

DEPARTMENT OF CIVIL ENGINEERING



MAJOR :CVL864 STRUCTURAL HEALTH MONITORING (2016-17)

Time allowed: 2 hours
Venue : LH 615

Date : 06 May 2017
Max marks : 30

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.

Explain how the global vibration technique can be applied on real-life structure such as bridges in the absence of any facility for force measurement.

(5 marks)

Question 2.

Derive an expression for mechanical impedance of a PZT patch. State the conditions necessary and the governing assumptions clearly.

(5 marks)

Question 3.

Describe the principle behind the low-cost version of the EMI technique involving a function generator and a DMM. In what way the |Y| signature is likely to differ from that acquired using a standard LCR meter? Why?

(3 marks)

Question 4.

- Derive an expression for strain measured by VWSG in terms of change in frequency of the metal wire.
- A stainless steel metal wire used as VWSG on a concrete structure has a length of 5 cm. If the change in frequency is registered as 10 Hz (decrease), compute the true strain induced in the structure if the temperature increases by 20 °C during the measurement. The prestrain induced in the wire by the manufacturer was 2000 microstrain. The coefficient of thermal expansion for steel and concrete are $10 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$ and $6 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$ respectively.

(2+4=6 marks)

Question 5.

State two limitations each of eddy current, acoustic emission and thermal imaging techniques for NDE

(3 marks)

Question 6.

What is "piezo-identified equivalent stiffness"? How can the remaining service life of a component under fatigue be expressed in terms of the piezo-identified equivalent stiffness?

(3 marks)

Question 7.

State a limitation of the EMI technique that does not favour its application under moderate or severe damage conditions. Explain the underlying reason for this observation. How can this limitation be circumvented?

(3 marks)

Question 8.

How can any debonding and breakage in a PZT patch can be identified?

(2 marks)