



Name :

Roll No. :

Invigilator's Signature :

**CS/M.Tech(EE (CI))/SEM-1/CIM-104(B)/2011-12
2011**

INDUSTRIAL AUTOMATION & CONTROL

Time Allotted : 3 Hours

Full Marks : 70

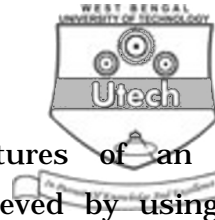
The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Instructions : Answer Question No. 1 and any *four* from the rest.
All questions carry *equal* marks. Try to answer to
the point.

1. Answer the following. $7 \times 2 = 14$

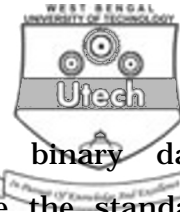
- a) What kind of a detector would you employ for dynamic strain measurement in a cantilever beam for impact type of loading ?
- b) What are the two additional components needed in an ac signal conditioning circuit and why ?
- c) Draw the circuit of a single Op-Amp based unity gain buffer amplifier. Show that its gain is unity.
- d) A synchro pair acts as an angular position error detector in carrier current systems. The output of the control transformer is directly fed to the control winding of the two phase ac servomotor. Would the motor be able to recognize the error polarity ? Explain.



- e) What are the two important features of an ac servomotor and how are those achieved by using a 'drag cup' type aluminium rotor ?
 - f) Why is a system with pure time delay, an infinite dimensional system ? How is the relative stability of the system affected by presence of the time delay ?
 - 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 V input signals typically represented in the PLCs ?
2. a) Give in block diagrammatic form the complete *dc* 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 gauges. Show by a neat sketch the placement of the gauges, their placement in a bridge circuit and derive the strain measurement formula. 4 + 4 + 6
3. a) Give in block diagrammatic form, a complete data acquisition and control (DA & C) system.
- b) Describe in brief the analog and digital input-output subsystems.
- c) Derive an equivalent digital control law for the P-I-D controller. 4 + 6 + 4



4. a) Explain the construction and principle of action of a step motor.
- b) What is half-stepping and micro-stepping in connection with step motor operation ? Explain with diagram.
- c) What is the difference between open loop and closed loop operation of the step motor ? $2 \times 4 + 4 + 2$
5. a) Why is it that in the process industry a pneumatic controller is preferred to an electronic controller ?
- b) Draw the circuit of an electronic analog P-I-D controller and derive its input-output relationship.
- c) Is the controller interacting or non-interacting type ? $2 + (4 + 6) + 2$
6. a) In what ways do the Programmable Logic Controller (PLC) differ from the general purpose compute ?
- b) List the important subsystems of a PLC and find the limits of its application areas.
- c) Expound the relay ladder logic and illustrate its use in PLC programming with an example. $2 + (4 + 2) + (4 + 2)$



7. a) RS-232 is the standard for serial binary data interconnector in instrumentation. Give the standard details and describe any one of the RS-232 connectors with pin configuration.
- b) What is the advanced version of the above and why is it advanced ?
- c) What is the IEEE standard digital interface for programmable instrumentation ? Briefly state its characteristics. $(2 \times 4) + 2 + 4$
8. Write short notes on any *two* of the following : 2×7
- a) Three Op-Amp based instrumentation amplifier
- b) Noise considerations in instrumentation
- c) Field bus architecture for networking in instrumentation
- d) Embedded systems : definition, application area and firmware.
-