

Name :

Roll No. :

Invigilator's Signature :

**CS/M.Tech(EE-OLD)/SEM-2/CI-2.5.1/2011
2011**

INDUSTRIAL AUTOMATION AND CONTROL

Time Allotted : 3 Hours

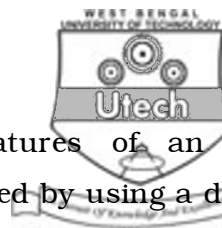
Full Marks : 70

The figures in the margin indicate full marks.

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

Question No. 1 is compulsory. Answer another *four* questions from the rest seven questions. All questions carry equal marks. Answers must be brief and to the point.

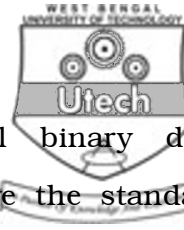
1. a) Which detector would you use for dynamic strain measurement in a cantilever beam fitted with strain gauges for impact loading ?
- b) What are the two additional components added in an *ac* signal conditioning circuit and why ?
- c) Draw the circuit of a single Op-Amp based unity gain buffer amplifier. Show that the gain is unity and what is its approximate input impedance ?
- d) A synchro transmitter and two synchro transformers are to be connected in a repeater system. that is, any (mechanical) angular input to the transmitter would be repeated in the two control transformers placed at remote locations. To start with, all three of them were aligned. Draw the connection diagram.



- 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 or 0-10 V input signal typically interpreted in the PLCs ? 2 × 7
2. a) Give in block diagrammatic form the complete *dc* signal conditioning circuit.
- b) Explain how zeroing and calibration are achieved in the 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 the analog input and the 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 ? $2 \propto 4 + 4 + 2$
5. a) Why is it that in the process industry a pneumatic controller is preferred to an electronic controller ?
- b) Draw schematically a pneumatic P-I-D controller and derive the input-output relationship.
- c) Is the controller interacting or non-interacting type ? $2 + (4 + 6) + 2$
6. a) State the ways in which a programmable logic controller (PLC) differs from a general purpose computer ?
- 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 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 it is so ?
- 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) Noise considerations in instrumentation
- b) Nozzle-flapper type amplifier in pneumatic control
- c) Realization of analog P-I-D controller using Op-Amps
- d) Field bus architecture for networking in instrumentation.
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