Code : 041606

B.Tech 6th Semester Exam., 2015

INTELLIGENT INSTRUMENTATION

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are ***NINE*** *questions in this paper.*

(iii) Attempt ***FIVE*** *questions in all.*

(iv) Question No. ***1*** *is compulsory.*

Answer any *seven* of the following questions : 2×7=14

A differential amplifier having CMRR 50,000 has a difference mode gain of 500. Calculate its common mode gain.

An active half-wave voltage follower circuit has an input of $10 \sin \omega t$ V. If the input resistance is 2 kΩ and feedback resistance is 10 kΩ, find the expression for the output voltage.

(c) List the desirable properties of an ideal OPAMP.

(d) Give the expression for the gain of a high-pass filter at a frequency ω, if its time constant is τ.

(e) State the condition when a low-pass RC filter acts as pure integrator.

(f) An 8-bit converter is used for a d.c. range of 0–10 V. Find the weight of LSB.

(g) A successive approximation ADC has a resolution of 20 mV. What will be its digital output for an analog input of 2·17 V?

(h) The 0–10 V ADC has to have a resolution of 0·025%. Find the r.m.s. value of quantization error.

(i) Define accuracy.

(j) How many different voltages can be output for a DAC with 6–bit resolution?

2. (a) Discuss the different features that differentiate an 'intelligent instrumentation' system from a 'dumb instrumentation' system. 7

(b) Discuss the components of an intelligent instrumentation system with the help of a block diagram. 7

Draw the circuit diagram of an instrumentation amplifier and derive the expression for gain. 7

(Continued)

(b) Derive the expression for transfer function of a band-pass RC filter. Draw its characteristics and also the Bode diagram. 7

4. (a) What are active filters? Describe a low-pass active filter and derive the expression for its cut-off frequency. Also, draw its frequency characteristics. 7

(b) Design a high-pass filter with a characteristic resistance of 50Ω and a cut-off frequency of 20 MHz and an attenuation of 80 dB at 5 MHz. 7

5. (a) Explain the working of current to voltage converter with a circuit diagram Compare it with a voltage follower circuit. 8

(b) Briefly explain the working of the following : 3×2=6

(i) Signal Integrator

(ii) Signal Multiplier

6. (a) Discuss smart sensor with the help of a block diagram.

(b) What do you mean by primary smart sensor? What are the application areas of smart sensor? 7

7. (a) What are the different types of compensation that can be achieved in smart sensors? 7

(b) Explain in brief the protocol for communication between host and smart sensor. 7

8. (a) Explain briefly the following terms with respect to an ADC : 2×4=8

(i) Quantization error

(ii) Resolution

(iii) Aperture time

(iv) Coding

(b) An analog voltage signal whose highest significant frequency is 1KHz is to be digitally coded with a resolution of 0·01% covering a voltage range of 0–10 V :

(i) Determine minimum number of bits in the digital code.

(ii) Determine r.m.s. value of quantization error.

(iii) Determine aperture time. 6

9. Write short notes on the following : 7×2=14

(a) Phase-locked loop

(b) R-2R digital to analog converter

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