

B.Sc.(Honours) Examination, 2019
Semester-IV (CBCS)
Physics (Honours)
Core Course: CC-10 (Theory)
(Analog Systems and Applications)

Time: Three Hours

Full Marks: 40

Questions are of value as indicated in the margin.

Answer *any four* questions.

1. Derive an expression for the carrier concentration in an intrinsic semiconductor from a consideration of the density of states and the Fermi function. 10
2. a) With a suitable diagram, explain the functioning of a DAC using an R-2R ladder. How does the current-to-voltage converter work in this case? 4+1
b) Describe the principle of the successive-approximation ADC. Why is this better than the counter method? 3+2
3. a) Derive the Einstein relationship between mobility and diffusion constant. What is the volt-equivalent of temperature? What is its approximate value at room temperature? 6
b) What is carrier lifetime? Show that excess minority carriers have an exponential decay with time. 3
c) Why is gold used in semiconductor? 1
4. Write an essay on the Hall effect. What are its uses? 7+3
5. With reference to a step-graded junction, derive an expression for the 'incremental capacitance' and hence describe the working of a varactor. 10
6. a) Describe the techniques of manufacture of a bipolar junction transistor. 4
b) In an RC-coupled common-emitter transistor amplifier, how is the operating point set (consider $V_{CC} = 10V$)? Use a circuit diagram. 3
c) Describe the role of R_E and C_E in the above amplifier, where the symbols have the usual meanings. 3
7. a) With a diagram, describe the working of an OP-AMP-based integrator. How is the virtual-ground formed? Why is it necessary to have a resistor in parallel with the feedback capacitor and how would you decide on a suitable value for it? 5
b) What does the circuit shown below do? Explain. 5

