



DEPARTMENT OF CIVIL ENGINEERING

MINOR I :CEL864 STRUCTURAL HEALTH MONITORING (2021-22)

Time allowed: 40 mins

Venue : Online

Date : 17 February 2022

Max marks : 15

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.

A mild steel pipe section of 500 mm internal diameter and 10 mm thickness is used to restrain earth retaining vertical panels in an underground excavation for metro construction. At one particular section, five vibrating wire strain gauges (VWSGs) of gauge length 8 cm are instrumented in the longitudinal direction uniformly distributed along the circumference. The baseline frequency is 80 Hz for the four VWSGs. Thermal effects are negligible.

- Determine the axial force in the member if the frequencies of the five gauges at the time of measurement are 65 Hz, 85 Hz, 71 Hz, 85 Hz and 63 Hz. Standard values may be assumed for gauge parameters.
- What is the possible reason that VWSGs are showing both tension and compression when the member is restraining excavation?

(10 marks)

Question 2.

A PZT patch of size 50x10x1 mm is hanging vertically with a thread from a fixed support. Compute the induced strain under an electric potential difference of 100 V applied across the thickness of the patch. No other force is applied on the beam. Assume 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.

(5 marks)