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| **Course Name:** | **Linear Integrated Circuits and Design** | **Semester:** | **V** |
| **Date of Performance:** | **11/09/2020** | **Batch No:** | **B1** |
| **Faculty Name:** | **Prof. Milind Marathe** | **Roll No:** | **1912052** |
| **Faculty Sign & Date:** |  | **Grade/Marks:** | **/25** |

**Experiment No: 3**

**Title: Implementation of Three Opamp instrumentation amplifier**

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| **Aim and Objective of the Experiment:** |
| To implement and analyze three Opamp Instrumentation amplifier using Opamp IC OP-07   * To interface bridge circuit with differential amplifier & compare the analytical values with simulated values. * To interface bridge circuit with 3 Opamp Instrumentation amplifier & compare the analytical values with simulated values. |

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| **COs to be achieved:** |
| **CO2:** Design circuits using opamp as linear applications. |

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| **Theory:** |
| Differential amplifier using opamp has limitation that it has low input resistance, which will lead to loading effect, if a preceding bridge circuit is connected to it. Also, the gain of differential amplifier is not very high and stable too. Also, the CMRR in case of differential amplifier is not very high.  To overcome the above problems, an improved version of differential amplifier i.e 3 opamp Instrumentation amplifiers is preferred.  Instrumentation amplifier is a kind of differential amplifier with additional input buffer stages. The addition of input buffer stages makes it easy to match (impedance matching) the amplifier with the preceding stage. The instrumentation amplifier also has some useful features like low offset voltage, high CMRR (Common mode rejection ratio), high input resistance, high gain etc. Instrumentation amplifiers are generally used in situations where high sensitivity, accuracy and stability are required. An instrumentation amplifier is a differential amplifier optimized for high input impedance and high CMRR. |

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| **Circuit Diagram:** |
| **1. Bridge Circuit:** |
| **2. Interfacing bridge circuit with Differential amplifier:** |
| **3. Interfacing bridge circuit with Instrumentation amplifier:** |

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| **Stepwise-Procedure:** |
| 1. Make the bridge circuit schematic in LTspice, simulate it and note down its and voltages.  2. Compare simulated values of and as found in step 1, with theoretically calculated values.  3. Next, interface the bridge circuit with differential amplifier circuit in LTspice.  4. Simulate the circuit in step 3, and note down the voltages , &  5. Compare simulated values of , & as found in step 4, with theoretical values.  6. Next, interface the bridge circuit with instrumentation amplifier circuit in LTspice.  7. Simulate the circuit in step 6, and note down the voltages , , ,  8. Compare simulated values of , , , & as found in step 7, with theoretical  values.  9. Record all the results in tabulated format. |

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| **Observation Table:** |
| **1. Bridge Circuit:**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Sr. No.** | **(in Ω)** | **Theoretical values**  **(in Volts)** | | **Simulated Values**  **(in Volts)** | | |  |  |  |  | | 1. | 1.01 kΩ | 7.5 | 7.53731 | 7.5 | 7.537313 | | 2. | 1.05 kΩ | 7.5 | 7.68292 | 7.5 | 7.68293 |   **2. Interfacing bridge circuit with Differential amplifier:**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **Sr. No.** | **(in Ω)** | **Theoretical values**  **(in Volts)** | | | **Simulated Values**  **(in Volts)** | | | |  |  |  |  |  |  | | 1. | 1.01 kΩ | 7.5 | 7.53731 | 0.3731 | 7.208045 | 7.184256 | 0.23789 | | 2. | 1.05 kΩ | 7.5 | 7.68292 | 1.8292 | 7.2245755 | 7.3411016 | 1.1652424 |   **3. Interfacing bridge circuit with Instrumentation amplifier:**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **Sr. No.** | **(in Ω)** | **Theoretical values**  **(in Volts)** | | | **Simulated Values**  **(in Volts)** | | | |  |  |  |  |  |  | | 1. | 1.01 kΩ | 7.5 | 7.53731 | 0.37306269 | 7.5 | 7.5373135 | 0.3730914 | | 2. | 1.05 kΩ | 7.5 | 7.68292 | 1.82901708 | 7.5 | 7.6829267 | 1.8290577 | |

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| **Calculations:** |
| **1. Bridge Circuit:**  **2. Differential amplifier:**    **3. Instrumentation Amplifier:** |

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| **Results:** |
| **1. Bridge Circuit:**  **Case 1:**    **Case 2:** |
| **2. Interfacing bridge circuit with Differential amplifier:**  **Case 1:**    **Case 2:** |
| **3. Interfacing bridge circuit with Instrumentation amplifier:**  **Case 1:**    **Case 2:** |
| **Post Lab Questions:** |
| 1. How does the Instrumentation amplifier avoids the loading problem when interfaced with Bridge circuit? 2. Vary the value of resistor in schematic such that the gain of instrumentation amplifier becomes double. Record your observations 3. Interface bridge circuit with Gain programmable instrumentation amplifier IC LT1167 (similar to AD620) with a gain of 10. |

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| **Conclusion:** |
| We implemented and analyzed three Opamp Instrumentation amplifier using Opamp IC OP-07 |

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| **Signature of faculty in-charge with Date:** |