

II B. Tech I Semester Regular Examinations, March - 2021
ELECTRONIC DEVICES AND CIRCUITS
 (Electrical and Electronics Engineering)

Time: 3 hours

Max. Marks: 75

Answer any **FIVE** Questions each Question from each unit
 All Questions carry **Equal** Marks
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- 1 a) Explain Hall effect. Derive expression of Hall voltage and state its applications. [9M]  
 b) If the energy band gap is 1.1 eV and electron mobility in silicon is  $0.13 \text{ m}^2 / \text{volt-sec}$ , hole mobility is  $0.05 \text{ m}^2 / \text{volt-sec}$  and  $N=3 \times 10^{25}/\text{m}^3$  at 300K. Find the intrinsic carrier concentration and conductivity of silicon. [6M]
- Or
- 2 a) Explain about V-I characteristics of PN junction diode in forward bias & reverse bias conditions. [8M]  
 b) Draw and explain the energy band diagram of PN junction diode. [7M]
- 3 a) List the salient features of Tunnel diode. [3M]  
 b) Explain the V-I characteristics of Photodiode. [6M]  
 c) Explain the construction and operation of LED. [6M]
- Or
- 4 a) Define ripple factor and derive an expression for ripple factor in a full-wave rectifier. [7M]  
 b) Give the comparison of various filter circuits in terms of ripple factors. [5M]  
 c) What are the advantages of a full-wave bridge rectifier as compared to a full-wave centre-tapped rectifier? [3M]
- 5 a) Draw and explain the input and output characteristics of BJT in common base configuration. [9M]  
 b) Calculate the  $\alpha_{dc}$  and  $\beta_{dc}$  for the given transistor for which  $I_C=5\text{mA}$ ,  $I_B=50\mu\text{A}$  and  $I_{C0} = 1\mu\text{A}$ . [6M]
- Or
- 6 a) Explain how a FET is used as a voltage variable resistor. [5M]  
 b) Define the following terms of a FET: [8M]  
 (i)  $I_{DSS}$   
 (ii) Trans conductance  
 (iii) Pinch-off voltage  
 (iv) Amplification factor  
 c) List the applications of FET. [2M]
- 7 a) Define stability factor. Explain the need of biasing. [6M]  
 b) A silicon transistor with  $\beta=80$  is used in self biasing arrangement with  $V_{CC} = 15\text{V}$ ,  $R_C = 4.7\text{K}\Omega$ . The operating point Q is at  $V_{CE} = 8.2\text{V}$ ,  $I_C = 1.2\text{mA}$ . Find the values of  $R_1$  and  $R_2$ . [6M]  
 c) What is the condition for thermal stability in CE configuration? [3M]

Or



- 8 a) Explain diode compensation against variation in base-emitter voltage  $V_{BE}$ . [6M]  
b) Draw a fixed bias circuit and derive an expression for the stability factor. [6M]  
c) Write a brief note on Thermal runaway. [3M]
- 9 Derive the expressions for voltage gain, current gain, input impedance and output impedance of CE amplifier using exact and approximate analysis. [15M]
- Or
- 10 a) Determine the current gain, input impedance and voltage gain when the transistor is connected in CB configuration with a load  $R_L=10K\Omega$ ,  $V_{CB}=10V$ ,  $I_C=1mA$ ,  $h_{ib}=20\Omega$ ,  $h_{ib}=5 \times 10^{-4}$ ,  $h_{fb}=-0.98$ ,  $h_{ob}=10^{-7} \Omega$ . [6M]  
b) From the low frequency small signal FET model, derive the FET parameters. [9M]

