Program: Instrumentation Engineering
Curriculum Scheme: Rev2019
Examination: SE Semester IV
Course Code: ISC403 and Course Name: Signal Conditioning Circuit Design
Time: 2 hour Max. Marks: 80
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| **Q1.** | **Choose the correct option for following questions. All the Questions are compulsory and carry equal marks** |
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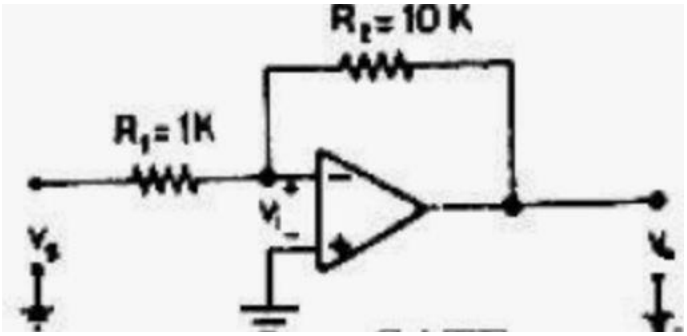
| | |
| 1. | The ideal opamp has the following characteristics |
| Option A: | $R_i= \infty$, $A_v= \infty$,$R_0= \infty$ |
| Option B: | $R_i= 0$, $A_v= \infty$,$R_0= \infty$ |
| Option C: | $R_i= \infty$, $A_v= \infty$,$R_0= 0$ |
| Option D: | $R_i= \infty$, $A_v= 0$,$R_0= 0$ |
| | |
| 2. | The inverting opamp as shown in figure has open loop gain of $2\times10^5$ , Closed loop gain will be   |
| Option A: | $2\times10^5$ |
| Option B: | -10 |
| Option C: | 10 |
| Option D: | -11 |
| | |
| 3. | A comparator with a Schmitt trigger has |
| Option A: | two trigger levels. |
| Option B: | a fast response. |
| Option C: | a slow response. |
| Option D: | one trigger level. |
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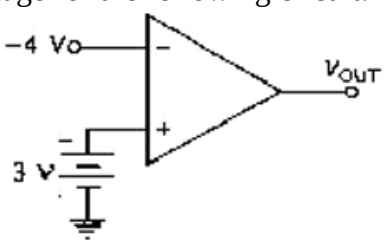
| 4. | Determine the output voltage for the following circuit.   |
| Option A: | +7 |

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| Option B: | -7 |
| Option C: | $+V_{sat}$ |
| Option D: | $-V_{sat}$ |
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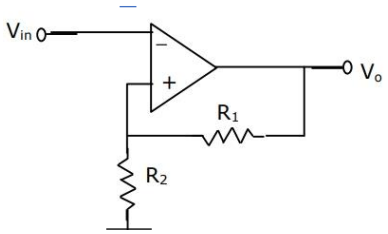
| 5. | The circuit shown in the figure is that of   |
| Option A: | Non-Inverting |
| Option B: | Inverting |
| Option C: | Oscillator |
| Option D: | Schmitt Trigger |
| | |
| 6. | One input terminal of high gain comparator circuit is connected to ground and a sinusoidal voltage is applied to the other input. The output of comparator will be |
| Option A: | Sine Wave |
| Option B: | Full rectified Sine Wave |
| Option C: | Half rectified Sine Wave |
| Option D: | Square Wave |
| | |
| 7. | Typically, an instrumentation amplifier has an external resistor used for |
| Option A: | establishing the input impedance |
| Option B: | setting the voltage gain |
| Option C: | setting the current gain |
| Option D: | interfacing with an instrument |
| | |
| 8. | A peak detector consists of |
| Option A: | a comparator, a transistor, and a capacitor |
| Option B: | a comparator, a diode, and a capacitor |
| Option C: | a comparator, a diode, and an inductor |
| Option D: | an integrator, a diode, and a capacitor |
| | |
| 9. | A monostable multivibrator has R = 100kΩ and the time delay T = 100ms, calculate the value of C? |
| Option A: | 1 µF |
| Option B: | 0.9µF |
| Option C: | 9µF |
| Option D: | 0.09µF |
| | |
| 10. | If the differential voltage gain and the common mode voltage gain of a differential Amplifier are 48 dB and 2 dB respectively, then it's common mode Rejection Ratio is |
| Option A: | 48dB |
| Option B: | 50dB |
| Option C: | 46 dB |
| Option D: | 23dB |

