B.SC. 4th Semester (Honours) Examination, 2019 (CBCS)

Subject : Physics

Paper : 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.

1. Answer *any five* of the following questions: 2×5=10

(a) Draw the energy level diagram of a p - n junction diode when it is forward biased.

(b) Write the $i - v$ equation of a p - n junction diode. Hence find the dynamic resistance of the diode.

(c) What do you mean by Carrier mobility of a semiconductor? Write the expression of the mobility of an electron in respect of effective mass, average momentum, relaxation time and charge of the electron.

(d) Draw the circuit diagram of half-wave rectifier circuit. Hence draw the output current wave-form for a sinusoidal input voltage.

(e) Draw the circuit diagram of a Zener diode circuit for application as a reference voltage.

(f) A transistor working in CE configuration has $\alpha = 0.98$. Find the values of β and Collector Current if the base current and reverse saturation current are $200\mu A$ and $5\mu A$ respectively.

(g) Draw the output characteristics of a p - n - p transistor working in CE configuration.

(h) Discuss the stabilisation of operating point of a transistor in active region from the appropriate transistor characteristic curve.

2. Answer *any two* of the following questions: 5×2=10

(a) What do you mean by ripple factor of a full-wave rectifier? Derive the expression of the ripple factor in terms of V_{rms} (RMS voltage) and V_{dc} (Dc-voltage) of the output of the rectifier. 1+4=5

(b) Draw the circuit diagram of a self-biased n - p - n transistor circuit under CE mode. Write the advantage of self-biasing in respect of thermal runaway. 3+2=5

(c) With neat circuit diagram of a R-C coupled CE transistor amplifier, discuss the principle of its operation. Hence graphically represent the gain as a function of frequency of the amplifier. 4+1=5

(d) What is CMRR of an operational amplifier? What will be its value if the operational amplifier is an ideal one? Derive the expression of CMRR of an operational amplifier in respect of A_1 and A_2, where A_1 and A_2 are voltage gains of the open-loop operational amplifier when inverting and non-inverting terminals are grounded respectively. 1+1+3=5

10×2=20

3. Answer *any two* of the following questions:

(a) With neat circuit diagram of a Hartley oscillator circuit, derive the expression of its oscillation frequency. 3+7=10

(b) (i) Drawing the circuit diagram of a bridge-rectifier, discuss its principle of operation. What is peak inverse voltage?

(ii) Why direct band-gap semiconductor is required for development of a LED? (3+4+1)+2=10

(c) In case of a feed-back amplifier, A and B are the gains of internal amplifier and feedback network respectively. Hence obtain the expression of overall feedback gain. Discuss the conditions, when the feedback amplifier will be a positive and a negative feedback amplifier. Discuss also, the condition when the feedback amplifier acts as an oscillator. Draw the schematic diagram of a current shunt feedback amplifier. 3+2+2+2+1=10

(d) With neat proper circuit diagrams discuss the uses of operational amplifier as a differentiator as well as an integrator. Hence obtain the expressions of output in both the cases. 5+5=10
