生考試試題

系所：機械系

科目：工程數學(1)

1. **(25%)** Consider the ordinary differential equation (O.D.E.) shown below, and y is a function of x

$$2x^2y' - xy + y^2 = 0.$$

Please find the general solution of the O.D. E.

2. Please solve the following O.D.E.s with initial conditions:

(a) $y'' + 2y' + y = 1, \quad y(0) = y'(0) = 0$ **(5%)**

(b) $y'' + 2y' + y = e^x, \quad y(0) = y'(0) = 0$ **(10%)**

(c) $y'' + 2y' + y = e^{-x}, \quad y(0) = y'(0) = 0$ **(10%)**

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3. **(25%)**

Please find the angle between vector $\vec{A} = 3\vec{i} + \vec{j} + 5\vec{k}$ and the plane of x + y + z = 0.

4. **(25%)**

Let $\boldsymbol{T}: R^3 \rightarrow R^3$ be the linear transformation

given by reflecting across the plane $-x_1 + x_2 + x_3 = 0$

(i) Show the matrix M representing $\boldsymbol{T}$ with respect to standard basis is: (15 %)

$$M = \begin{bmatrix} 1/3 & 2/3 & 2/3 \\ 2/3 & 1/3 & -2/3 \\ 2/3 & -2/3 & 1/3 \end{bmatrix}$$

(ii) Find the inverse matrix M^{-1}.(10%)

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科目：材料力學

1. During a tension test of a mild-steel specimen (see Figure 1), the extensometer shows an elongation of 0.004 mm with a gage length of 50 mm. Assume that the steel is stressed below the proportional limit and that the modulus of elasticity E = 210 GPa.
   (a) (10%) Determine the maximum normal stress in the specimen.
   (b) (5%) Determine the maximum shear stress in the specimen.
   (c) (10%) Draw a stress element oriented at an angle of 45° to the axis of the bar and show all stresses acting on the faces of this element.

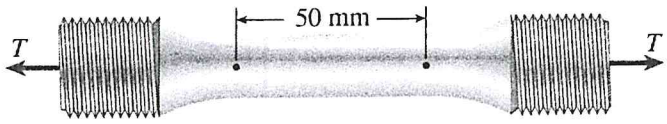

Figure 1

2. In Figure 2, the post in soil is has a diameter of 60 mm. If it is subjected to the load of 20 kN and the soil provides a frictional resistance that is uniformly distributed along its sides of w = 4 kN/m. The modulus of elasticity of the post E = 13.1 GPa.
   (a) (10%) Determine the force **F** at its bottom needed for equilibrium.
   (b) (15%) Determine the displacement of the top of the post A with respect to its bottom B.

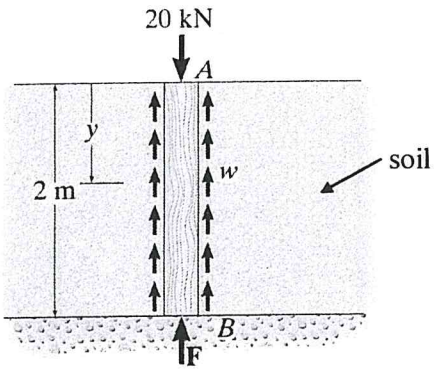

Figure 2

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3. (25%) A ship has a propeller drive shaft that is turning at 1200 rev/min while developing 1500 kW. If it is 2 m long and has a diameter of 80 mm, determine the maximum shear stress in the shaft caused by torsion.

4. (25%) The supports at A and B exert vertical reactions on the wood beam. If the allowable shear stress is τ_{allow}= 100MPa, determine the intensity w of the largest distributed load that can be applied to the beam. (See Figure 3)

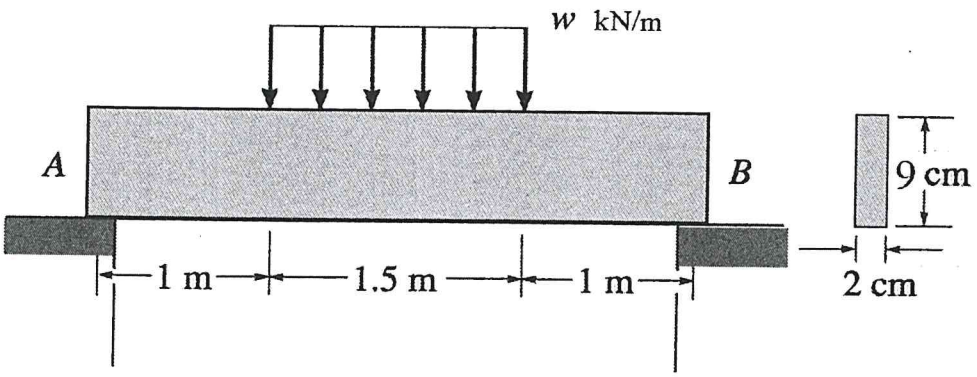

Figure 3