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| 11. | A 22-kohm resistor and a 0.02-μF capacitor are connected in series to a 5-V source. How long will it take the capacitor to charge to 3.4 V? |
| Option A: | 0.4ms |
| Option B: | 0.5ms |
| Option C: | 0.6ms |
| Option D: | 0.7ms |
| | |
| 12. | What is the major advantage of the R/2R ladder DAC as compared to a binary-weighted-input DAC? |
| Option A: | Its operation is much more easily analyzed. |
| Option B: | The virtual ground is eliminated and the circuit is therefore easier to understand and troubleshoot. |
| Option C: | It uses only two different resistor values. |
| Option D: | It has fewer parts for the same number of inputs. |
| | |
| 13. | A RTD has a resistance of 2Ω at 0° C and 3Ω at 100° C. What will be the resistance when temperature rises to 300° C. |
| Option A: | 4Ω |
| Option B: | 5Ω |
| Option C: | 1Ω |
| Option D: | Will remain same |
| | |
| 14. | When the reference junction is the same temperature as the measurement junction in a thermocouple circuit, the output voltage (measured by the sensing instrument) is |
| Option A: | Unreliable |
| Option B: | Noisy |
| Option C: | Reverse polarity |
| Option D: | Zero |
| | |
| 15. | The draw backs of strain gauges are:<br><br>S1: Low fatigue life<br>S2: They are expensive, brittle and sensitive to temperature<br>S3: Poor linearity<br>Choose the correct one |
| Option A: | S1 only |
| Option B: | S1 and S3 |
| Option C: | S2 and S3 |
| Option D: | S1 and S2 |
| | |
| 16. | Find the strain that results from a tensile force of 1000 N applied to a 10-m aluminum beam having a cross-sectional area. Solution The modulus of elasticity is $6.89X10^{10}$ |
| Option A: | 3.63μm/m |

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| Option B: | 36.3μm/m |
| Option C: | .275μm/m |
| Option D: | 2.75m/μm |
| | |
| 17. | Which signal conditioning circuit is most suitable for photovoltaic detectors |
| Option A: | Inverting Amplifier |
| Option B: | Voltage divider |
| Option C: | I to V converter |
| Option D: | Wheatstone Bridge |
| | |
| 18. | What type of interface does a DAQ (Data acquisition) hardware creates? |
| Option A: | Interface between two similar signals |
| Option B: | Interface between a computer and signal |
| Option C: | Interface between two dissimilar signals |
| Option D: | Interface between two similar hardware |
| | |
| 19. | Sample and hold circuit are used in |
| Option A: | Analog to Digital modulation |
| Option B: | Digital to analog modulation |
| Option C: | Pulse position modulation |
| Option D: | All of the above |
| | |
| 20. | Find out the gain value by which each input of the averaging amplifier is amplified ?( Assume there are four inputs) |
| Option A: | 0.5 |
| Option B: | 0.25 |
| Option C: | 1 |
| Option D: | 2 |

| **Q2.** | |
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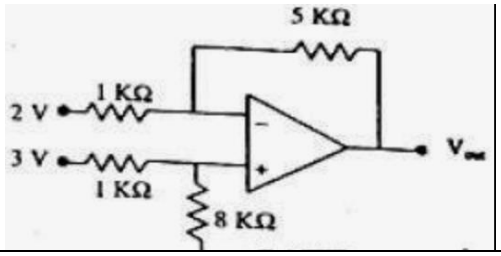
| | **Solve any four -5 marks each.** **20 marks** |
| i. | Determine the output voltage for the given figure   |
| ii. | Signal Conditioning analysis shows that the following equation must relate output voltage to input voltage: Design a circuit to implement following equation. $V_{out} = -(3V_1 + 2V_2)$ |
| iii. | Derive the expression for output of Differentiator with the help of labelled diagram, Draw the waveform for triangular wave input. |
| iv. | Design an Monostable Multivibrator using IC 555 for 10KHz frequency and 75% duty cycle. |

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| v. | A potentiometric displacement sensor is to be used to measure work-piece motion from 0 to 10 cm. The resistance changes linearly over this range from 0 to 1KΩ. Develop signal conditioning to provide a linear, 0V to 10V output. |
| vi. | Draw and explain the signal conditioning associated with Thermistor. |

| **Q3.** | |
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| | **Solve any Two-10 marks each. 20 marks** |
| i. | Draw and explain principle and construction of strain gauge. What is the signal conditioning associated with it. |
| ii. | Derive the expression for output voltage of Precision Full wave Rectifier . Explain the working with circuit diagram and waveforms. |
| iii. | Derive the expression for output voltage of R-2R Digital to Analog with the help of labelled diagram and suitable example. |