B.Sc. 4th Semester (Honours) Examination, 2020-21

PHYSICS

Course ID: 42413 **Course Code: SH/PHS/403/C-10**

Course Title: Analog Systems and Applications (T10)

Time: 1 Hour 15 Minutes **Full Marks: 25**

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

Section-I

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

(a) What do you mean by quiescent point of transistor amplifier?

(b) If α is 0.99 in case of a bipolar junction transistor, find the value of β.

(c) The intrinsic carrier density of a pure semiconductor is 10^{20} m^{-3} at 300 K. The hole concentration decreases to 10^{18} m^{-3} upon doping with donor type impurities. Estimate the value of electron density.

(d) If the reverse saturation current in a semiconductor diode is found 10 μA and 105 μA at 300 K and 330 K, respectively, find the band gap of the semiconductor.

(e) What do you mean by positive and negative feedback in amplifiers?

(f) Mention one important advantage of a FET over a conventional bipolar junction transistor.

(g) Explain the static and dynamic resistance of a semiconductor diode.

(h) How does Hartley oscillator differ from Colpitts's oscillator?

Section-II

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

(a) The n-p-n transistor is connected in CE configuration in which collector supply is 8V and voltage drop across resistance R_L connected in the collector circuit is 0.5V. The value of R_L = 800ohm. If α = 0.96, determine collector emitter voltage and base current.

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(b) "The barrier potential of a p-n junction diode cannot be measured simply by placing a voltmeter across the diode terminals"- explain very briefly. Derive an expression of the width of depletion region across a p-n junction, in terms of impurity concentrations. [2+3]

(c) (i) What is doping? (ii) A sample of silicon has electron and hole mobilities of 0.13 and 0.05 $m^2/V{\cdot}s$, respectively at 300 K. It is doped with phosphorous and aluminum with doping densities of 1.5×10^{21} m^{-3} and 2.5×10^{21} m^{-3}, respectively. Estimate the conductivity of the doped silicon sample at 300 K. [1+4]

(d) (i) An LED operates at 1.5 V and 5 mA in forward bias. Estimate the number of photons emitted per second assuming external efficiency of the LED is 75%. (ii) Distinguish between avalanche and Zener breakdown. [3+2]

Section-III

3. Answer any ***one*** of the following questions: 10×1=10

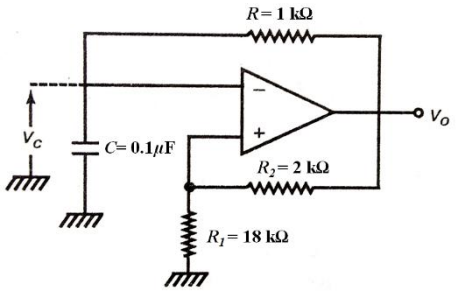
(a) (i) What is a MOSFET? Draw a typical set of static drain characteristics and transfer characteristics of a MOSFET and explain?

(ii) Calculate the static and dynamic resistance of a p-n junction germanium diode if the room temperature is 27^0C and reverse saturation current I_s = 1μA when a forward bias of 0.2V is applied. [(1+2+2)+ 5]

(b) (i) Find the value of CMRR for an amplifier with two inputs from the information that the output is 2.01 mV when the inputs are 110 μV and 90 μV, but output is 2 mV when inputs are 10 μV and -10 μV.

(ii) Explain how an OP-AMP may be used as an integrator.

(iii) Calculate the frequency of oscillation for the following circuit:



[3+3+4]