Please check that this question paper contains nine questions and three printed pages within first ten minutes.

[Total No. of Questions: 09] [Total No. of Pages: 03]

Uni. Roll No. ....

Program: B.Tech. (Batch 2018 onward)
Semester: 3rd
Name of Subject: Analog Electronics
Subject Code: PCEE-102
Paper ID: 16065
Scientific calculator is Allowed

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11 MAY 2023

Detail of allowed codes/charts/tables etc. NIL

Time Allowed: 03 Hours **Max. Marks: 60**

NOTE:

1) Parts A and B are compulsory
2) Part-C has Two Questions Q8 and Q9. Both are compulsory, but with internal choice
3) Any missing data may be assumed appropriately

Part – A **[Marks: 02 each]**

Q1.

a) Define a P-N junction diode. What are two different types of charge carriers in P-N junction diode?

b) Draw the schematic symbol of a BJT and label its terminals. Explain the I-V characteristics of a BJT in the active region.

c) Describe the operation of a MOSFET as a switch in the cut off and saturation regions.

d) Define a differential amplifier and explain its significance in analog signal processing. Discuss the advantages of using a differential amplifier in applications such as amplification and noise rejection.

e) An ideal op-amp is connected in an inverting amplifier configuration with a gain of -10. If the input voltage is 2 V, calculate the output voltage.

f) Design an op-amp integrator circuit with a time constant of 0.1 seconds. If the input voltage is a square wave with a frequency of 1 kHz and an amplitude of 2 V, calculate the output voltage waveform.

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Part – B **[Marks: 04 each]**

Q2. Describe the working principle of a half-wave rectifier. Compare and contrast the advantages and disadvantages of a half-wave rectifier and a full-wave rectifier.

Q3. Define the small-signal model of a BJT and explain its significance in amplifier design. Derive the expression for the voltage gain of a common-emitter amplifier using the small-signal model.

Q4. Define the ideal characteristics of an operational amplifier. Explain the implications of infinite open-loop gain, infinite input impedance, zero output impedance, and zero offset voltage in an ideal op-amp.

Q5. A power amplifier has a supply voltage of 24 V and a load resistance of 8 ohms. If the amplifier is designed to deliver a maximum power of 50 W, calculate the peak output voltage and the maximum current delivered to the load.

Q6. Design a biasing circuit for a common-source MOSFET amplifier using a resistor and a voltage divider network. The MOSFET has a threshold voltage of 2 V and requires a drain current of 2 mA. The supply voltage is 10 V. Calculate the resistor values for proper biasing.

Q7. a) Compare and contrast the inverting and non-inverting amplifier configurations.

b) Derive the voltage gain equations for both inverting and non-inverting amplifiers.

Part – C **[Marks: 12 each]**

Q8. Derive the small-signal equivalent circuit of a common-emitter amplifier. Calculate the voltage gain, input impedance, and output impedance of the derived small-signal model. Discuss the importance of coupling and bypass capacitors in small-signal amplifier circuits.

OR

P.T.O.

Explain the operating principle of a Zener diode and its unique characteristic in the reverse-biased region. A Zener diode has a breakdown voltage of 5.6 V. If a current of 10 mA flows through the diode when it is reverse biased, calculate the dynamic resistance of the Zener diode.

Q9. Explain the concept of lead and lag compensation in control systems. Derive the transfer function of a lead compensator using an op-amp. Discuss the advantages and limitations of lead and lag compensators.

OR

Derive the small-signal equivalent circuit of a direct-coupled multi-stage amplifier. Calculate the voltage gain, input impedance, and output impedance of the derived small-signal model. Discuss the advantages and disadvantages of using direct coupling in multi-stage amplifiers.

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