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C 3389

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Seventh Semester

Mechanical Engineering

ME 1402 — MECHATRONICS

(Common to B.E. Part-Time Mechanical Engineering)

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Identify the different mechatronics systems used in automobiles.
2. What is the working principle of an eddy current proximity sensor?
3. A hydraulic cylinder is to be used to move a work piece through a distance of 60 mm in 20 seconds. A force of 15 kN is required to move the work piece. Determine the required hydraulic liquid flow rate if a cylinder with a piston diameter of 75 mm is available.
4. Suggest suitable actuator for robot arm joint and justify.
5. Derive the equation for a translational mechanical system model with spring and mass.
6. Give an example for two-step mode control unit.
7. Draw the ladder logic diagram to represent two switches that are normally open and both have to be closed for a motor to operate.
8. Devise a timing circuit that will switch an output on for 1 sec then off for 20 sec, then on for 1 sec, then off for 20 sec, and so on.

9. Identify the sensor, signal conditioner and display elements in the Bourdon pressure gauge.
10. List the advantages of mechatronics design over traditional design.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Compare and contrast the control system for the domestic central heating system involving a bimetallic thermostat and that involving a microprocessor. (8)
- (ii) Explain the static performance characteristics of a sensor. (8)

Or

- (b) Write short notes on :
- (i) Thermocouple
- (ii) Piezoelectric transducer
- (iii) Incremental encoder
- (iv) Photovoltaic transducer. (16)
12. (a) Discuss about the following actuation systems :
- (i) Self-excited wound field shunt configuration dc motor.
- (ii) Self-excited wound field series configuration dc motor.
- (iii) Stepper motor.
- (iv) Induction motor. (16)

Or

- (b) A flat belt, 7 mm thick and 95 mm wide transmits power between two pulleys running at 1500 m/min. The mass of the belt is 0.85 kg/m length. The angle of lap in the smaller pulley is 155° and the coefficient of friction between the belt and pulley is 0.25. If the maximum permissible stress in the belt is 2 MN/m^2 find the maximum power transmitted and initial tension in the belt. (16)
13. (a) A hot object with capacitance C and temperature T , cools in a large room at temperature T_a . 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. (16)

Or

- (b) (i) Propose a model for a stepped shaft used to rotate a mass and derive an equation relating the input torque and the angular rotation. Neglect damping effect. (8)
- (ii) Describe and compare the characteristics of
- (1) proportional controller
- (2) proportional plus integral controller. (8)
14. (a) Devise a system, using a PLC that could be used with a conveyor belt which is used to move an item to work station. The presence of the item at the work station is detected by means of breaking a contact activated by a beam of light to a photosensor. There it stops for 100 sec for an operation to be carried out and then starts moving. The motor for the belt is started by a normally open start switch and stopped by a normally closed switch. (16)

Or

- (b) Devise a circuit that could be used with a domestic washing machine to switch on a pump to pump water for 100 sec into the machine, then switch off the pump and switch on a heater for 50 sec to heat the water. The heater is then switched off and another pump is switched on for 100 sec to empty the water from the machine. (16)
15. (a) Explain the mechatronics systems used in an automatic camera with a neat block diagram. (16)

Or

- (b) Design a pick and place robot using mechatronics elements and explain about the robot control. (16)