

**Five-Year Integrated M.Sc. Examination 2022-2023**

**Semester: V**

**Paper: PH-3-5-2**

**Subject: Physics (Electronics)**

**Time: Four Hours**

**Full Marks: 80**

**Questions are of value as indicated in the margin.  
Answer Question number 1 and any three from the rest.**

1. Answer any five questions: 5x4 = 20
  - (a) Explain the working principle of a photodiode.
  - (b) Explain qualitatively how depletion layer and contact potential are developed at the junction of a semiconductor diode.
  - (c) Explain the concepts of dc and ac current gains of a p-n-p transistor in CB mode with circuit diagram.
  - (d) Explain the concept of virtual ground of an operational amplifier.
  - (e) Draw circuit diagrams of AND, OR and NOT gates by using NAND gates only. Also, write the truth tables.
  - (f) Define h parameters for a linear circuit.
  - (g) Explain the working principle of a transistor RS latch.
  
2.
  - (a) Find an expression for the mobility of free electrons in a n-type semiconductor.
  - (b) Starting from the expression of current density due to holes on drift and diffusion currents, find an expression for the contact potential at the junction of a semiconductor diode.
  - (c) An ac voltage of peak value 30 V is connected in series with a silicon diode and load resistance of 600 ohm. If the forward resistance of the diode is 30 ohm, find (i) peak current through the diode, (ii) peak output voltage. What will be these values, if the diode is assumed to be ideal.8+8+4 = 20
  
3.
  - (a) What are the main disadvantages of a single stage transistor amplifier in CE mode?
  - (b) Draw the circuit diagram of an RC coupled transistor amplifier in CE mode and explain its working principle briefly. What are the main advantages of this amplifier over single stage amplifier?
  - (c) Obtain the expressions for input impedance and current gain of a linear circuit in terms of h parameters.
  - (d) An n-p-n transistor is connected in CE mode in which collector supply is 8 V and the voltage drop across resistance  $R_c$  connected in the collector circuit is 0.6 V. The value of  $R_c$  is 500 ohm. If current gain is 0.96, calculate (i) collector-emitter voltage and (ii) base current.2+(6+2)+6+4 = 20
  
4.
  - (a) State and explain the basic characteristics of an operational amplifier.
  - (b) Explain the operation of an inverting voltage amplifier and obtain an expression for the closed-loop gain.
  - (c) Explain the working principles of a differential amplifier and a differentiator using operational amplifier.
  - (d) Explain the working principle of a binary full adder using logic gates.3+3+(4+4)+6 = 20

5. (a) Draw the circuit diagrams for unclocked and clocked D flip-flops by using NAND gates only and explain their working principles. What is the main advantage of a D flip-flop over RS flip-flop?
- (b) Explain the working principle of an 'enhancement type' MOSFET. What is the main advantage of an 'enhancement type' MOSFET over 'depletion type' MOSFET?
- (c) Draw an electronic circuit diagram to convert a decimal number to a binary number and explain the same.

$$(3+3+1)+(6+1)+6 = 20$$