Name : .....

Roll No. : .....

Invigilator's Signature : .....

2010

MECHATRONICS AND MODERN CONTROL

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct lternatives for any *ten* of the following : 10 × 1 = 10

   i) LVDT can measure

      a) strain b) displacement

      c) f rce d) all of these.

   ii) Differential amplifier

      a) amplifies the difference between the input voltages

      b) compares which of the two voltages is larger

      c) inverts the potential difference

      d) none of these.

   iii) Pressure can be measured by the use of

      a) The Bourdon Tube b) Accelerometer

      c) Tachometer d) Encoder.

iv) A 4/2 DCVs has

a) 2 ports b) 4 ports

c) 6 ports d) none of these.

v) Laplace Transform of unit step function is

a) s b) $\frac{1}{s}$

c) s^2 d) $\frac{1}{s^2}$.

vi) The binary equivalent to $(39)D$ is

a) 100111 b) 101001

c) 111000 d) none of these.

vii) The example of solid state switch is

a) diode b) thyristor

c) triac d) all of these.

viii) The condition of a normal poppet valve is

a) open b) close

c) either open or close d) none of these.

ix) Program counter is a register of

a) 1 bit b) 8 bit

c) 16 bit d) 64 bit.

x) The crystalline material which generate charge in response to heat flow is known as

a) pyroelectric b) piezoelectric

c) thermistors d) thermostats.

xi) The Boolean equation for the XOR gate is

a) $A.B = Q$ b) $\overline{A} = Q$

c) $A + B = Q$ d) None of these.

xii) In a word microprocessor means

a) CPU-on-a-chip

b) ALU-on-a-chip

c) Computer-on-a-chip

d) IC-on-a-chip

e) microscope processing.

xiii) Semicondutor type tempeature sensor is

a) RTD b) Thermistor

c) Thermome er d) Pyrometer.

xiv) Non Musk-able interrupt is

a) RST 7 5 b) RST 6·5

c TRAP d) INTR.

xv) Self generating transducers are

a) passive transducer

b) active transducer

c) primary transducer

d) secondary transducer.

GROUP – B

(Short Answer Type Questions)

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

2. In binary coding A = 1001001011 and B = 110001101. Find the value of $A + B$ and $A - B$ in binary and hexadecimal format.

3. State the characteristics of stepper and brush less DC motor.

4. Compare between hydraulic and pneumatic control circuit system.

5. What effect does a flow control valve have on an actuator ? What is another way to control he flow rate to an actuator ? Describe the difference between meter-in and meter-out flow control. Draw a hydra lic cylinder with meter-in-flow control of both strokes.

6. Write short notes on operational amplifier and also state its applications. $\frac{1}{2} + \frac{1}{2} + 2 + 2$

GROUP – C

(Long Answer Type Questions)

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

7. a) State the role of PLC. Draw a ladder logic program where an eclectic motor is to be run by using one open contact push button switch, one closed contact push button switch and a relay switch. 7

b) Write the names and main functions of hydraulic symbols are marked (by 1 to 10) in the hydraulic circuit diagram of an automobile breaking system given in figure. 8

Figure 1 : Hydraulically control automobile breaking system circuit diagram.

8. a) Along with the necessary circuit explain how 4 numbers of bonded strain gauges can be used for measuring force giving the highest sensitivity. 6

   b) How a thermostat can be used as a controller ? 4

   c) What is piezoelectricity ? How can it be used as force measurement or pressure sensor ? 5

9. Show that output voltage is proportional to mechanical strain for small change in gauge resistance.

   A resistance is bonded to a beam of 50 mm long and having a cross section of 5 mm^2 and Young modulus E = 200 GPa. The strain gauge has a unstrained resistance of 220 Ω and gauge factor (GF) of 2 when a load is applied a resistance change by 0·013 Ω. Find the change of length of the beam and amount of force applied to beam.

10. a) Prove that, NOR gates are the universal gates. 3

    b) De cribe with block diagram an 8085 microprocessor. What are the importances of microprocessors and microcontrollers ? 8

    c) Write a program for Intel 8085 microprocessor to add two binary numbers A = 11 and B = 10 and store the result. 4

11. a) Compare the characteristics of open-loop and closed-loop control systems in machines or process control applications. 5

b) A closed-loop system shown in Figure. 1 has a process transfer function $G(s)=\frac{1}{s(s+4)}$ and is used with proportional control. Obtain the following :

i) the system type

ii) the steady-state errors when used with a step input and ramp input. 10

Figure. 2 : System with proportional control