

Total No. of Printed Pages—7

5 SEM TDC PHY M 4

2019

(November)

PHYSICS

(Major)

Course : 504

(**Electronics**)

Full Marks : 60

Pass Marks : 24/18

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Answer the following as directed : $1 \times 6 = 6$

- (a) To extend the depletion region of a $p-n$ junction predominantly into p -region, the concentration of impurities in the p -region must be
- (i) much higher than the concentration of impurities in n -region

(2)

- (ii) much less than the concentration of impurities in n -region
- (iii) equal to the concentration of impurities in n -region
- (iv) zero

(Choose the correct answer)

(b) Silicon diodes are less suited for low-voltage rectification as

- (i) it cannot withstand high temperature
- (ii) its reverse saturation current is low
- (iii) its cut-in voltage is high
- (iv) its breakdown voltage is high

(Choose the correct answer)

(c) The phenomenon known as 'early effect' in a bipolar transistor is due to

(i) the reverse biasing of base-collector junction

(ii) the forward biasing of emitter-base junction

(iii) electron hole recombination at the base

(iv) None of the above

(Choose the correct answer)

(d) The phase shift between the input and output voltage in a common-base small signal amplifier is

(i) 180°

(ii) -180°

(iii) 90°

(iv) 0°

(Choose the correct answer)

(e) What is meant by common-mode rejection ratio?

(f) If the output of an OR gate is connected to both the inputs of a NAND gate, the resulting circuit is a _____ gate.

(Fill in the blank)

2. (a) What is diffusion current in a semiconductor? 2

(b) A half-wave rectifier is used to supply 10 V d.c. to a resistive load of 400Ω . If the crystal diode has a forward resistance of 20Ω , determine the value of a.c. voltage supplied to the circuit. 2

(c) Which configuration of bipolar transistor is termed as emitter follower? For what purpose is it used? 2

(d) The collector leakage current in a transistor is $300 \mu\text{A}$ in CE arrangement. If the transistor is now connected in the CB arrangement, what will be the leakage current? Given $\beta = 100$. 2

(e) Explain how an OP-AMP can be used as an integrator. 2

(f) Draw a logic diagram to implement the Boolean expression

$$y = BC \overline{(AB + \overline{C})} \quad 2$$

3. Answer any *two* from the following : $7 \times 2 = 14$

(a) Explain why the energy levels of an atom become energy bands in a solid. What is the effect of acceptor impurities on the energy band structure of a *p*-type semiconductor? Derive an expression for the concentration of electrons in the conduction band. $2+1+4=7$

(b) Explain the terms 'barrier potential' and 'depletion region' as applied to a *p-n* junction. From the expression for diode current, show that the dynamic resistance of an ideal junction diode is inversely proportional to the forward current. What is the breakdown mechanism of a lightly doped junction diode? $3+3+1=7$

- (c) Draw a simple d.c. power supply circuit. Explain the importance and principle of working of filter circuit and voltage regulator in a power supply circuit. $1+3+3=7$

4. (a) What is transistor biasing? Explain the potential divider method of biasing and calculate the stability factor. Why is this method commonly preferred? $1+4+1=6$

Or

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

- (b) Draw the circuit diagram of a R-C coupled CE transistor amplifier and discuss the role of the emitter bypass capacitor and coupling capacitor. $1+2=3$

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) What is monolithic IC? State the demerits of ICs over discrete circuits. 1+2=3

6. (a) What is a NAND gate? Show that appropriate combination of NAND gates may act as (i) XOR gate and (ii) half-adder. 1+2+1=4

(b) State De Morgan's theorems and apply them to simplify the following equation : 2+2=4

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

(c) Use K-map to simplify the equation

$$x = \overline{A}\overline{B}\overline{C} + \overline{B}C + \overline{A}B \quad 2$$
