'समानो मन्त्रः समितिः समानी'

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 4th Semester Examination, 2023

CC10-PHYSICS

ANALOG SYSTEMS AND APPLICATIONS

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.

GROUP-A

1. Answer any ***five*** questions from the following: 1×5 = 5

   (a) "Si is prefered material over Ge in electronic devices" — Justify.

   (b) Which charge carriers have higher mobility and why?

   (c) A transistor connected in CE mode has α = 0.99. Calculate the β value. The symbols carry their usual meaning.

   (d) What do you mean by load line of a transistor?

   (e) The temperature co-efficient of zener breakdown voltage is negative. Explain it.

   (f) What is Barkhausen criterion for a feedback amplifier to function as an oscillator?

   (g) Mention few advantages of using negative feedback amplifiers.

   (h) Draw a neat circuit diagram of a bridge rectifier.

GROUP-B

Answer any *three* questions from the following 5×3 = 15

2. (a) Why determination of Q point is important for a transistor amplifier? 1

   (b) Discuss the input and output characteristics of a CE p-n-p transistor. 2+2

3. (a) Explain the conduction process for extrinsic semi-conductor using band theory of solids. 3

   (b) Determine the conductivity of pure Ge at 300 K. Assume the intrinsic carrier concentration is 2.5×10^{19} m^{-3}, electron's mobility = 0.375 m^2/V.s and hole's mobility = 0.175 m^2/V.s. 2

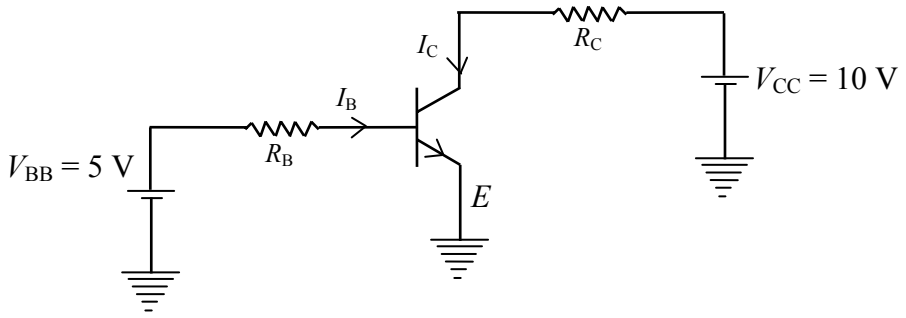
4. Give a neat circuit diagram of Wien bridge oscillator and explain how it works. Show that the voltage gain of the amplifier used in this oscillator must be greater than 3. 1+2+2

5. (a) With a neat sketch, describe the construction of n-channel JFET. Describe its principle of operation. 2+2

   (b) What are the advantages of using FET over BJT? 1

6. (a) In a transistor, can the emitter be used as collector and vice-versa? — Explain. 2

   (b) Consider the circuit given below. Find the value of R_B and R_C required to operate the transistor at I_C = 1 mA and V_{CE} = 5 V. Assume $\beta_{d.c}$ = 100 and V_{BE} = 0.7 V. 3



GROUP-C

Answer any *two* questions from the following 10×2 = 20

7. (a) Derive an expression for the width of depletion region across a p-n junction in terms of impurity concentration. 4

   (b) Calculate the ratio of the current for a forward bias of 0.06 V to the current for the same value of reverse bias applied to a Ge p-n diode at 27°C (η = 1). 3

   (c) What do you mean by static and dynamic resistance of a diode? How does dynamic resistance vary with current and temperature? 1+1+1

8. (a) What are the fundamental differences among the class A, class B and class C amplifiers? 3

   (b) Draw the circuit of RC coupled amplifier. Obtain an expression for the voltage gain in mid-frequency range. 2+5

9. (a) Calculate the closed loop gain of a voltage amplifier using negative feedback. 3

   (b) In a phase shift oscillator $R = R_L$ = 1 mΩ and C = 75 pF. At what frequency does the circuit oscillate? 3

   (c) Show that the intrinsic carrier concentration is proportional to $T^{3/2}e^{-Eg/2kT}$. 4

10. (a) Explain how an OPAMP may be used as, (i) Differentiator, (ii) Integrator. For each case, mention the modifications required to use the devices for practical purpose, with proper circuit diagram. 2+2+$1\frac{1}{2}+1\frac{1}{2}$

    (b) Draw a circuit using one or more OP-AMP whose output v_0 is given as $v_0 = 4v_1 + 6v_2$, where v_1 and v_2 are two input signals. 3

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