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- 1 a) Briefly explain about Fermi Dirac function and Fermi level in intrinsic and extrinsic semiconductors. [9M]
- b) Find the conductivity of silicon atom when the donor impurities of 1 in  $10^8$  is applied. The intrinsic value of silicon atom is  $1.5 \times 10^{10} \text{ cm}^{-3}$  at  $300^0\text{K}$ . The mobility of the electrons and holes are  $1300 \text{ cm}^2 / \text{V-s}$  and  $500 \text{ cm}^2 / \text{V-s}$  respectively. The number of silicon atoms is  $5 \times 10^{25} \text{ cm}^{-3}$ . [6M]
- Or
- 2 a) State and explain Mass Action law. [6M]
- b) The current flow through a PN-junction diode is 0.75 mA at forward-biased voltage 350 mV and 20 mA at forward-biased voltage 500 mV. Determine the value of  $\eta$  if the junction operates at 295K. [6M]
- c) List the applications of PN-junction diode. [3M]
- 3 a) Explain in detail about principle of operation and characteristics of Tunnel diode. [10M]
- b) List the salient features and applications of LED. [5M]
- Or
- 4 a) A centre-tapped single-phase full-wave rectifier has two diodes and the forward resistance of each diode is 25 ohms. The transformer secondary voltage from centre to each half of the secondary winding is  $30 \sqrt{2} \sin \omega t$  and the load resistance is 2000 ohms. Determine (i) the average value of load current, and (ii) the peak inverse voltage of each diode. [6M]
- b) Sketch the circuit of a bridge rectifier and explain its operation [7M]
- c) Why are filters used in a dc power supply? [2M]
- 5 a) Explain the various current components in a transistor. [6M]
- b) Give the comparison between CB, CE and CC configurations of BJT. [5M]
- c) Write a brief note on Photo transistor. [4M]
- Or
- 6 a) Explain the drain characteristics of JFET. [5M]
- b) Derive the relationship between trans conductance, drain resistance and amplification factor. [4M]
- c) An N-channel FET has the following parameters: [6M]  
 $I_{DSS} = 12\text{mA}$ ,  $V_P = -8\text{V}$  and  $g_{mo} = 4000 \mu\text{s}$   
 Determine the drain current and trans conductance at  $V_{GS} = -5\text{V}$

- 7 a) Explain about Thermal stability. [5M]  
b) Design a collector to base bias circuit for the given specifications: [8M]  
 $V_{CC} = 15V$ ,  $V_{CE} = 5V$ ,  $I_{CE} = 5mA$  and  $\beta=100$ .  
c) What are the factors affecting the Q-point? [2M]

Or

- 8 a) Define Q-point. [2M]  
b) Give the comparison between fixed bias, collector to base bias and self-bias [6M]  
circuits.  
c) Draw a circuit which uses a diode to compensate for changes in  $I_{CO}$ . Explain [7M]  
how stabilization is achieved in the circuit  
9 a) Obtain CB parameters in terms of CE parameters. [12M]  
b) Define the various h-parameters and give their units. [3M]

Or

- 10 a) Draw the h-parameter equivalent circuit for a typical common base amplifier and [8M]  
derive expressions for  $A_i$  and  $A_v$ .  
b) Draw the small signal model of an FET and explain the significance of each [7M]  
element.

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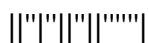
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- 1 a) Explain energy band diagram of insulator, semiconductor and conductor. [9M]
 b) At room temperature of 300K, the Fermi level is 0.35 eV above the valence bond in a P-type semiconductor. When the temperature is increased to (i) 350K, and (ii) 400K, calculate the position of Fermi level. [6M]
- Or
- 2 a) Discuss in brief about the current components in PN junction diode. [7M]
 b) Explain the volt-ampere characteristics of PN junction diode. [8M]
- 3 a) Explain the breakdown mechanisms in semiconductor diodes. [8M]
 b) Briefly explain about the different operating regions of SCR. [7M]
- Or
- 4 a) Draw the circuit diagram of a full-wave rectifier using center-tap transformer. Explain its working principle. [7M]
 b) A sinusoidal voltage whose $V_m = 24V$ is applied to a half-wave rectifier. The diode may be considered to be ideal and $R_L = 1.8 K\Omega$ is connected as load. Determine the following: [8M]
 (i) Peak value of current
 (ii) RMS value of current
 (iii) DC value of current
 (iv) Ripple factor
- 5 a) Draw and explain the input and output characteristics of BJT in common emitter configuration. [9M]
 b) Explain about Ebers-Moll model of a transistor. [6M]
- Or
- 6 a) With the help of neat sketches explain the operation of JFET. [8M]
 b) What is the importance of SiO_2 layer in MOSFET? [3M]
 c) What is MOSFET? What are the different types of MOSFETs? [4M]
- 7 a) Explain the importance of biasing. [4M]
 b) Briefly explain about stabilization against variations in V_{BE} and β for the self-bias circuit. [7M]
 c) Write a brief note on Stability factors. [4M]

