Total No. of Questions—**12**] [Total No. of Printed Pages—**4+2**

Seat No.	

[4857]-162

S.E. (E & TC/Electronics) (First Semester) EXAMINATION, 2015

SOLID STATE DEVICES AND CIRCUITS

(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from each Section.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) For the diode shown in Fig. 1 calculate the currents I_1 and I_2 consider both the diodes having R_f = 10 Ω and V_r = 0.6 V. [6]

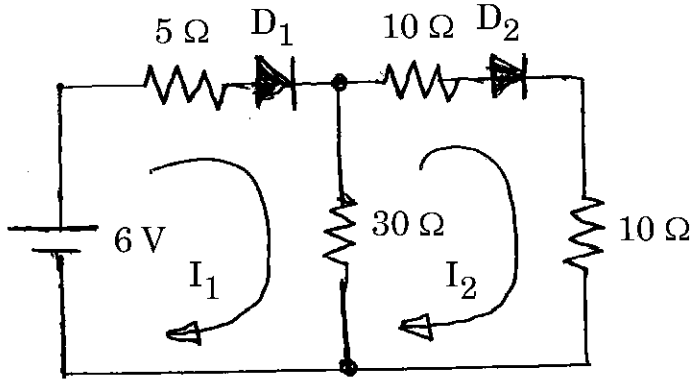

Fig. 1

P.T.O.

(*b*) Write volt-ampere equation for a PN junction diode. Explain the significance of each symbol. Calculate the ideal current values in forward and reverse biased condition. [6]

(*c*) Explain photodiode with respect to construction, working, characteristics and applications. [6]

Or

2. (*a*) Explain the following non-ideal current voltage characteristics of MOSFET : [9]

(*i*) Finite output resistance

(*ii*) Body effect

(*iii*) Subthreshold conduction.

(*b*) For the voltage divider bias circuit using EMOSFET has R_1 = 22 MΩ, R_2 = 18 MΩ, R_D = 3 kΩ and R_S = 820 Ω, V_{DD} = 40 V, V_T = 5 V, $I_{D(ON)}$ = 3 mA at $V_{GS(ON)}$ = 10 V. Determine V_G, R_G, I_D, V_{DS} and V_{GS}. [9]

3. (*a*) Draw and explain the following biasing techniques for EMOSFET. Also calculate V_{GS} and V_{DS} both techniques : [10]

(*i*) Voltage divider bias

(*ii*) Voltage feedback bias.

(*b*) Determine A_V, R_I, R_o and r_o for the CS amplifier with voltage divider bias. This configuration has the following components R_1 = 22 MΩ, R_2 = 18 MΩ, R_D = 3 kΩ and R_S = 820 Ω, V_{DD} = 40 V, V_T = 5 V, $I_{D(ON)}$ = 3 mA at $V_{GS(ON)}$ = 10 V, λ = 0.03 V^{-1}. [6]

Or

4. (*a*) Compare MOSFET with BJT. [4]

(*b*) Draw the high frequency model for MOSFET. [4]

(*c*) Explain the terms in brief : [8]

(*i*) BiCMOS technology

(*ii*) MOSFET Scaling.

5. (*a*) Derive the relation for A_i, R_i, A_v, Y_o, A_{vs} and A_{is} for CE amplifier without R_E. [8]

(*b*) What is thermal runaway ? How to avoid it ? State the expression for power dissipation (P_D) with significance. [8]

Or

6. (*a*) Compare Common Emitter, Common Base and Common Collector configurations of BJT. [4]

(*b*) Design the single stage BJT amplifier if V_{CC} = 12 V, V_{CE} = 4.94 V, I_C = 1.37 mA, V_E = 0.63 V, V_{BE} = 0.61 V, S = 9 and β = 300. [6]

(*c*) Write a short note on temperature compensation against V_{BE} and I_{CO} using diode. [6]

SECTION II

7. (*a*) Define lower and upper cut-off frequencies of an amplifier. Why are these frequencies called as half power frequencies ? [6]

(*b*) Write the formulae for A_V (low) and A_V (high) in terms of A_V (mid) and explain each term. [4]

(*c*) An RC coupled amplifier has mid band gain A_V (mid) = 80 and the input resistance 10 kΩ is fed from an ideal source, through the coupling capacitor of 0.22 μF. Calculate : [8]

(*i*) The lower cut of frequency

(*ii*) Voltage gain at 400 Hz

(*iii*) The frequency at which gain is 10 dB down the mid band value.

Or

8. (*a*) Enlist the advantages of square wave testing method over frequency response method. [3]

(*b*) In RC coupled amplifier derive the following relations : [7]

$$t_r = 0.35 / f_H \text{ and } \% P = \pi f_L * 100 / f$$

(*c*) Draw the high frequency π model of transistor and derive the expressions for g_m, $r_{bb'}$ and $r_{b'e}$. Write their typical values. [8]

9. (*a*) For the amplifier circuit shown in Fig. 2, identify the topology and find Gain, input impedance and output impedance with feedback. Assume h_{fe} = 50 and h_{ie} = 1.1. K. [8]

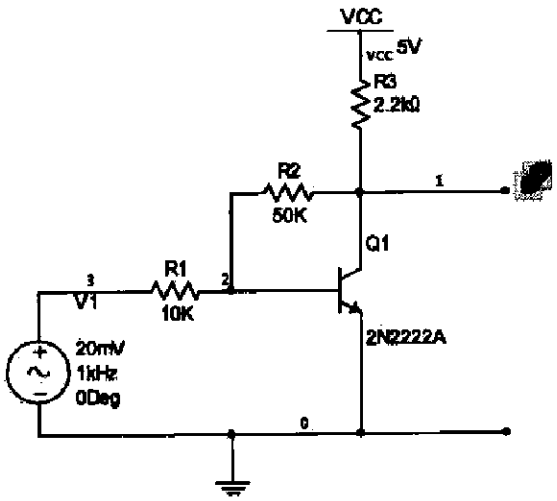

Fig. 2

(*b*) Prove that the output impedance for voltage sampling decreases and input impedance for series mixing increases with negative feedback. [8]

Or

10. (*a*) State the Barkhausen criteria for sustained oscillations. Draw the circuit diagram of Colpitts' oscillator using BJT and derive the expression for frequency of oscillations. [8]

(*b*) Compare Voltage series, Voltage shunt, current series and current shunt topology on the basis of Gain, R_o, R_i, mixing and sampling. [8]

11. (*a*) Write a short note on three-point method of Harmonic distortion. [6]

(*b*) How are the even harmonic distortions eliminated from class B push-pull amplifier ? [6]

(*c*) Differentiate between class A, class B, and class AB Power Amplifier. [4]

Or

12. (*a*) For class B push-pull Amplifier supply voltage is +24 V. The amplifier is driving loudspeaker of resistance 8 ohms as load. If turns ratio of complete primary to secondary winding of output transformer is 4 : 1, calculate DC input power, AC output power, Efficiency and Power dissipation per transistor. [8]

(*b*) Collector base junction of certain transistor dissipates 2 W of power. The thermal resistance from case to air is 20°C and junction to case is 8°C and free air temperature is 25°C. What is the junction temperature and case temperature ? [4]

(*c*) Prove that the % efficiency for class A power amplifier is 25%. [4]