Total No. of Printed Pages—5

PAR/CCM-27/13

2014

ELECTRONICS

FIRST PAPER

Full Marks : 200

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. *(a)* Draw the *I-V* characteristics of a *p-n* junction diode—

(i) under dark condition;

(ii) when exposed to solar light. 3+3=6

(b) Explain in detail both the characteristics physically. 10

(c) What is Fermi level? Derive the expressions for Fermi level in intrinsic, *P*-type and *N*-type semiconductors. 9

2. *(a)* Explain the following :

(i) Mobility

(ii) Conductivity

(iii) Energy gap

(iv) Intrinsic concentration

Also give the reason about the variation of these parameters with temperature.

4+4=8

(b) When a diode is reverse biased with 6 V, it has a junction capacitance of 10 pF. When the reverse bias increases to 10 V, the capacitance drops to 8·43 pF. Find whether the junction is abrupt or graded. 7

(c) Explain the *I-V* characteristics of tunnel diode with the help of energy band diagram. 10

3. (a) Design a voltage divider circuit in Fig. 1 given below to operate from 12 V supply. The bias conditions are to be $V_{CE} = 3\,V$, $V_E = 5\,V$ and $I_C = 1\,mA$. 10

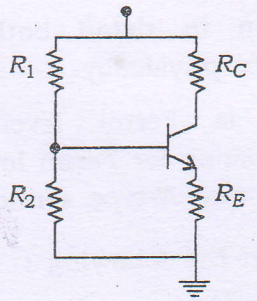

Fig. 1

(b) Draw the circuit diagram for a BJT differential amplifier using a single polarity supply. Explain the d.c. and a.c. operations of each circuit. Write equations for voltage gain and input, output impedance for a differential amplifier. 10

(c) A Zener diode shunt regulator has to supply a load current which varies from 0 to 200 mA at 10 V. The input to the regulator varies from 15 V to 20 V. Assume that Zener diode voltage stabilizes at a minimum current of 10 mA. Calculate the value of the series resistor and power rating of the Zener diode. 5

4. (a) Write in short on the following observed in BJT : 5×3=15

(i) Base width modulation

(ii) Emitter band gap narrowing

(iii) Current crowding

(b) For the transistor amplifier shown in Fig. 2 below, find A_I, A_V, A_{VS}, R_o and R_i, if h parameters are given as

$h_{ie} = 1{\cdot}1\ \text{k}\Omega$, $h_{re} = 2{\cdot}5 \times 10^{-4}$

$h_{fe} = 50$, $h_{oe} = 25 \times 10^{-6}$ ℧ 10

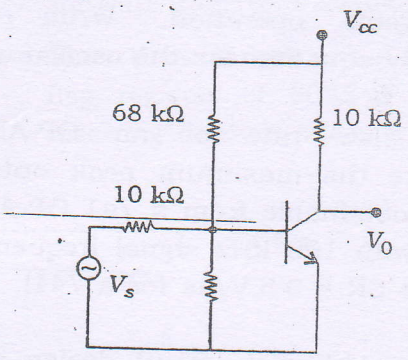

Fig. 2

5. *(a)* Discuss briefly about multi-emitter transistor (MET) and its method of fabrication. Also mention the application of MET. 6+3=9

(b) Explain MOS capacitor and its fabrication method. Compare MOS capacitor with reverse biased *P-N* junction used as capacitor. 5+3=8

(c) Why stick diagrams are important in integrating devices in microelectronics? Discuss about various color coding schemes in stick diagram. 5+3=8

6. *(a)* Draw the circuit diagram of an OP-AMP Wien bridge oscillator. Sketch the oscillator output waveforms and explain the circuit operation. Write the frequency equation for the oscillator. 12

(b) Define slew rate of an OP-AMP. Calculate the maximum peak output voltage obtainable from a 741 OP-AMP circuit with 100 kHz signal frequency. [Assume SR = 0·5 V/μs for a 741]. 5

(c) What are different layout design and analysis tools? Discuss CAD tools scheme in detail. 8

7. *(a)* List in detail the steps involved in fabricating a monolithic IC. Illustrate the steps with suitable diagrams wherever necessary. 15

(b) Define sheet resistance R_s. What is the total length required to fabricate a 20-kΩ resistor whose width is 20 μm, if R_s = 200 Ω/square? What is the width required to fabricate a 5-kΩ resistor whose length is 25 μm? 10

8. *(a)* What do you understand by addressing mode of a computer or processor? Write about various addressing modes of 8085 μP with two examples for each one of them. 10

(b) Discuss in detail about hardware and software interrupts available in 8085 μP. 8

(c) Show the arrangement of flag bits in the flag register of 8085 μP. Explain the meaning of each one of them. 7

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