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Roll No.

CC82

M. Tech. EXAMINATION, 2021

(Third Semester)

(B. Scheme) (Re-appear)

(ME)

MEM601B

MECHATRONICS

Time : 2½ Hours]

[Maximum Marks : 75

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

Note : Attempt *Four* questions in all. All questions carry equal marks.

1. (a) Describe Mechatronics design process and advance approaches in mechatronics.
(b) Define sensor and transducer. Describe performance characteristics of commonly used sensors used in mechatronics systems. Describe the sensor that is used to measure the fuel level in the tank in the modern cars.
2. (a) Explain the requirements for signal conditioning. Describe the principle and main methods of digital-to-analogue convertor.
(b) Name the various types of displays. Explain any *one* of the display system for data presentation.
3. (a) Explain the principle of process control valves, their characteristics and sizing.
(b) Explain the principle and working of the variable reluctance stepper motor.

4. (a) Derive a differential equation for a DC generator. The generator may be assumed to have a constant magnetic field. The armature circuit has the armature coil, having both resistance and inductance, in series with load. Assume that the load has both resistance and inductance.
- (b) What will be (i) the undamped angular frequency, (ii) the damping factor, (iii) the damped angular frequency, (iv) the rise time, the percentage maximum overshoot and (v) the 0.2% setting time for a system which gave the following differential equation for a step input y ?

$$d^2x/dt^2 + 5dx/dt + 16x = 16y.$$
5. (a) A closed-loop system has a forward path having two series elements with transfer function 5 and $1/(s+1)$. If the feedback path has a transfer function $2/s$, what is the overall transfer function of the system ?
- (b) What will be the steady-state response of a system with a transfer function $5/(s^2 + 3s + 10)$ when subject to the input $2 \sin(2t + 70^\circ)$?
6. Explain the basis on which the following forms of adaptive control system function :
 - (a) gain-scheduled
 - (b) self-tuning
 - (c) model-reference.
7. (a) Explain what logic gates might be used to control a safety locks system for the operation of a machine tool.
- (b) Draw a block diagram of a basic microprocessor and explain the function of each subsystem.
8. Compare and contrast possible solutions to design problems when considered from the traditional and mechatronic point of view.