

B.Sc. 4th Semester (Honours) Examination, 2023 (CBCS)

Subject : Physics

Course : CC-X

Time: 2 Hours

Full Marks: 40

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

Group-A

1. Answer any five questions from the following:

2×5=10

- What is a hole in semiconductor? How does it move through a crystal?
- What are direct and indirect band gap semiconductors? Give example.
- The mobility of electron in Si at 300 K is $0.130 \text{ m}^2/\text{Vs}$. Calculate the diffusion constant of electron.
- Write down the principle of a photo diode.
- The value of α of a transistor is 0.98. If it changes by 0.5% what would be the corresponding percentage change in the value of β ?
- The power gain of an amplifier is 30 dB. If the input power is 1 mW, what is the output power?
- What do you mean by class A, class B and class C amplifiers?
- What is thermal runaway in transistors and how can it be avoided?

Group-B

Answer any two questions from the following.

5×2=10

- Explain the concept of diffusion and drift current in a semiconductor. Find the concentration of holes and electrons in a p -type germanium if the conductivity is $100 (\Omega\text{m})^{-1}$.
[Given: $n_i = 2.5 \times 10^{19}$ electrons/ m^3 , hole mobility $\mu_p = 0.18 \text{ m}^2/\text{Vs}$] (1½+1½)+2
- Draw a neat circuit diagram for the collector to base bias arrangement of an n - p - n transistor in CE mode. Obtain an expression for its stability factor. What is the advantage of this circuit? 1+3+1
- Define the four h -parameters used in an h -parameter equivalent circuit of a transistor. Which of them can be neglected in a simplified model and why? Why h -parameter model is not valid at high frequencies? 3+1+1

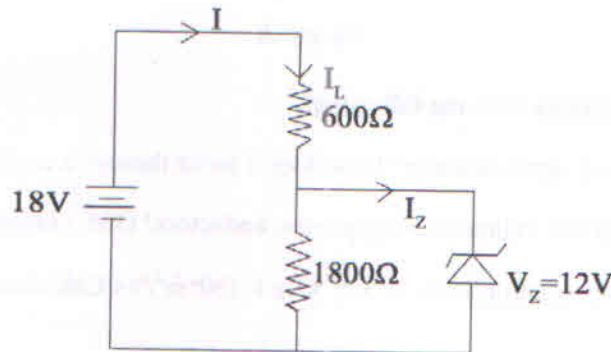
5. Draw a neat diagram of a two stage RC coupled transistor amplifier. Derive an expression for mid frequency voltage gain. What are the effects of coupling capacitor, (C_C) and bypass capacitor (C_E) in the low frequency range? 1+3+1

Group-C

Answer any two questions from the following.

10×2=20

6. Draw the circuit diagram of a full wave rectifier with a resistive load, using junction diodes. Calculate the ripple factor. Does it give a perfect dc? What is a filter circuit? Using an ideal zener diode, determine whether the zener diode in the circuit is biased properly. If so, find I_Z and I_L . (1+4)+1+1+3



7. With proper diagram, show different current components in a $p-n-p$ (or $n-p-n$) transistor under normal biasing condition. Draw the output characteristics of that transistor in CE configuration. Identify and explain different regions in the graph. What is Early effect? 3+2+4+1
8. Explain the concept of virtual ground in an OP-AMP. Is there a virtual ground in non-inverting mode of operation? Explain how an OP-AMP can be used as an integrator.

Consider an OP-AMP integrator circuit, with input resistance $R = 100 \text{ k}\Omega$, feedback capacitor $C = 1 \mu\text{F}$ and power supplies $= \pm 12\text{V}$. If input voltage 1 volt is applied at the input inverting terminal determine the nature of output. (2+1)+4+3

9. Describe the working principle of a feedback amplifier with the help of a block diagram. Derive an expression for overall transfer gain.

State Barkhausen Criterion for oscillation.

With a suitable diagram, explain the operation of an R-C phase shift oscillator.

An RC amplifier has mid-frequency gain of 100 and bandwidth of 20kHz. If the amplifier is now provided with a negative feedback network with $|\beta| = 0.02$, what will be the new bandwidth?

(2+2)+1+4+1