WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 4th Semester Examination, 2023

### PHSACOR10T-PHYSICS (CC10)

Time Allotted: 2 Hours

Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

**Question No. 1 is compulsory and answer any *two* from the rest**

$2 \times 10 = 20$

1. Answer any *ten* questions from the following:

    (a) For an unbiased p-n junction diode, sketch the variation of space charge, electric field and potential as a function of distance across the junction.

    (b) What is meant by diffusion capacitance of a p-n junction?

    (c) Can a voltmeter measure the built-in-barrier potential across the abrupt or step p-n junction?

    (d) What are the sources of instability of Q-point for CE amplifier?

    (e) Why do Si or Ge diodes not emit light but GaAs diodes do?

    (f) How can you use a bipolar junction transistor (BJT) as a switch?

    (g) Draw the waveform that will be shown in a CRO across a-b
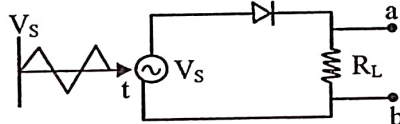
    (h) In the Zener regulator circuit shown below, calculate current through the series resistance (R_S)
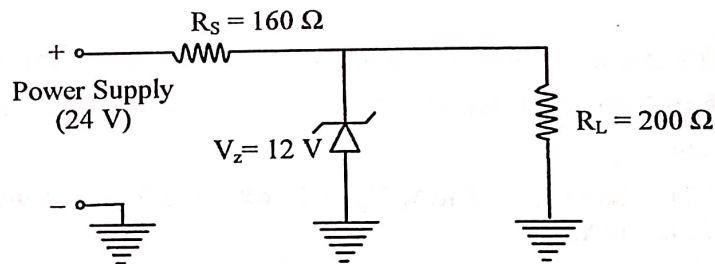
    (i) Why the noise behaviours of JFET is less than that of a BJT?

    (j) How is a power amplifier different from a voltage amplifier?

    (k) Explain the current-voltage characteristics of a solar cell.

    (l) A Zener diode with break-down voltage 6 V is connected in series with a $100\,\Omega$ resistance and a load of $0.5\,k\Omega$ connected across the diode. The maximum allowable current through the Zener diode is $30\,mA$. Calculate the operating range of the input voltage.

(m) If the input of an OPAMP integrator circuit is 1 volt then find and draw the nature of the output voltage. Assume R = 1 MΩ and C = 2 μF.

(n) An amplifier has a voltage gain of –100 and a feedback ratio of –0.04. Find (i) the output voltage of the feedback amplifier for an input voltage of 60 mV and (ii) find the feedback voltage.

2. (a) A full wave rectifier is operated from 50 Hz supply with 60 V (r.m.s.). It is connected to a load drawing a current of magnitude 200 mA and using 100 μF filter capacitor. Calculate the d.c. output voltage and the r.m.s. value of ripple voltage. Also calculate the ripple factor.   1+2+2

(b) Draw the circuit diagram of a logarithmic amplifier and a comparator using OPAMP and derive an expression for output voltage for the logarithmic amplifier.   1+2+2

3. (a) Draw a labeled circuit diagram of a two-stage R-C coupled amplifier. Find the mid-frequency gain of the amplifier with the help of an ac equivalent circuit. Explain why the gain of R-C coupled amplifiers falls at high frequencies.   2+3+2

(b) A two-stage RC coupled amplifier uses transistors having h-parameters $h_{ie} = 1500\ \Omega$ and $h_{fe} = 250$. If the load resistance is 10 kΩ, find the value of the coupling capacitor for having a lower cut-off frequency of 10 Hz.   3

4. (a) Define "Slew rate". Find the input signal maximum frequency for a specified "Slew rate" of an OP-AMP.   1+2

(b) Is an external input signal necessary for the output of an oscillator? If not, how are oscillations initiated?   2

(c) Explain the working principle of Colpitts oscillator circuit using BJT.   5

5. (a) What are the fundamental differences between Class A and Class C amplifiers?   2

(b) Negative feedback reduces the gain of an amplifier still this feedback is widely used, why?   2

(c) What is JFET? An n-channel Si (having dielectric constant 12) JFET with a channel width of 0.06 cm is doped with a concentration $N_d = 10^{21} m^{-3}$. Find the pinch off voltage.   1+3

(d) An n channel FET has I_{DSS} = 8 mA, V_p = –4 volt. Find V_{GS} that will result in a drain current of 4.5 mA.   2

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