Fourth Semester Examination, April – 2005

BASIC ELECTRONICS

Full Marks : 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any five questions from the rest.

The figures in the right-hand margin indicate marks for the questions.

1. Answer the following : 2×10

(a) If the depletion width of a p-n junction with doping levels of $N_A = 10^{16}/cm^3$ and $N_D = 10^{18}/cm^3$ is x_d, what distance does the depletion region penetrate into the n-side of the junction ?

0.5 x_d

P.T.O.

(b) What is the value of the current I in the following circuit (Fig. 1) assuming V_Z=5.6V and V_D=0.7V.

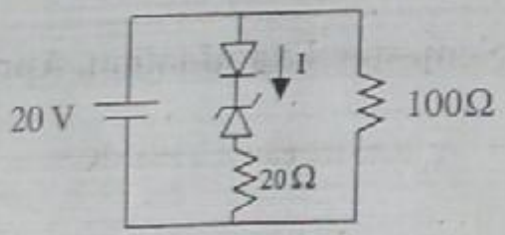

Figure 1

(c) If $292_{10}=1204_b$, determine the value of b.

(d) Convert the decimal number 359 to its octal equivalent.

(e) Find the node voltage V_2 and I_C for the following circuit (Fig. 2). Take β to be very high.

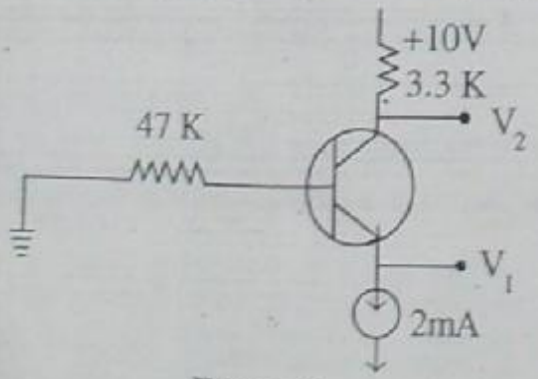

Figure 2

(f) An enhancement type NMOS transistor with V_t=2V has its source terminal grounded and its gate is given 3V. In what region of operation the device operate for V_D=0.5V and V_D=1V ?

(g) Draw and scale the output waveform of the following circuit (Fig. 3) if a sinewave of 10V p-p is applied to the following circuit.

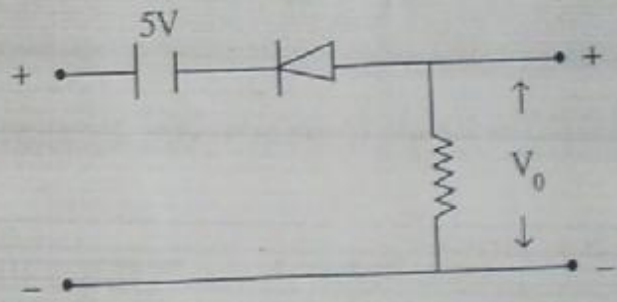

Figure 3

(h) A 10V forward voltage is applied to a silicon diode in series with a load of 10KΩ. Draw the dc load line and find its slope.

(i) If each inverter in the following figure (Fig. 4) has a propagation delay of 10ns, determine the waveshape of the output waveform V_o. What is its frequency ?

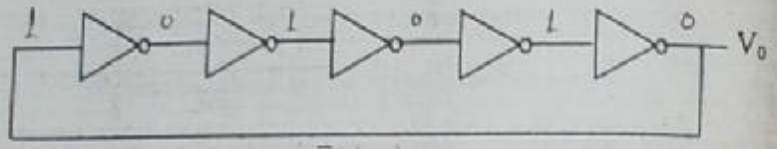

Figure 4

(j) Apply DeMorgan's law to the following expression :

$$\overline{A\bar{B}(C+\bar{D})}$$

2. A germanium diode displays a forward voltage of 0.25V at 10mA current at room temperature(300°K). Estimate the reverse saturation current(I_s) assuming unity ideality factor. Calculate the bias voltage needed for diode currents of 1mA and 100mA. Also estimate the values of I_s and diode forward current at 0.25V at 30°C above room temperature. 10

3. A bridge rectifier uses a diode with forward resistance of 5Ω each. Transformer secondary resistance is 5Ω and the secondary voltage is 30V(rms). Determine the dc output voltage for I_{dc} = 200mA and the rms value of the output ripple voltage. 10

4. For both the circuits shown below (Fig. 5a, 5b), calculate I_B,I_C and V_{CE}. Take V_{cc}=12V, V_{BB}=5V, R_B=86K, R_C=1K, R_E=1K, R_F=80K, V_{BE}=0.7V and β=120.

(a) 5

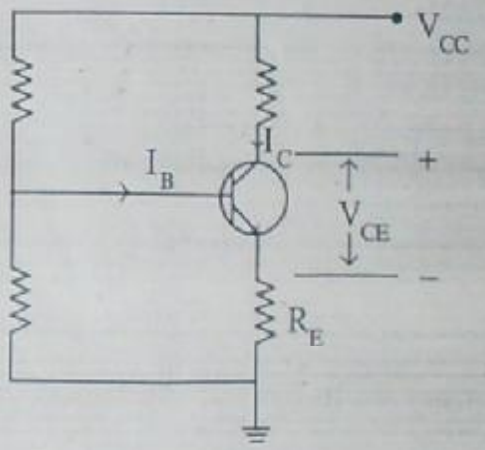

Figure 5a

(b) 5

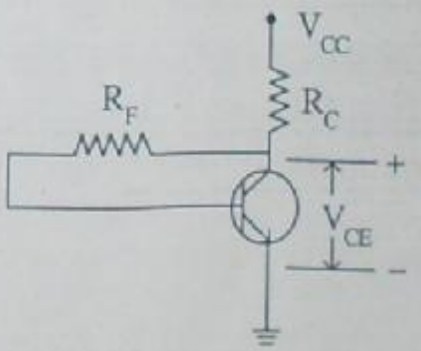

Figure 5b

6. Derive the transfer characteristics in terms of R, I_s (I_s being the reverse saturation current of the transistor) and V_T. Assume n = 1. (For the circuit shown in Fig. 6). 10

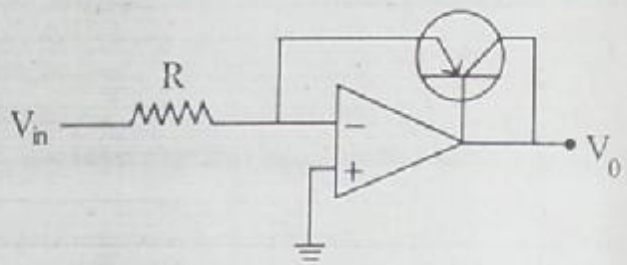

Figure 6

7. (a) Bring out the essential differences between an analog communication system and a digital communication system. 5

   (b) What type of time base is used in a CRO ? Explain with a neat sketch. 5