ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER – 2006

ELECTRONIC MEASUREMENT AND INSTRUMENTATION

SEMESTER – 3

Time : 3 Hours] [Full Marks : 70

Group – A

(Multiple Choice Questions)

1. Choose the correct answers for any *ten* of the following : $10 \times 1 = 10$

i) In an electrodynamometer type of wattmeter

a) the current coil is fixed

b) the pressure coil is fixed

c) both of the coils are movable

d) any of the coils is fixed. ☐

ii) In spring controlled moving iron instruments, the scale is

a) uniform

b) cramped at the lower end and extended at the upper end

c) extended at both the lower and upper ends

d) cramped at both the lower and upper ends. ☐

iii) A pyrometer is calibrated between 200 – 1000 degree Celsius. Its span is

a) 800 degree Celsius b) 200 degree Celsius

c) 1000 degree Celsius d) 1200 degree Celsius. ☐

iv) When a 50 Hz sinusoidal signal is given to the *y* plates and the time base signal is turned off in the *x* plates of a CRO, the trace on the screen

a) is a horizontal line b) is a vertical line

c) is a spot d) is a sinusoidal waveform. ☐

v) A transducer converts

a) mechanical energy into electrical energy

b) mechanical displacement into electrical signal

c) one form of energy into another form of energy

d) electrical energy into mechanical form. ☐

vi) The gauge factor is defined as

a) $\frac{\Delta L}{L} / \frac{\Delta R}{R}$ b) $\frac{\Delta R}{R} / \frac{\Delta L}{L}$

c) $\frac{\Delta R}{R} / \frac{\Delta D}{D}$ d) $\frac{\Delta R}{R} / \frac{\Delta \rho}{\rho}$ ☐

vii) Piezoelectric transducers are

a) passive transducer b) active transducer

c) inverse transducer d) both (b) & (c). ☐

viii) For measurement of low impedance by Q-meter the component is connected in

a) parallel b) series

c) direct d) none of these. ☐

ix) Thermistor is used for measurement of

a) temperature b) displacement

c) pressure d) flow. ☐

x) Power in a 3-phase four wire circuit can be measured by using

a) two wattmeters b) four wattmeters

c) three wattmeters d) one wattmeter. ☐

xi) The null detector for a 50 Hz bridge balance cannot be a

a) head phone b) PMMC

c) vibration galvanometer d) MI instrument. ☐

Group - B

(Short Answer Questions)

Answer any *three* questions of the following. $3 \times 5 = 15$

2. Describe with a neat diagram, the Wien-bridge method for measuring unknown frequency.

3. Write a short note on semiconductor type strain guage.

4. Draw the functional block diagram of a DMM. Explain how A.C. current is converted into an equivalent D.C. voltage for operation. What is the function of sweep generator circuit in a CRO ? 2 + 2 + 1

5. What is the function of spectrum analyzer ? A first order transducer is used to indicate pressure. When pressure is abruptly changed from 5 bar to 30 bar, the transducer indicates 20 bar after 30 seconds. Determine the time required to reach the indication 95% of the final pressure. 1 + 4

Group - C
(Long Answer Questions)

Answer any *three* questions of the following. $3 \times 15 = 45$

6. a) Explain the functions of the internal structure of a cathode ray tube with neat diagram.
   b) What are Lissajous patterns ? Explain how phase & frequency can be measured using these figures.
   c) What are the differences between CRO dual beam and dual trace ? What is the function of delay line ? $7 + (1 + 3) + (3 + 1)$

7. What is piezoelectric effect ? Draw the equivalent circuit of the piezoelectric transducer and derive the transfer function of that circuit.

   A quartz piezoelectric crystal having thickness of 2 mm and voltage sensitivity of 0·055 V - m/N is subjected to a pressure of 1·5 MN/m^2. Calculate the voltage output. If the permittivity of quartz is $40{\cdot}6 \times 10^{-12}$ F/m, calculate its charge sensitivity. $2 + 10 + 3$

8. a) Why can low resistance not be measured by a Wheatstone bridge ?
   b) Derive the expression for measurement of low resistance by Kelvin's Double bridge.
   c) With a circuit diagram explain how capacitance can be measured by Schering bridge.
   d) The circuit for measurement of effective resistance 'r_1' and self-inductance 'L_1' of a coil is as follows :
   arm '*ab*' — the unknown coil impedance in series with a resistance 'R_1'
   arm '*bc*' — a pure resistance 'R_3'
   arm '*cd*' — a pure resistance 'R_4'
   arm '*da*' — an inductor with self inductance 'L_2' and internal resistance 'r_2'
   The bridge supply voltage is between '*a*' and '*c*'. Under balance condition $R_1 = 1{\cdot}36\ \Omega$, $R_4 = R_3 = 100\ \Omega$, $r_2 = 32{\cdot}7\ \Omega$, $L_2 = 47{\cdot}8$ mH. Calculate L_1 and r_1. $1 + 5 + 5 + 4$

9. Write short notes on any *three* of the following : $3 \times 5 = 15$
   a) Error in MI type instrument (DC and AC)
   b) Spectrum analyser
   c) Q-meter
   d) LVDT
   e) Low resistant measurement.