Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (EE)/SEM-1/CIM-104(b)/2010-11

2010-11
INDUSTRIAL AUTOMATION AND 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.

Answer Question No. 1 compulsorily and any *four* from the rest.

1. Answer *all* the following : 7 × 2 = 14

   a) Hick's clinical thermometer measures human body temperature. The instruction is to wait for half-a-minute before taking the reading. Is it because the measuring system is

      i) a zero order system with a pure time delay of a half-a-minute

      ii) a first order system with a time constant greater than half-a-minute

      iii) a first order system with a time constant equal to half-a-minute

      iv) a first order system with a time constant less than half-a-minute ?

      Explain your answer.

b) Which detector would you use for *dynamic* strain measurement in a cantilever beam for impact loading and why ?

c) What are the two additional components added to an *a.c.* signal conditioning circuit and why ?

d) Draw the circuit of a single Op-Amp based buffer amplifier. Find its gain and bandwidth.

e) What are the two important features of an *a.c.* servomotor and how are those achieved by using an aluminium drag cup rotor ?

f) Define *relative* stability of a closed loop system. How is it affected by the presence of the pure time delay in a time delay system ?

g) A programmable logic controller (PLC) basically deals only with discrete inputs and outputs (I/O). How are analog 4-20 mA and 0-10 mA and 0-10 V input signals going to be typically represented in the PLCs ?

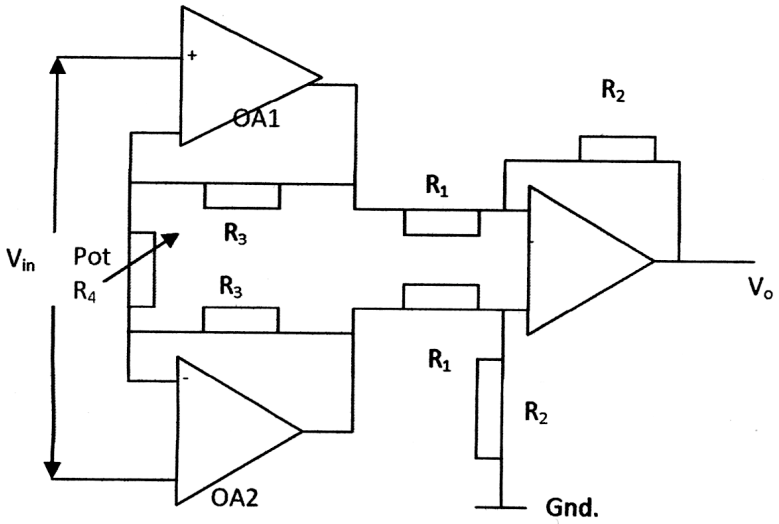
2. a) Give in block diagrammatic form the complete *d.c.* signal conditioning circuit.

b) Explain how 'zeroing' and 'calibration' are achieved in above.

c) The strain in a cantilever beam due to loading is measured by a set of four identical resistance strain gauge. Show by a neat sketch the placement of the gauges, the connection diagram in the bridge circuit and derive the strain measurement formula. 4 + 4 + 6

3. a) A single Op-Amp based instrumentation amplifier (IA) suffers from certain deficiencies. What are those ?

b) A three Op-Amp based IA is shown in Fig. below. Analyze the circuit to find its gain parameter. Are the deficiencies mentioned above removed ?



4 + 6 + 4

4. a) Power system engineers use supervisory control and data acquisition (SCADA) for distribution automation purpose. Draw in block diagrammatic form the data acquisition (DA) system and give brief description of the constituent blocks.

b) How would you add supervisory control command and acknowledge instructions to the system ? 4 + 6 + 4

5. a) Explain the construction and principle of action of a VR or PM step motor.

   b) What is half-stepping and micro-stepping in connection with step motor operation ? Explain with torque diagrams.

   c) Draw and explain the switching circuit for the step motor. (2 × 3) + 4 + 4

6. a) Draw the circuit of an analog electronic P-I-D controller and find its transfer function. Identify the elements for setting the proportional band, reset and rate times.

   b) Deduce the incremental P-I-D control law for implementation on a digital processor. 4 + 4 + 2 + 4

7. Write an essay on communication and networking in instrumentation with emphasis on serial and parallel communications and field bus architecture for networking. 6 + 4 + 4

8. Write short notes on any *two* of the following : 2 × 7

   a) Lock-in amplifiers and its use in *a.c.* signal conditioning circuits

   b) Noise considerations, use of shielded wire in instrumentation

   c) Two phase *a.c.* servo motor, unbalanced operation

   d) Embedded systems — definition, application area and firmware.