2019

B.Sc. (Hons)

4th Semester Examination

# PHYSICS

## Paper - C10T

Full Marks : 40 Time : 2 Hours

*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 : 2×5=10

   (a) Show that the total conductivity of a semiconductor is $\sigma = e\left(p\mu_p + n\mu_n\right)$ where p = density of holes, n = density of electron, $\mu_p$ = mobility of hole, $\mu_n$ = mobility of electron.

   (b) What is ripple factor ? Show that the ripple factor of a half wave rectifier is 1.21.

(c) Determine the operating frequency of Hartley Oscillator where $L_1 = 1000\mu H$, $L_2 = 100\mu H$ are connected in series and C = 20PF.

(d) Explain — "BJT is a current controlled device but FET is a voltage controlled device".

(e) Explain how an OPAMP can be used as voltage comparator.

(f) How does the dynamic resistance ($r$) of a pn junction depend on forward current ?

(g) Sketch the variation of space change, electric field and potential as a function of distance across the junction of an open circuited p-n junction.

(h) How is the depletion region formed in p-n junction ?

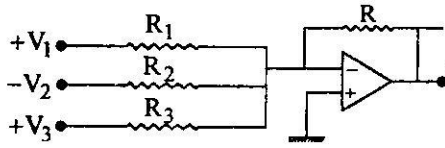
2. Answer any *four* of the following : 5×4=20

(a) (i) Show that the barrier width of a p-n diode is $W = \sqrt{\frac{2 \in V_0}{e}\left(\frac{N_a + N_D}{N_A N_D}\right)}$, symbols having their usual meaning. 2½

(ii) A full wave rectifier use two diodes, the internal resistance of each diode may be assumed at $20\Omega$. The transformer r.m.s secondary voltage from centre tap to each end of secondary is 50V and load resistance $980\Omega$. Find mean and r.m.s load current. 2½

(b) (i) Explain how an OPAMP can be used as a logarithmic amplifier. 2½

(ii) Calculate the output voltage of the following circuit




2½

(c) (i) Establish the relation

$I_C = \beta J_B + (1+\beta) I_{CBO}$ for CE transistor in active region, where symbols have usual meaning.

(ii) Thermal noise in CE circuit is much higher than that in CB circuit. Explain. 3+2

*[ Turn Over ]*

(d) Draw a neat diagram of a bridge rectifier. What are its advantages over a full wave rectifier ?

A 6.8V, 300 mW Zener diode is used as voltage regulator with resistance $R_L = 1K\Omega$ and a series resistance Rs = $220\Omega$.

Find the minimum and maximum values of input voltage for which the output will be maintained constant at 6.8V. 1+1+3

(e) (i) What do you mean by stability of bias point of a bipolar junction transistor ?

(ii) With neat diagram, discuss the bias stability of an emitter bias circuit. 2½+2½

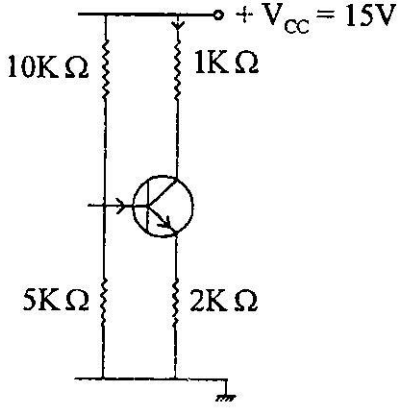
(f) (i) What are the advantages of negative feedback in amplifiers ?

(ii) How are the input and output resistances of an amplifier modified in voltage series feedback ? 2+3

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

(a) (i) What is differential amplifier ? Draw the circuit of an emitter coupled differential amplifier and explain its operation.

(ii) The following figure shows the voltage divider bias method. Draw the D.C load line and determine the operating point. (Assuming the transistor to be of Si)




1+5+4

(b) Deduce an expression for the voltage gain and phase difference for a lead-lag network. Show that the output is in phase with the input at resonance. Design a Wien bridge oscillator using this network. How is the amplitude of oscillation controlled in the circuit ? 3+2+1+2+2