# **INSTITUTE OF AERONAUTICAL ENGINEERING**

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech III SEMESTER END EXAMINATIONS (REGULAR/ SUPPLEMENTARY) - FEBRUARY 2024 Regulation: UG20

## ANALOG ELECTRONICS

Time: 3 Hours (ELECTRICAL AND ELECTRONICS ENGINEERING)Max Marks: 70

Answer ALL questions in Module I and II Answer ONE out of two questions in Modules III, IV and V All Questions Carry Equal Marks All parts of the question must be answered in one place only

### $\mathbf{MODULE}-\mathbf{I}$

1. (a) Outline the working of P-N junction diode and draw the V-I characteristics of the diode.

[BL: Understand] CO: 1|Marks: 7]

(b) Find the value of DC resistance and AC resistance of a Germanium junction diode at  $250^{\circ}$ C with reverse saturation current,  $I_o = 25\mu$ A and at an applied voltage of 0.2V across the diode?

[BL: Apply| CO: 1|Marks: 7]

#### $\mathbf{MODULE}-\mathbf{II}$

- 2. (a) Explain in detail about the terms gain, input and output impedances of a N channel MOSFET. [BL: Understand| CO: 2|Marks: 7]
  - (b) For the CS amplifier given that  $R_i = 5k\Omega$ ,  $R_1 = 5M\Omega$ ,  $R_2 = 1M\Omega$ ,  $R_D = 10 k\Omega$ ,  $R_S = 3k\Omega$ ,  $R_3 = 50 \Omega$ ,  $R_L = 20 k\Omega$ , V + = 24 V, V - = -24 V,  $K_0 = 0.001 A/V_2$ ,  $V_{TO} = 1.75 V$ ,  $\Lambda = 0.016 V-1$ . Solve for the gain Av  $= v_o/v_i$ , the input resistance  $r_{in}$ , and the output resistance  $r_{out}$ . The capacitors can be assumed to be AC short circuit at the operating frequency. [BL: Apply] CO: 2|Marks: 7]

#### MODULE – III

- 3. (a) Discuss the different coupling schemes which are used in amplifiers. List out the applications of different power amplifiers. [BL: Understand| CO: 3|Marks: 7]
  - (b) The two-stage amplifier shown in Figure 1 uses transistors  $Q_1$  and  $Q_2$ , both having current gain  $\beta$  of 80 and dynamic emitter resistance, r'e, of 25  $\Omega$  each. Find out the overall voltage gain of the amplifier. [BL: Apply] CO: 3|Marks: 7]



Figure 1

- 4. (a) Summarize the following terms of amplifier
  - i) Frequency response
  - ii) Decibel gain
  - iii) Bandwidth [BL: Understand] CO: 4|Marks: 7]
  - (b) For a class B amplifier using a supply of  $V_{CC} = 12$  V and driving a load of 8 $\Omega$ , determine
    - i) Maximum load power
      - ii) DC input power
      - iii) Collector efficiency.

#### $\mathbf{MODULE}-\mathbf{IV}$

- 5. (a) State the need for feedback. Write the advantages and disadvantages of positive and negative feedback. [BL: Understand] CO: 5[Marks: 7]
  - (b) Draw and design a Hartley oscillator with  $L_1 = 2$  mH,  $L_2 = 20\mu$ H, mutual inductance, M =  $40\mu$ H and a variable capacitance. Determine the range of capacitance values, if the frequency range of oscillation is varied between 750 kHz and 3000 kHz. [BL: Apply] CO: 5[Marks: 7]
- 6. (a) What is the frequency for RC phase shift oscillator? Explain how better frequency stability is obtained in crystal oscillator? [BL: Understand] CO: 5|Marks: 7]
  - (b) Choose the value of capacitor C and transistor gain  $h_{fe}$  to provide an oscillator frequency of  $f_o = 2$  kHz for the circuit in Figure 2. The circuit values are  $h_{ie} = 2$  k $\Omega$ ;  $R_1 = 20$  k $\Omega$ ;  $R_2 = 80$  k $\Omega$ ;  $R_c = 10$  k $\Omega$  and R = 8 k $\Omega$ . Also find the value of feedback resistor  $R_3$ .

[BL: Apply| CO: 5|Marks: 7].

[BL: Apply] CO: 4|Marks: 7]





#### MODULE - V

- 7. (a) Examine the DC and AC performance characteristics of operational amplifier. Differentiate between open loop and closed loop gain of op amp. [BL: Understand] CO: 6[Marks: 7]
  - (b) Determine the input impedance and output voltage for the circuit in Figure 3.

[BL: Apply] CO: 6|Marks: 7]



Figure 3

- 8. (a) Describe the working of a square wave generator using op-amp. List the specifications of practical op amp. [BL: Understand| CO: 6|Marks: 7]
  - (b) Calculate the total offset voltage for the circuit of Figure 4 for an op-amp with specified values of input offset voltage,  $V_{IO} = 4$  mV and input offset current  $I_{IO} = 150$  nA.

[BL: Apply] CO: 6|Marks: 7]



Figure 4

 $-\circ\circ\bigcirc\circ\circ-$