Roll No. .....

22225

M. E./M. Tech. 1st Semester (M.D.)

Examination – June, 2013

MECHATRONICS AND PRODUCT DESIGN

Paper : M-809-A

Time : Three hours] *[Maximum Marks : 100*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt any *five* questions. All questions carry equal marks.

1. (a) Describe the role of Mechatronics in industries. Also list some Mechatronics system you see every day. 10

(b) Mechatronics is the synergistic integration of mechanical engineering with electronics and control engineering for the design and manufacture of products. Justify the statement. 10

2. (a) Draw the circuit of an S-R flip flop using NAND gates. Modify it to include clock. Derive J-K

circuit from S-R flip flop circuit & explain its, truth table. 10

(b) Give the comparison between microprocessors and microcontrollers. 10

3. (a) Explain the different types of control systems with suitable examples. 10

(b) A strain gauge is bonded to a beam which is 10 cm long and has a cross-sectional area of 4 cm^2. The unstrained resistance and gauge factor of the strain gauge are 220 ohm and 2.2 respectively. On the application of the load, the resistance of the gauges changes by 0.013 ohm. If the modulus of elasticity for the steel is 207 GN/m^2, calculate : 10

(i) the change in the length of the steel beam and

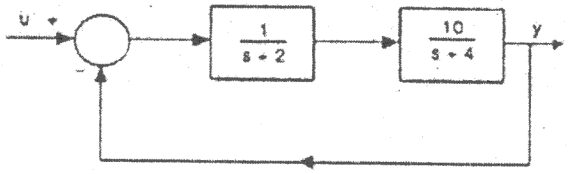
(ii) the amount of force applied to the beam.

4. (a) Give a comparison between analog type and digital type instruments. 10

(b) Draw the circuit of a counter type A/D converter and explain its operation. 10

5. (a) What is an electrical actuation system ? What are the devices used in such systems ? 10

(b) A feedback control system has transfer function of $G(s)=\frac{s^2+3s+2}{s(s^2+7s+12)}$. Derive two different state models for the system, giving the state-equations for each model. 10



6. (a) Discuss briefly the various thermal systems building blocks. 10

(b) A hot object, capacitance C and temperature T, cools in a large room at temperature T_r. If the thermal system has a resistance R. Derive an equation describing how the temperature of the hot object changes with time and give an electrical analogue of the system. 10

7. (a) Explain an incremental encoder. What are their applications ? 10

(b) What are the various sensors and actuators used in CNC machines ? Explain their working in CNC machines. 10

8. Write down a short explanation to express your understanding on any *five* of the following terms : $4 \times 5 = 20$

(a) Light sensors,

(b) Pneumatic and hydraulic system,

(c) Application of flip flops,

(d) Load cell,

(e) Stepper motor and servo motors,

(f) Use of MATLAB and SIMULINK.
