

JK Lakshmipat University, Jaipur
Institute of Engineering and Technology

End Term Examination

B.Tech. III Year/[V Semester]/[2014]

Student ID



Course Name: Engineering Materials and Components

Course Code: ECE 503

Max Marks: 40

Time: 03.00 hr

Instructions:

1. Attempt all sections.
2. Questions must be answered in proper sequence.

Section A

Q.1. Tick the correct choice and write your selection in the answer sheet. [0.5x10=5]

- (i) Which of the following instruments will be used to measure alternating current?
(a) moving-iron voltmeter (b) permanent magnet type ammeter
(c) induction-type ammeter (d) moving-coil voltmeter
- (ii) The source of emission of electrons in a CRT is:
(a) Diode (b) accelerating anodes
(b) Post accelerating anodes (d) oxide coated cathode
- (iii) The value of permeability of a magnetic material in air is:
(a) $4\pi \times 10^{-7}$ (b) $4\pi \times 10^{-9}$ (c) $2\pi \times 10^{-7}$ (d) $\pi \times 10^{-7}$
- (iv) Magnetic pick-up sensors produce:
(a) Pulses from a rotating shaft with mechanical contact
(b) Pulses from a rotating shaft without any mechanical contact
(c) An analog signal in the form of a continuous drag
(d) None of the above
- (v) The performance of capacitive level indicator is severely affected by dirt, because they change:
(a) area of plate (b) distance between two plates
(c) dielectric constant (d) none of the above
- (vi) Laser based level measurement depends on:
(a) the accurate detection of the time it takes for a light pulse to travel to the process material surface and back.
(b) The velocity of light
(c) X-ray radiation
(d) All of them

- (vii) Metals used in Bourdon tubes should not undergo:
 (a) fatigue (b) hysteresis (c) creep (d) all of the above
- (viii) A capacitive pressure transducer indicates changes in pressure by changing the:
 (a) voltage output of an a.c. circuit (b) alternating current
 (c) capacitance (d) frequency
- (ix) Radiation pyrometers:
 (a) contain a radiation detector
 (b) compare objects visible radiation with that of a reference
 (c) contains no recording device
 (d) all of the above
- (x) In inductive type thickness gauge, the inductance of the coil depends on:
 (a) reluctance of the magnetic circuit
 (b) eddy current of magnetic circuit
 (c) capacitance of the magnetic circuit
 (d) all of these

Q.2. Fill in the blanks:

[1x5=5]

- (i) The three main controls in a CRO are (a) _____, (b) _____, and (c) _____.
- (ii) Gauge factor of the strain gauge is defined as the unit change in _____ per unit change in _____.
- (iii) The capacitance of a capacitor is directly proportional to _____ and _____ and inversely proportional to _____.
- (iv) Bimetallic thermometers are made of two metals with different _____.

Section B

(20 Marks)

Solve any four questions. All questions carry equal weightage.

- Q.B1. A platinum resistance sensor is to be used to measure temperatures between 0 and 200°C. Given that the resistance $R_T \Omega$ at $T^\circ\text{C}$ is given by $R_T = R_0(1 + \alpha T + \beta T^2)$ and $R_0 = 100.0$, $R_{100} = 138.50$, $R_{200} = 175.83\Omega$, calculate:
 (a) the values of α and β
 (b) the non-linearity at 100°C as a percentage of full-scale deflection.
- Q.B2. Design a high input impedance amplifier with a voltage gain of 42.
- Q.B3. A variable dielectric capacitive displacement sensor consists of two square metal plates of side 5 cm, separated by a gap of 1 mm. A sheet of dielectric material 1 mm thick and of the same area as the plates can be slid between them as shown in Figure Q.B3. Given that the dielectric constant of air is 1 and that of the dielectric material 4, calculate the capacitance of the sensor when the input displacement $x = 0.0, 2.5$ and 5.0 cm.

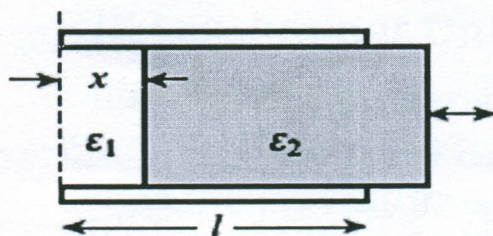


Fig Q. B.3.



Q.B4. Figure Prob. B.4. shows a block diagram of a force transducer using negative feedback. The elastic sensor gives a displacement output for a force input; the displacement sensor gives a voltage output for a displacement input. V_S is the supply voltage for the displacement sensor.

(a) Calculate the output voltage V_0 when

(i) $V_S = 1.0 \text{ V}$, $F = 50 \text{ N}$

(ii) $V_S = 1.5 \text{ V}$, $F = 50 \text{ N}$.

(a) Comment on the practical significance of the variation of the supply voltage V_S .

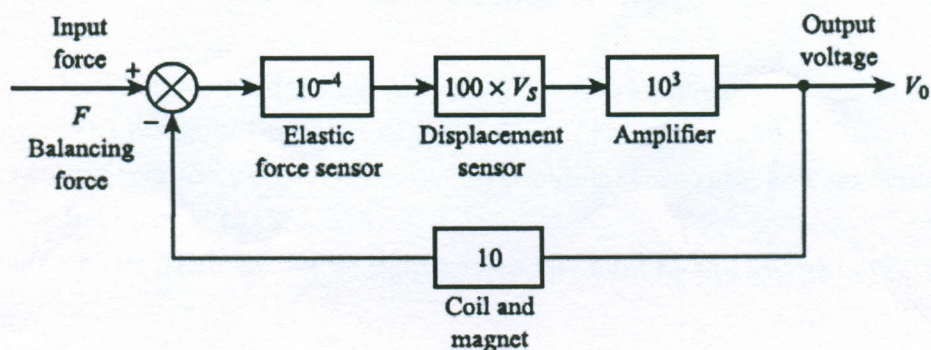


Fig. Q.B.4.

Q. B.5. Specify the circuit and components for opamp circuit with a gain of -4.5.

Section C

(10 Marks)

Q.C. Develop a control system of an automatic coffee vending machine. Insertion of a coin and pushing of buttons provides a paper cup with coffee that can be black, with sugar, with cream, or with both. Describe and design a complete PLC based system to perform this task.