

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

PAPER ID : 3073

Roll No.

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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 $I-V$ characteristics of a Tunnel diode.

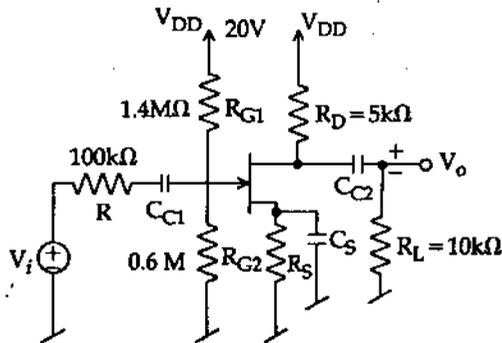
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(e) Enlist and draw the basic configuration of single stage MOS amplifier. Explain its working.

(f) Show that $g_m = \frac{2I_D}{V_{GS} - V_t}$ 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 Hz 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 $R = 100K\Omega$ connected in the feedback path.

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

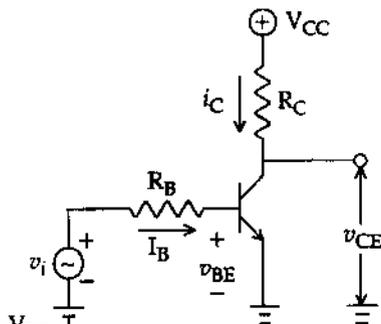


Figure 1

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

- Explain the working of BJT as a switch.
- Explain the effect of base-charging capacitance and base emitter junction capacitance on BJT characteristics.
- Draw and explain complete hybrid π model of BJT.
- 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 $V_t = 2$ V, $\mu_n \text{cox} = 20 \mu\text{A}/\text{V}^2$, $L = 10 \mu\text{m}$, and $W = 100 \mu\text{m}$, $\lambda = 0$.

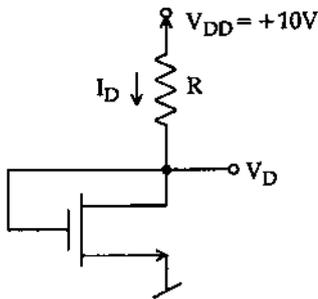


Figure 2

- (c) Both n-channel MOSFETs in Fig. 4 are identical and their v_i 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.

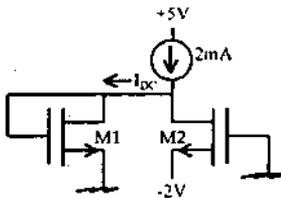


Fig. 4.

4. Attempt *any two* parts of the following : (10×2=20)

- (a) Draw and explain all basic feedback topologies used for negative feed back. What happens to input resistance and output 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 feedback 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.

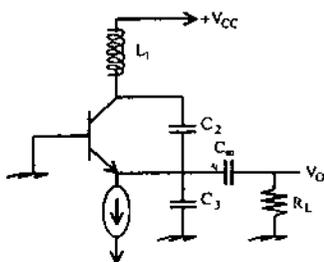


Fig. 5.

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