

Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech (ME)/SEM-1/ME-104/2009-10
2009
SIGNAL CONDITIONING &
DATA ACQUISITION SYSTEM

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.*

GROUP - A

Answer any *three* questions.

1. a) What is the purpose of analog signal conditioning ? 2
- b) Mention two areas where Wheatstone bridge is used for signal conditioning. 2
- c) What is 'lead compensation' ? How can Wheatstone bridge be used for reducing error due to 'lead compensation' ? 5
- d) A bridge circuit is used with a sensor located 100 m away. The bridge is not lead compensated and the cable to the sensor has a resistance of $0.45 \Omega/\text{m}$. The bridge nulls with $R_1 = 3400 \Omega$, $R_2 = 3445 \Omega$ and $R_3 = 1560 \Omega$. What is the sensor resistance ? 5



2. a) What do you mean by 'impedance matching' ? 2
- b) What is 'critical frequency' of a passive high-pass filter ?
Find out the output voltage to input voltage ratio of that filter. 5
- c) Pulses for a stepper motor are being transmitted at 2000 Hz. Design a filter to reduce 60 Hz noise but reduce the pulses by no more than 3 dB. 5
- d) Mention the drawbacks of 'passive divider circuit'. 2
3. a) Draw the circuit diagram of an 'Instrumentation Amplifier'. Find out the input-output relation. Mention two areas of its application. 5
- b) A sensor outputs a range of 20 – 200 mV as a variable varies over its range. Develop signal conditioning circuit so that the voltage becomes 0 – 5 V. The circuit should have very high input impedance. 5
- c) Draw and explain the operation of 'span and zero' adjustment circuit. 4
4. a) Mention the names of different types of voltage to current converter. Why is the conversion from voltage signal to current signal needed ? 2
- b) What do you mean by 'loading error' ? 2

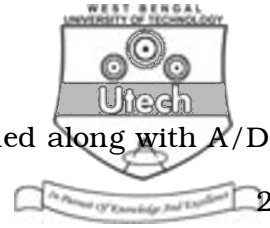


- c) Draw and explain the operation of a 'voltage to current converter' with grounded load. 5
- d) What is 'triac' ? Draw the circuit of a 1 ϕ half-controlled full-wave rectifier with series connected R - L load. Draw and explain the output waveform of such a circuit. 5
5. a) Design a 1st order high-pass Butterworth filter with cut-off frequency of 1.5 kHz and pass-band gain of 2. 5
- b) What is 'notch' filter ? Design a 60 Hz active notch filter circuit. 5
- c) Draw the circuit and output waveform of a 'wideband reject' filter. 4

GROUP - B

Answer any *two* questions.

6. a) What is 'shaft encoder' ? Explain its operation with diagram. 5
- b) Mention the advantages of 'successive approximation' type A/D converter. Explain its operation with block diagram. 2 + 5
- c) What is 'flash converter' ? 2



7. a) Why is 'sample and hold' circuit needed along with A/D converter ? 2
- b) Name the different types of errors introduced in S & H circuit using MOS switches ? 1
- c) How are those errors eliminated in series sampling ? Explain with diagram. 6
- d) State and prove 'uniform sampling theorem'. 5
8. a) Draw and explain the operation of a multi-channel Data Acquisition System (DAS). 5
- b) What type of ADCs are used for DAS and why ? 4
- c) For what specific purpose PLC is used ? What is 'Ladder diagram' ? 5
9. Write short notes on any *two* of the following : 2 × 7
- a) Data logger
- b) Pulse amplitude modulation
- c) R-2R ladder circuit.
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