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5 SEM TDC PHY M 4

2015

(November)

PHYSICS

(Major)

Course : 504

(Electronics)

Full Marks : 60
Pass Marks : 24

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer the following as directed : 1×6=6

(a) The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength 2480 nm is incident on it. The band gap of the semiconductor is

(i) 1·1 eV *(ii)* 0·7 eV

(iii) 0·5 eV *(iv)* 2·5 eV

(Choose the correct answer)

(b) In the depletion region of an unbiased *p-n* junction, there are

(i) holes

(ii) electrons

(iii) mobile ions

(iv) immobile ions

(Choose the correct answer)

(c) Which configuration of bipolar transistor is called an 'emitter follower'?

(d) Define the term 'half power frequency'.

(e) If A_d is the differential gain and A_c is the common mode gain of a differential amplifier, the common mode rejection ratio is defined by

(i) A_d / A_c

(ii) A_c / A_d

(iii) $\frac{A_d - A_c}{A_d}$

(iv) $\frac{A_d - A_c}{A_c}$

(Choose the correct answer)

(f) Simplified form of Boolean expression $(A + \overline{B} + \overline{A}B)C$ is

(i) 1

(ii) 0

(iii) C

(iv) $\overline{C}$

(Choose the correct answer)

2. (a) A crystal diode having internal resistance 200 Ω is used as a half-wave rectifier. If the applied voltage is $V = 50 \sin \omega t$ volt and load resistance is 800 Ω, find the d.c. value of output current. 2

(b) Distinguish between Zener break down and Avalanche break down of a *p-n* junction. 2

(c) In the common-base configuration of a transistor with $\alpha = 0 \cdot 96$, the voltage drop across 4 kΩ load resistance is 3 V. Determine the base current. 2

(d) Discuss the effect of negative feedback on the stability of an amplifier. 2

(e) What is the function of silicon dioxide layer in an IC? How is it formed? 2

(f) Draw a logic diagram to implement the Boolean expression $y = (A + \overline{B})B$. 2

3. Answer any *two* of the following :

(a) Draw the circuit diagram of a full-wave rectifier with shunt capacitor filter and explain its operation. Derive the expressions for its ripple factor and efficiency without filter. 3+4=7

(b) Differentiate semiconductors, conductors and insulators on the basis of band theory. What is meant by Fermilevel in semiconductor? Show that the Fermilevel of an intrinsic semiconductor lies at the middle of the forbidden gap. 3+1+3=7

(c) Define mobility, conductivity and current density. Derive an expression for the conductivity of doped semiconductors. What is the effect of temperature on the conductivity of a semiconductor? 3+3+1=7

4. (a) What is meant by leakage current in a transistor? Show that

$$I_C = \beta I_B + I_{CEO}$$

where the symbols have usual meaning. 1+2=3

(b) Draw the circuit diagram of an *R-C* coupled amplifier and give its high frequency equivalent circuit. Calculate the gain at high frequency range and explain the result. 2+4=6

Or

Explain the working of a direct coupled class A transistor power amplifier with relevant diagram. Show that the maximum efficiency of this amplifier is only 25%. 3+3=6

5. (a) Give the principle of working of a crystal oscillator. Find the expressions for the resonant frequencies in the two modes of vibration and show that they are approximately equal. 2+2+2=6

(b) Explain how an OP-AMP can be used as a summing amplifier. 3

6. (a) State De Morgan's theorem and apply it to simplify the expression

$$y = \overline{\overline{A}B\overline{C}} + \overline{A\overline{B}C}$$ 3

(b) Discuss the working of a half adder by giving its logic diagram and truth table. 3

(c) Use K-map to simplify the equation

$$y = \bar{A}B\bar{C}D + \bar{A}BCD + AB\bar{C}D + ABCD \qquad 2$$

(d) Show that

$$(A + B)(\bar{A} + C)(B + C) = \bar{A}B + AC \qquad 2$$

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