



DEPARTMENT OF CIVIL ENGINEERING

MINOR :CEL864 STRUCTURAL HEALTH MONITORING **(2023-24)**

Time allowed: 90 mins
Venue : LH 308

Date : 28 February 2024
Max marks : 20

NOTE: (a) This question paper contains one page only. (b) All questions are compulsory. (c) Assume any data which you deem is necessary but not supplied. (d) Draw neat and clear sketches wherever required.

Question 1.

Derive an expression for the flexibility matrix of a structure in terms of mass normalized mode shapes and eigen frequencies. What is the main advantage of flexibility approach over the stiffness approach ?

(08 marks)

Question 2.

A PZT patch of size 5x5x0.2 mm is bonded at the mid-point at the bottom flange of a steel girder ISMB 600 supporting a bridge deck over a canal. A peak voltage of 1.527 V is generated after a car weighing 700 kg passes over the bridge at a high speed. Compute the peak flexural strain induced by the passing vehicle.

Also estimate the vertical deflection at the mid point assuming the car to be a point load and the girder to be simply supported and having a span of 7.5 m.

Given: Electric permittivity = 2.12×10^{-5} F/m , piezoelectric strain coefficient = 2.10×10^{-10} m/V, Young's modulus of PZT patch = 6.67×10^{10} N/m² , Young's modulus of steel = 2×10^{11} N/m² , moment of inertial of ISMB 600: 91, 800 cm⁴, cross-sectional area of ISMB 600: 156 cm².

(07 marks)

Question 3.

Determine the strain measured by an electrical strain gauge if the measured resistance increases from 120.673 Ω to 120.752 Ω after the application of load and change of temperature from 36°C to 31°C. Assume gauge factor as 2.16, the coefficient of thermal expansion of the gauge material as $6 \times 10^{-6} \text{C}^{-1}$ and that of the host structure as $10 \times 10^{-6} \text{C}^{-1}$.

(05 marks)