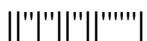
Or



- 8 a) Derive an expression for the condition to avoid thermal runaway. [6M]
b) What are the disadvantages of fixed bias? [2M]
c) Design a voltage divider bias circuit for specified condition $V_{CC} = 12V$, $V_{CE} = 6V$, $I_C = 1 \text{ mA}$, $S = 20$, $\beta = 100$ and $V_E = 1V$. [7M]
- 9 a) Explain the small signal operation of CG amplifier and also derive an expression for its performance measure. [8M]
b) Explain how to calculate CE h-parameters from the input and output characteristics. [7M]

Or

- 10 a) A CE amplifier is drawn by a voltage source of internal resistance $r_s = 800 \Omega$, and the load impedance is a resistance $R_L = 1000\Omega$. The h-parameters are $h_{ie} = 1K\Omega$, $h_{re} = 2 \times 10^{-4}$, $h_{fe} = 50$ and $h_{oe} = 25 \mu A/V$. Compute the current gain, input resistance, voltage gain and output resistance. [10M]
b) Name the three small signal models used for a BJT. Which of the three models of a BJT provide accurate analysis and why? [5M]



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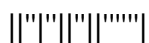
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- 1 a) Write notes on the following terms: [8M]
 (i) electron
 (ii) hole
 (iii) conductivity
 (iv) mobility
- b) Derive an expression for continuity equation and explain its importance. [7M]
- Or
- 2 a) The current flow through a PN-junction germanium diode is 50 mA for a forward biased voltage of 0.5V at 300K. Calculate the static and dynamic resistances of the diode. [4M]
- b) Discuss in brief about the effect of temperature on V-I characteristics of a diode. [7M]
- c) Differentiate between transition and diffusion capacitances. [4M]
- 3 a) Explain how a zener diode acts as a voltage regulator. [4M]
- b) Write a brief note on Zener breakdown mechanism in a zener diode. [5M]
- c) Draw and explain the V-I characteristics of the UJT. [6M]
- Or
- 4 a) Draw the circuit diagram of half-wave rectifier. Explain its working principle. [10M]
 Determine the following parameters:
 (i) dc output voltage
 (ii) rms output voltage
- b) Determine the ripple factors of an L-section filter and Capacitive filter with $C=50\mu\text{F}$, $V_{dc}=12\text{V}$, $R_L=10\text{ K } \Omega$, $f=50\text{Hz}$ and $L=10\text{H}$ used with FWR. [5M]
- 5 a) Explain about transistor as an amplifier. [7M]
- b) Define α , β and γ of a transistor. Show how they are related to each other. [8M]
- Or
- 6 a) Give the comparison between JFET and MOSFET. [4M]
- b) Explain the principle of operation of enhancement MOSFET. [6M]
- c) Explain the transfer characteristics of JFET. [5M]
- 7 a) Derive an expression for the stability factor of a self bias circuit. [6M]
- b) Explain the operation of collector to base bias. [7M]
- c) Define stability factor 'S'. [2M]

Or

1 of 2



- 8 a) Explain how thermistor is used for bias compensation. [7M]
b) Explain about stabilization against variations in V_{BE} , I_C and β . [8M]
- 9 a) Draw and explain the h-parameter model of a BJT for CC configuration. [7M]
b) Explain the determination of h-parameters from transistor characteristics. [8M]
- Or
- 10 a) The h-parameters of a transistor used in CE amplifier are given as: $h_{ie}=1K\Omega$, $h_{re}=2 \times 10^{-4}$, $h_{fe}=100$ and $h_{oe}=20\mu A/V$. If $R_c = 5K\Omega$ and $R_s = 1K\Omega$, determine A_I , A_V , R_I and R_O . [10M]
b) Give the comparison of FET amplifiers. [5M]