Total No. of Printed Pages—6

5 SEM TDC PHY M 4

2013

(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 as directed : 1×6=6

(a) The peak voltage in the output of a half-wave rectifier without filter is 10 V. The d.c. component of output voltage is

(i) $\frac{10}{\sqrt{2}}$ V *(ii)* $\frac{10}{\pi}$ V

(iii) 10 V *(iv)* $\frac{20}{\pi}$ V

(Choose the correct answer)

(b) The unit of the ratio of mobility and diffusion coefficient of a semiconductor is

(i) V^{-1}

(ii) $cm\,V^{-1}$

(iii) $V\ cm^{-1}$

(iv) Vs

(Choose the correct answer)

(c) The voltage gain of an amplifier with 9% negative feedback is 10. The voltage gain without feedback will be

(i) 90

(ii) 10

(iii) 100

(iv) 1·25

(Choose the correct answer)

(d) The maximum theoretical efficiency of a class *B* push-pull transistor amplifier is

(i) 25%

(ii) 50%

(iii) 70·7%

(iv) 78·5%

(Choose the correct answer)

(e) An oscillator using series resonant circuit with inductor L and capacitor C produces oscillations of frequency f. If L is doubled and C is changed to $4C$, the frequency of oscillation will be

(i) $f/2$

(ii) $f/4$

(iii) $8f$

(iv) $f/2\sqrt{2}$

(Choose the correct answer)

(f) What is the minimum number of gates required to perform the logic operation $A + \bar{A}B$?

2. Answer the following : 2×6=12

(a) Distinguish between Zener breakdown and avalanche breakdown in a p-n junction.

(b) Find the ratio of electron to hole concentration in an n-type silicon crystal having donor concentration $1{\cdot}4 \times 10^{24}$ m^{-3} and intrinsic carrier concentration $1{\cdot}4 \times 10^{18}$ m^{-3}.

(c) The power gain of a C-B amplifier is 800 and the voltage amplification factor is 840. Find the collector current, when the base current is 1·2 mA.

(d) The capacitor used in a Wien bridge oscillator is of 300 pF. What should be the value of the resistance so that the frequency of oscillation is 20 Hz?

(e) What is negative feedback? How can it increase the stability of an amplifier?

(f) Using Boolean algebra, prove that

$$(A+B)(A+C) = A+BC$$

3. Distinguish between metal, semiconductor and insulator in terms of energy bands. Define Fermi level of a material and indicate its position for *p*-type and *n*-type semiconductors. Show that the Fermi level for an intrinsic semiconductor lies in the middle of the forbidden gap. 3+2+3=8

Or

Explain the formation of potential barrier in a *p-n* junction. Derive an expression for the barrier potential. What happens to the barrier under forward and reverse biased conditions? 3+4+1=8

4. What is ripple factor? Calculate the ripple factor of a full-wave rectifier. Discuss any one method for minimizing ripple factor. 1+3+2=6

(Continued)

5. *(a)* Explain how amplification is achieved in a transistor. 3

(b) What is transistor biasing? Discuss the voltage divider bias method of transistor biasing and calculate the stability factor. 1+(3+2)=6

Or

Draw the circuit diagram of a *R-C* coupled amplifier and give its low-frequency equivalent circuit. Calculate the gain at low-frequency range and explain why gain increases with frequency. 2+4=6

6. *(a)* Draw the electrical equivalent circuit of a vibrating piezoelectric crystal. Find the expressions for resonant frequencies in the two modes of vibrations and show that they are approximately equal. 1+(3+1)=5

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

(c) Show how an OP-AMP can be used as a differentiator or an integrator. 2

7. *(a)* Draw the logic diagram of a full-adder and discuss its working by giving the truth table. 4

(b) State De Morgan's theorem and apply it to show that

$$\overline{\overline{A+B}+\overline{C}} = (A+B)C$$ 2+2=4

(c) What is a Karnaugh map? How many squares are there in a three-variable Karnaugh map? 1+1=2

★★★