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5 SEM TDC PHY M 4

2016

(November)

PHYSICS

(Major)

Course : 504

(Electronics)

Full Marks : 60

Pass Marks : 24 (Backlog) / 18 (2014 onwards)

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 ratio of $I_{r.m.s.}$ and $I_{d.c.}$ of a full-wave rectifier is

(i) 0·48

(ii) 1·11

(iii) 1·21

(iv) 1·57

(Choose the correct answer)

(b) The probability of occupancy of the Fermi level at room temperature is

(i) 100%

(ii) 0%

(iii) 50%

(iv) 75%

(Choose the correct answer)

(c) Which of the following specifications is not correct for a common-collector amplifier?

(i) High-input impedance

(ii) Low-output impedance

(iii) High-voltage gain

(iv) High-current gain

(Choose the correct answer)

(d) What is the maximum theoretical efficiency of a class B push-pull transistor power amplifier?

(e) Crystal oscillators are superior to *L-C* oscillators mainly because of their

(i) small crystal size

(ii) wide frequency range

(iii) high value of *Q*

(iv) better frequency stability

(Choose the correct answer)

(f) What is the minimum number of gates required to implement the logic operation $X + \overline{X}Y$?

2. Answer the following questions : 2×6=12

(a) Intrinsic resistivity of silicon at 27 °C is $2 \cdot 8 \times 10^3$ Ω-m. If the hole and electron mobilities are 0·18 $m^2V^{-1}s^{-1}$ and 0·38 $m^2V^{-1}s^{-1}$, calculate the intrinsic carrier density of silicon.

(b) What is meant by mobility of a carrier? How does it depend upon temperature and doping concentration?

(c) Distinguish between class A and class B amplifiers.

(d) An amplifier with negative feedback gives an output of 12·5 V with an input of 1·5 V. If the feedback is removed, the same output can be obtained for an input of 0·25 V. Calculate the feedback fraction.

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

(f) Simplify the following Boolean equation :

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

3. (a) Why do the energy levels of an atom become energy bands in a solid? Sketch the energy band picture for (i) an intrinsic, (ii) an *n*-type and (iii) a *p*-type semiconductor indicating the positions of the Fermi level, the donor or the acceptor levels. Distinguish between drift current and diffusion current in a semiconductor. 2+3+2=7

(b) Explain the terms 'barrier potential' and 'depletion region' as applied to a *p-n* junction. Plot and explain the *I-V* characteristic of a junction diode. Also write an expression for diode current. 3+3+1=7

Or

Discuss the two mechanisms of junction breakdown. Draw the circuit diagram of a d.c. power supply and explain the action of Zener diode as voltage regulator. 3+1+3=7

4. (a) What is non-linear distortion? Mention any two methods of minimizing it. 1+2=3

(b) What is transistor biasing? Discuss the base resistor method of biasing. What are its advantages and disadvantages? 1+3+2=6

Or

Write down the hybrid equations of a transistor and define the *h*-parameters. What are the advantages of using the *h*-parameters? 1+3+2=6

5. *(a)* Explain the principle of operation of Wien bridge oscillator and find an expression for the frequency of oscillation. 5

(b) Discuss briefly the steps involved in fabricating a monolithic integrated circuit. 4

6. *(a)* Draw the logic diagram of a full adder. Write the Boolean expressions for sum and carry, and give its truth table. 2+1+2=5

(b) Establish that the NAND gate is a universal gate. 2

(c) Use K-map to simplify the following Boolean expression : 2

$$X = \overline{A}B + \overline{A}\,\overline{B}\,\overline{C} + AB\overline{C} + A\overline{B}\,\overline{C}$$

(d) Draw a logic diagram for implementation of $Y = A\overline{B} + B\overline{A}$. 1

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