(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3073 Roll No.

B.Tech.

THIRD SEMESTER EXAMINATION, 2006-07

SOLID STATE DEVICES AND CIRCUITS

Time : 3 Hours *Total Marks : 100*

Note : *(i)* *Attempt* ***ALL*** *questions.*

(ii) *All questions carry equal marks.*

(iii) *In case of numerical problems assume data wherever not provided.*

(iv) *Be precise in your answer.*

1. Attempt *any four* parts of the following : **(5x4=20)**

(a) Why is Schottky barrier diode called hot carrier diode ? How is it different from that of a signal diode ?

(b) Explain how light signal is converted into electrical signal in a photo diode ?

(c) Why CC configuration is called a voltage buffer ? What is its other name ?

(d) Draw and explain the Ebers-Moll model.

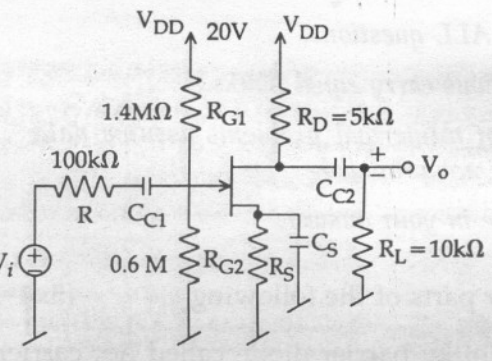
(e) Draw and explain *v-i* characteristics of a Tunnel diode.

(e) Enlist and draw the basic configuration of single stage MOS amplifier. Explain its working.

(f) Show that $gm = \frac{2 I_D}{V_{GS} - V_t}$ in a MOSFET

3. Attempt *any two* parts of the following : **(10x2=20)**

(a) What are the values of coupling capacitors C_{C1} and C_{C2} and bypass capacitor C_S of the circuit of figure 3 so that the low frequency response will be dominated by a pole at 100 H_2 and that the nearest pole or zero will be atleast a decade away. Also determine the midband gain.



$R_S = 3.5k\Omega$, $r_o = \infty$, $V_p = -2V$ $I_{DSS} = 8mA$.

Figure 3

(b) (i) State Miller Theorem.

(ii) Using Miller's Theorem find the input resistance of the resulting circuit of feed back amplifier. Consider a high frequency response of a common emitter amplifier with a voltage gain 0.97 V/V and a resistance R = 100KΩ connected in the feedback path.

(f) Draw the output charactristics of a common emitter amplifier shown in figure 1. Draw the load line and find its slope.

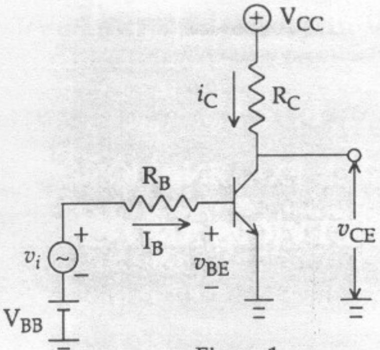


Figure 1

2. Attempt *any four* parts of the following : (5x4=20)

(a) Explain the working of BJT as a switch.

(b) Explain the effect of base-charging capacitance and base emitter junction capacitance on BJT characteristics.

(c) Draw and explain complete hybrid π model of BJT.

(d) For the circuit shown in figure 2. $I_D = 0.4$ mA. Find the value of R and V_D. The N.MOS Transistor has $V_t = 2V$, $\mu_n cox = 20\mu A/V^2$, $L = 10\mu m$, and $W = 100\mu m$, $\lambda = 0$.

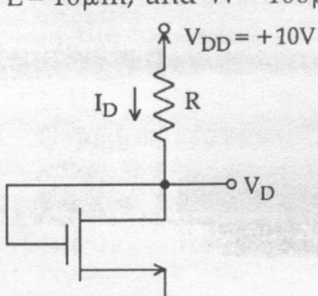


Figure 2

(c) Both n-channel MOSFETs in Fig. 4 are identical and their vi characteristics are expressed as

$$I_{DS}=[(V_{GS}-1)V_{DS}-\frac{V_{DS}^2}{2}]\text{mA for } V_{DS}<(V_{GS}-1),$$

$$I_{DS}=(V_{GS}-1)^2 \text{ mA for } V_{DS}>(V_{GS}-1).$$

How much dc current flows through M1 MOSFET.

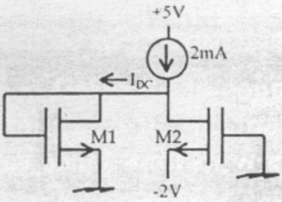


Fig. 4.

4. Attempt *any two* parts of the following : **(10x2=20)**

(a) Draw and explain all basic feedback topologies used for negative feed back. What happens to input resistance and ouput resistance in case of voltage series and current series feed back.

(b) Explain the following terms with reference to negative feed back.

(i) Gain desensitivity

(ii) Band width extension

(iii) Noise reduction

(iv) Nonlinear distortion reduction.

(c) An amplifier with a low frequency gain of 100 and poles at 10^4 and 10^6 rad/s is incorporated in a negative feed back factor β. For what value of β do the poles of the closed loop amplifier coincide ? What is the corresponding Q of the resulting second order system ? For what value of β is a maximally flat response achieved ?

5. Attempt *any two* parts of the following : **(10x2=20)**

(a) Draw the circuit of a clapp oscillator and derive the expression of its frequency of oscillation.

(b) What are advantages of a crystal oscillator ? Draw the equivalent circuit of a piezoelectric crystal and show how its impedance varies with frequency.

(c) Obtain the frequency of oscillation of the LC oscillator shown in Fig. 5. The BJT has very large β. Also obtain the condition of oscillation.

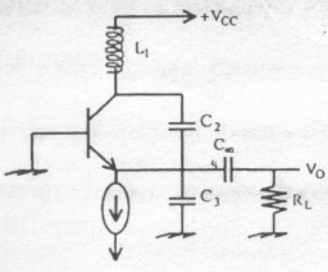


Fig. 5.

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