

M.Tech..I.E.E. 1st Yr. 1st Semester Examination, 2024-25

SUBJECT: Sensor Interfacing Circuits

Code: PG/IEE/PE/T/113A

Figures out of the right margin indicate full marks.

Instructions: ***Candidates are required to answer Group A and any 9 (nine) from Group B to D taking at least 2 from each group***

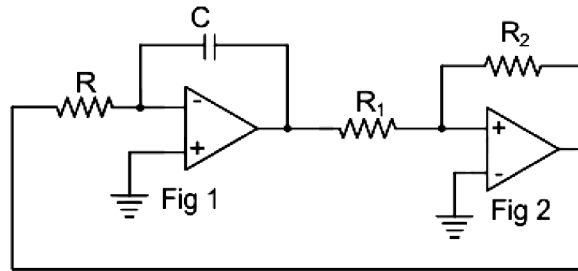
Group – A

10x1=10

- (i) In Schmitt trigger circuit, the nature of feedback is
- (a) positive
 - (b) negative
 - (c) nil
 - (d) imaginary
- (ii) To reject common mode noise, we prefer
- (a) instrumentation amplifier
 - (b) inverting amplifier
 - (c) integrating amplifier
 - (d) summing amplifier
- (iii) If we increase the order of the filter, it becomes
- (a) more practical
 - (b) less complex
 - (c) ideal
 - (d) non ideal
- (iv) Data acquisition is the process in which, physical variables from the real world are
- (a) converted into electrical signals
 - (b) modified and converted into a digital format for processing
 - (c) converted into mechanical signals
 - (d) converted into pneumatic signal

(v)

(v)



The Fig 1 and Fig. 2 represent

- (a) Integrator and differentiator
 - (b) Oscillator and multivibrator
 - (c) Integrator and Schmitt trigger
 - (d) Differentiator and integrator
- (vi) A Schmitt trigger circuit achieves hysteresis by utilizing
- (a) The magnetic properties of transformer core
 - (b) Avalanche multiplication in Zener diode
 - (c) The Barkhausen principle
 - (d) Regenerative positive feedback
- (vii) The number of comparators required in a 4 bit Flash Analog to Digital converter (ADC) is
- (a) 4
 - (b) 5
 - (c) 15
 - (d) 16
- (viii) The resolution of a Digital to Analog Converter is dependent on
- (a) number of bites
 - (b) input impedance
 - (c) sampling rate
 - (d) conversion time
- (ix) The advantage of using a dual slope Analog to Digital converter in a digital multimeter is that
- (a) Its high accuracy
 - (b) Its less conversion time
 - (c) Its output in BCD format
 - (d) Its uses comparator
- (x) In Data acquisition, physical variables from the real world are
- (a) converted into pneumatic signals
 - (b) modified and converted into a digital format for processing
 - (c) converted into mechanical signals
 - (d) modified and converted into hydraulic signal

Group B (C01)

2. (a) Why signal conditioning circuitry is required to process the sensor output?
- (b) With a suitable circuit diagram describe the signal conditioning circuitry for AC LVDT.
- (c) Name three different types of commonly used LVDTs. Specify their applications in industry.

2 + 5 + 3 = 10

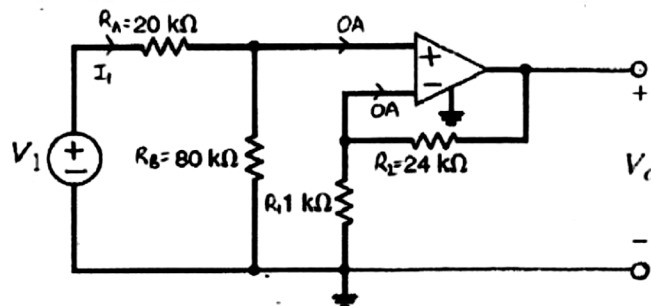
3. (a) What do you understand by the term CMRR?
- (b) Can you replace an instrumentation amplifier used in the signal conditioning circuit of a particular transducer by a differential amplifier? Give reasons.

3 + 3 + 4 = 10

4. (a) How is the common mode signal rejected by using Instrumentation amplifier in signal conditioning circuitry?
- (b) Compare integrator with differentiator from the application point of view.
- (c) Estimate the percentage error in output voltage due to finite CMRR of 50 dB, when the inputs are $V_1=1.0$ volt and $V_2= 1.01$ volt for the OpAmp.

3 + 3 + 4 = 10

5. (a) State briefly the working principle of 2-wire transmitter. Explain the usage of V to I and I to V amplifier in sensor interfacing.
- (b) Calculate the gain of the amplifier given below.



3 + 4 + 3 = 10

Group C (CO2)

6. (a) How does a dual slope integrating type ADC function?
 (b) Which type of ADC will you prefer for high conversion speed and how does this converter achieve high speed?
 (c) Calculate the number of comparators required to construct a 3 bit ADC.

$$4 + (2 + 3) + 1 = 10$$

7. (a) Describe the operation of 4 bit Weighted resistor type DAC.
 (b) State the disadvantages of such type DACs.
 (c) Explain why DAC circuits based on R-2R ladder networks are more popular than binary-weighted resistor networks.

$$4 + 4 + 2 = 10$$

8. (a) Examine the final output voltage expression of a 4-bit R-2R ladder type DAC.
 (b) Explain the operation of any one type of ADC.
 (c) Give an example of Digital to Analog Converter in real life.

$$4 + 4 + 2 = 10$$

9. (a) Define resolution in Analog to Digital Converters.
 (b) An 8 bit DAC has a resolution of 20mV/bit. What is the analog output voltage for the following digital input codes (the MSB is the leftmost bit)?
 (i) 00010110 and (ii) 10000000
 (c) The 4 bit resistance ladder has resistor values of $R = 10\text{k}\Omega$ and $2R = 20\text{k}\Omega$. V_{ref} is 10 V. Find the resolution of the ladder and I_{out} for a digital input of 1111.

$$2 + 5 + 3 = 10$$

Group D (C03)

10. (a) What do you mean by “Brickwall Filter”? How does the behaviour of a band pass filter change if we increase the order?
(b) Discuss the virtual instrumentation from conventional instrumentation.

$$4 + 3 + 3 = 10$$

11. (a) Suggest a suitable transducer for measurement of load in electronic weighing machine.
(b) Explain the working principle of the said transducer.
(c) Illustrate the acquisition circuitry required for the suggested transducer applicable for the above mentioned weighing system.

$$2 + 4 + 4 = 10$$

12. (a) Define multivibrator with a few applications.
(b) How does a VCO work as a multivibrator?
(c) Illustrate the working principle of PLL with a suitable circuit diagram.

$$(2+2)+3+3=10$$

13. (a) What is the significance of using notch filter for biomedical signal conditioning? Design a BP filter of 1st order having lower cut off frequency 2 kHz and higher cut off frequency 100 kHz.
(b) Outline the behaviour of a low pass filter when the filter polynomial's order is increased.

$$(2 + 4) + 4 = 10$$