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| **Course Name:** | **Electronic Circuits Analysis and Design** | **Semester:** | **IV** |
| **Date of Performance:** | **05/04/2021** | **Batch No:** | **B2** |
| **Faculty Name:** | **Prof. Sonia Joshi** | **Roll No:** | **1912052** |
| **Faculty Sign & Date:** |  | **Grade/Marks:** | **/25** |

**Experiment No: 3**

**Title: To study the frequency response of a MOSFET amplifier.**

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| **Aim and Objective of the Experiment:** To study the frequency response of a MOSFET amplifier. |
| 1) To calculate maximum gain.  2) To calculate lower cut off frequency, higher cut off frequency and bandwidth from frequency response. |

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| **COs to be achieved:** |
| CO1: Learn the dependency of the amplifier gain over the frequency range |

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| **Theory:** |
| Enhancement MOSFET, or eMOSFET, can be classed as normally-off (non-conducting) devices, that is they only conduct when a suitable gate-to-source positive voltage is applied, unlike Depletion type mosfets which are normally-on devices conducting when the gate voltage is zero.  However, due to the construction and physics of an enhancement type mosfet, there is a minimum gate-to-source voltage, called the threshold voltage VTH that must be applied to the gate before it starts to conduct allowing drain current to flow.  In other words, an enhancement mosfet does not conduct when the gate-source voltage, VGS is less than the threshold voltage, VTH but as the gates forward bias increases, the drain current, ID (also known as drain-source current IDS) will also increase, similar to a bipolar transistor, making the eMOSFET ideal for use in mosfet amplifier circuits. |

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| **Circuit Diagram:** |
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| **Stepwise-Procedure:** |
| 1. Make the connections as per the Circuit diagram.  2. Apply the sinusoidal input signal to the circuit.  3 Observe transient response of the circuit  4. Apply AC signal at the input of the circuit  5. Observe the Frequency response of the circuit  6. Calculate maximum gain and lower cut off frequency, higher cut off frequency bandwidth theoretically and practically. |

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| **Observation Table:** |
| **A)Bypass**  **1) Transient response**   |  |  |  |  | | --- | --- | --- | --- | | **Sr No** | **Input Signal** | **Vo(Thr)** | **Vo(Prac)** | | **1** | **20mv** |  | **62.206591mV** |   **2) Frequency Response**   |  |  |  |  | | --- | --- | --- | --- | | **Sr No** | **Input Signal frequency** | **Highest Gain in dB** | | |  |  | **Thr** | **Prac** | | **1** | **20mv** |  | **61.844112mV** | |

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| **Waveform** |
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| **Post Lab Subjective/Objective type Questions:** |
| 1. Explain how MOSFET functions?   In general, the MOSFET works as a switch, the MOSFET controls the voltage and current flow between the source and drain. The working of the MOSFET depends on the MOS capacitor, which is the semiconductor surface below the oxide layers between the source and drain terminal.   1. Explain the three regions of operation of a MOSFET.  * **Cut off region** – A MOS device is said to be operating when the gate-to-source voltage is less than Vth. Thus, for MOS to be in cut-off region, the necessary condition is –   0 < VGS < Vth                           -                       for NMOS  0 > VGS > Vth                                    -for PMOS (as threshold voltage of PMOS is negative)  Cut-off region is also known as sub-threshold region. In this region, the dependence of current on gate voltage is exponential. The magnitude of current flowing through MOS in cut-off region is negligible as the channel is not present. The conduction happening in this region is known as sub-threshold conduction.   * **Linear or non saturation region** – For an NMOS, as gate voltage increases beyond threshold voltage, channel is formed between source and drain terminals. Now, if there is voltage difference between source and drain, current will flow. The magnitude of current increases linearly with increasing drain voltage till a particular drain voltage determined by the following relations –   VGS ≥ Vth  VDS < VGS – Vth  The current is, then, represented as a linear function of gate-to-source and drain-to-source voltages. That is why, MOS is said to be operating in linear region. The linear region voltage-current relation is given as follows:  Id(Linear) = µ Cox W/L (Vgs – Vth – Vds/2) Vds.    Similarly, for P-MOS transistor, condition for P-MOS to be in linear region is represented as:                          VGS < Vth                       OR                         VSG > |Vth|              And      VDS > VGS + Vth                          OR             VSD < VSG - |Vth|   * **Saturation Region** – For an NMOS, at a particular gate and source voltage, there is a particular level of voltage for drain, beyond which, increasing drain voltage seems to have no effect on current. When a MOS operates in this region, it is said to be in saturation. The condition is given as:   VGS ≥ Vth  VDS > VGS – Vth              The current, now, is a function only of gate and source voltages:                          Id(saturation) = µ Cox W/L (Vgs – Vth – Vds/2)2 |

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| **Conclusion:** |
| We calculated maximum gain.and lower cut off frequency, higher cut off frequency and bandwidth from frequency response.of a MOSFET. |

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