Total number of printed pages – 7

B. Tech

BENG 1105

Second Semester Examination — 2008

BASIC ELECTRONICS

Full Marks – 70

Time : 3 Hours

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

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Define mobility and conductivity of an intrinsic semiconductor.

   (b) A diode has a reverse saturation current of 5 μA at 25 °C for a reverse voltage of 20 V. Calculate the reverse resistance.

P.T.O.

(c) An ideal P-N junction diode acts like a bistable switch. Justify.

(d) Define ac load line and dc load line of a npn transistor connected in CE configuration.

(e) How emitter bypass capacitor in a CE amplifier prevents signal degeneration ?

(f) Sketch the JFET drain characteristic with $V_{GS} = 0$. Show the ohmic and pinch-off regions.

(g) Derive an expression for the frequency of oscillation of a three stage RC oscillator when the three R and C components are equal.

(h) An audio signal given by $15 \sin 2\pi(2000\ t)$ amplitude modulates a sinusoidal carrier wave $60 \sin 2\pi(100{,}000\ t)$. Find the modulation index and percent modulation.

(i) Convert 25.625_{10} to its binary equivalent.

(j) What is time base ? Define deflection sensitivity of an oscilloscope.

2. (a) Write the analytical equation for the current which describes both the forward and reverse characteristics of a diode. A silicon diode has a forward voltage drop of 1.2 V for a forward dc current of 100 mA. It has a reverse current of 1 μA for a reverse voltage of 10 V. Calculate the bulk and reverse resistance of the diode. Find the ac resistance at forward dc current of 25 mA. 5

(b) Explain how diodes are useful for clamping operation. Draw a negative clamping

circuit. Find the relation between the time constant of the circuit and the time period of the input signal. What should be the full discharge time, in terms of the time constant of the circuit, for the capacitor you have used. 5

3. (a) The following measurements were made in a transistor connected in a circuit.

I_C =10.525 mA ; I_B=100 μA and I_{CBO} = 5 μA.

Find the values for α_{dc}, β_{dc} and I_E. 5

(b) Draw the circuit of an emitter follower. Derive an expression for its output impedance. List two applications of an emitter follower. 5

4. (a) The data sheet for a JFET indicates that $I_{DSS} = 16$ mA and $V_{GS(off)} = -5$V. Find the drain current I_D for $V_{GS} = 0$ V, -1 V and -4 V. 4

(b) What is enhancement mode of n-channel MOSFET ? 2

(c) Draw the circuit for CMOS logic inverter. Explain the flow of current and power. 4

5. (a) An RC coupled amplifier has a midband frequency gain of 400 and lower and upper 3 dB frequencies of 100 Hz and 10 kHz. A negative feedback with $\beta = 0.01$ is incorporated in the amplifier circuit. Find the gain with feedback and new bandwidth with feedback. 5

(b) What are crystal oscillators ? Write their characteristic features. List two applications. 5

6. (a) What is frequency stability of an oscillator? Draw the circuit for a RC phase shift oscillator. What are the advantages and disadvantages of this oscillator ? 5

(b) Draw a differential amplifier circuit. Derive an expression for its CMRR. What is the role of emitter resistor ? List two applications of differential amplifier. 5

7. (a) Draw a differentiator circuit using an OPAMP and derive an expression for its output voltage v_o in terms of input voltage v_i. 5

(b) Prove the Boolean identity

$(A + B)(A + C) = A + BC$. 2

(c) Simplify the Boolean expression. 3

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

8. (a) Discuss AD and DA conversion techniques used in digital communication. 5

(b) Draw a simplified fibre optic communication system. Explain the principle of operation. 5
