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ME 1818 PE 22

Roll No. of candidate

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2022

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B.Tech. 8th Semester End-Term Examination

Mechanical Engineering

MECHATRONICS (Program Elective-2)

(New Reg (w.e.f. 2017-18) & New Syllabus (w.e.f. 2018-19))

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Fill in the blanks: (10 × 1 = 10)
- (a) The main function of Actuator is _____. (*to detect motion/to produce motion*).
 - (b) _____ detects the state of system parameters, inputs and outputs. (*Digital controls/Sensors*).
 - (c) _____ not an example of mechatronic system. (*Manual camera/Laser Printer*)
 - (d) The dwell section of the cam is the part that _____. (*allows the follower to remain at the same level for a significant period of time/drives the follower upwards*)
 - (e) A _____ valve is needed when positive displacement pump is used. (*flow control/pressure relief*)
 - (f) The simplest form of direction control valve is a _____. (*needle/check*)
 - (g) The effective area of a double acting cylinder is _____ for the extension stroke than that for the retraction stroke. (*more/less*)
 - (h) A limited rotation hydraulic motor provides rotary output over a _____ angle. (*finite/infinite*)

[Turn over

- (i) _____ drawback of the pneumatic signals. (*Compressibility of fluid (air)/More expensive than hydraulic*)
- (j) _____ part of the microprocessor is used to perform the manipulation of data. (*Resistor/Arithmetic and logic unit*)
2. (a) What are the different classes of mechatronic products? Cite an example of each. (4)
- (b) State four reasons of incorporating mechatronics in manufacturing industry. (4)
- (c) Explain briefly the application of mechatronics in engine management system of an automobile (7)
3. (a) Define the term associated with a transducer:
- (i) Non-linearity error
- (ii) Drift
- (iii) Resolution
- (iv) Output impedance
- (v) Types of inputs. (1+1+1+1+1 = 5)
- (b) Explain the working of a 'displacement' and a 'fluid pressure' measuring sensor. (5+5 = 10)
4. (a) How is the working of a single acting hydraulic cylinder controlled? (5)
- (b) A pressure relief valve contains a poppet with 4.20 cm² area on which the system pressure act. During assembly a spring with a spring constant of 3200 N/cm is installed in the valve to hold the poppet against its seat. The adjustment mechanism is then set so that the spring is initially compressed 0.50 cm from its free length condition. In order to pass full pump flow through the valve at the PRV pressure setting, the poppet must move 0.30 cm from its fully closed position. Determine:
- (i) Cracking pressure;
- (ii) Full pump flow pressure (PRV pressure setting)
- (iii) What should be the initial compression of the spring in the PRV, if the full pump flow pressure is to be 40% greater than the cracking pressure? (2+2+3+3 = 10)

5. (a) What are 'inverting' and 'non-inverting' amplifiers. (3+3 = 6)
- (b) Show that the output signal is the sum of input signals for an adder circuit. (5)
- (c) Show the function of a comparator to check the focus of laser light on CD. (4)
6. (a) What are the three main parts of a microprocessor? (3)
- (b) Write the transfer function of a spring-mass damper system. Indicate the state of damping of a system having the transfer function $G(s) = \frac{1}{s^2 + 8s + 16}$ and subjected to a unit step input. (2+5 = 7)
- (c) Write a note on *proportional controllers*. (5)
7. Write short notes on (*any three*): (3 × 5 = 15)
- (a) External Gear Pump
- (b) Stepper motor
- (c) Control of double acting pneumatic cylinder
- (d) Ladder symbols.
- (e) Microprocessor v/s Microcontroller.
- (f) Programming sequence in CNC turning.

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