B.Sc. PHYSICS
FOURTH SEMESTER
ANALOG SYSTEMS & APPLICATIONS
BSP – 403

(Use Separate Answer Scripts for Objective & Descriptive)

Duration: 3 hrs. Full Marks: 70

(PART-A: Objective)

Time: 20 min. Marks: 20

Choose the correct answer from the following: ***1X20=20***

1. A semiconductor has generally_____valence electrons
   a. 2 b. 3
   c. 6 d. 4

2. An n-type semiconductor is
   a. Positively charged b. Negatively charged
   c. Electrically neutral d. None of the mentioned

3. In the depletion region of a *pn* junction, there is a shortage of
   a. Acceptor ions b. Electrons and holes
   c. Donor ions d. None of the mentioned

4. The leakage current of a *pn* junction is due to
   a. Minority carriers b. Majority carriers
   c. Junction capacitance d. Depletion layer

5. With forward bias to a *pn* junction, the width of the depletion layer
   a. Decreases b. Increases
   c. Remains the same d. None of the mentioned

6. When the graph between current and voltage across a device is a straight line, the device is referred to as
   a. Linear b. Active
   c. Non-linear d. Passive

7. The doping level in a Zener diode is _____that of a crystal diode.
   a. The same as b. Less than
   c. More than d. None of the mentioned

8. A transistor has
   a. One *pn* junction b. Two *pn* junction
   c. Three *pn* junction d. Four *pn* junction

9. The element that has the biggest size in a transistor is
   a. Collector b. Base
   c. Emitter d. Collector-base junction

10. In a *pnp* transistor the current carriers are
    a. Acceptor ions
    b. Donor ions
    c. Free electrons
    d. Holes

11. The value of β of a transistor is generally
    a. 1
    b. Less than 1
    c. Between 20 and 500
    d. Above 500

12. The most commonly used semiconductor in the manufacture of a transistor is
    a. Germanium
    b. Silicon
    c. Carbon
    d. None of the mentioned

13. Transistor biasing is done to keep_____in the circuit.
    a. Proper direct current
    b. Proper alternating current
    c. The base current small
    d. Collector current small

14. The circuit that provides the best stabilization of operating point is
    a. Base resistor bias
    b. Collector feedback bias
    c. Voltage divider bias
    d. Emitter bias

15. The ideal value of stability factor is
    a. 100
    b. 200
    c. More than 200
    d. 1

16. A single stage transistor amplifier contains_____and associated circuit.
    a. Two transistors
    b. One transistor
    c. Three transistors
    d. Four transistors

17. The purpose of capacitor in a transistor amplifier is to
    a. Protect the transistor
    b. Cool the transistor
    c. Couple or bypass the ac component
    d. Providing biasing

18. The common-mode gain is
    a. Very high
    b. Very low
    c. Always unity
    d. Unpredictable

19. A voltage follower
    a. Has a voltage gain of 1
    b. Is non-inverting
    c. Has no feedback resistor
    d. All of the mentioned

20. An oscillator converts
    a. a.c. power into d.c. power
    b. d.c. power into a.c. power
    c. mechanical power into a.c. power
    d. None of the mentioned

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PART-B : Descriptive

Time : 2 hrs. 40 min. Marks : 50

[Answer question no.1 & any four (4) from the rest]

1. a. Explain the forward biased and reversed biased *pn* junction with suitable current-voltage characteristics. **8+2=10**

   b. What do you mean by an ideal diode? Draw the circuit and characteristics for an ideal diode.

2. a. Draw the circuit diagram and explain the operation of a half-wave rectifier. **3+4+3 =10**

   b. Derive the expression for the efficiency of a half-wave rectifier.

   c. A crystal diode having internal resistance of 20Ω is used for half-wave rectification. If the applied voltage $v = 50 \sin \omega t$ and RL=800Ω, find (i) rms current, (ii) ac and dc power output, (iii) efficiency

3. a. Draw the common emitter (CE) configuration of a transistor and define the current amplification factor. **2+4+4 =10**

   b. Establish the relation between α and β of a transistor and find the expression for collector current in CE configuration

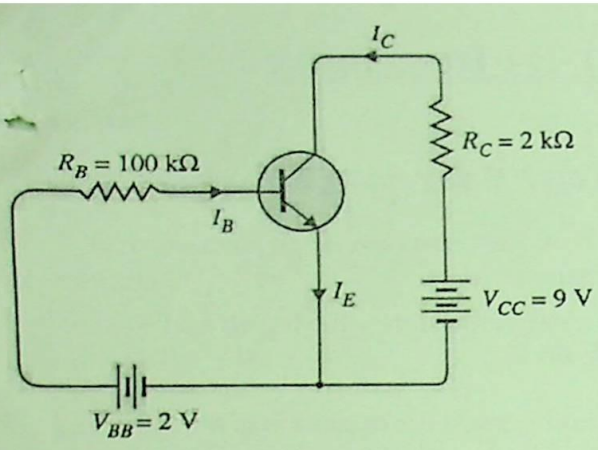
   c. (i) Calculate I_E for which β=50 and I_B=20μA.

   (ii) A transistor is connected in CE mode. Collector supply is 8V and voltage drop across load resistor is 0.5V. If α=0.96 and load resistor is 800Ω, calculate collector-emitter voltage and base current.

4. a. What do you mean by transistor biasing? What is its need? **2+3+5 =10**

   b. Define stability factor*S*. Derive the general expression of *S* for CE mode transistor configuration.

   c. Figure below shows the biasing with base resistor method. Determine I_C and V_{CE} (neglect V_{BE} and β=50). If R_B in the circuit is changed to 50kΩ, find the new operating point.



5. a. Draw the h-parameter model of an ideal CE transistor and calculate the froward and reverse parameters. 5+5=10

   b. With the help of a neat and labelled diagram, explain the various types of power amplifiers.

6. a. With suitable diagram, explain the principle of positive and negative feedback in amplifiers. Mention the advantages of negative feedback in amplifiers? 6+4=10

   b. An amplifier rated 40W output power is connected to a 10Ω speaker. Calculate: (i) the input power required for full power output if the power gain is 25dB, (ii) the input voltage for rated output if the amplifier voltage gain is 40dB.

7. a. With the help of a neat and labelled diagram, explain the operation of a *single ended output* differential amplifier. 6+2+2 =10

   b. What do you mean by common mode rejection ratio of a differential amplifier.

   c. A differential amplifier has an output of 1V with a differential input of 10mV and an output of 5mV with a common-mode input of 10mV. Find the CMRR in dB.

8. a. With suitable diagram, explain the inverting and non-inverting applications of OP-Amp and find the expression of voltage gain in each case. 6+4=10

   b. Explain the operation of a LC circuit for producing sinusoidal oscillations. How can one produce undamped oscillations from the tank circuit?

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