B.TECH. IN ELECTRONICS AND COMMUNICATION ENGINEERING (BTECVI)

Term-End Examination

December, 2013

BIELE-013 : DEVICE MODELLING FOR CIRCUIT SIMULATION

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **any seven** questions. All questions carry **equal** marks.*

1. A symmetrical $p^+ - n - p^+$ bipolar transistor has **10** the following properties :

$A = 10^{-4}$ cm^2	*emitter* $N_a = 10^{17}$	*base* $N_d = 10^{15} cm^{-3}$
$W_b = 1$ μm	$\tau_n = 0.1$ μs	$\tau_p = 10$ μs
$n_i = 1.5 \times 10^{10} cm^{-3}$	$\mu_p = 200$	$\mu_n = 1300$
	$\mu_n = 700$	$\mu_p = 450$

    (a) Calculate the saturation current $I_{ES} = I_{CS}$

    (b) With $V_{EB} = 0.3V$ and $V_{CB} = -40V$, calculate the base current I_B, assuming perfect emitter injection efficiency.

    (c) Calculate the base transport factor B, emitter injection efficiency γ and amplification factor β, assuming that the emitter region is long compared with L_n.

2. Discuss the principle of circuit simulation with its objectives in detail. **10**

3. (a) How a circuit is described in SPICE ? **5**
   (b) Define the BSIM model for MOS. **5**

4. How the circuit elements can be modeled in SPICE ? Explain General format for model statement, also state the command for operating temperature, Independent dc sources and dependent sources. **10**

5. Explain mobility model for MOSFET. Also explain short channel MOSFET I-V characteristics. **10**

6. Write short note on : **5+5**
   (a) DIBL (Drain-induced Barrier lowering)
   (b) MOS Capacitor

7.   **10**
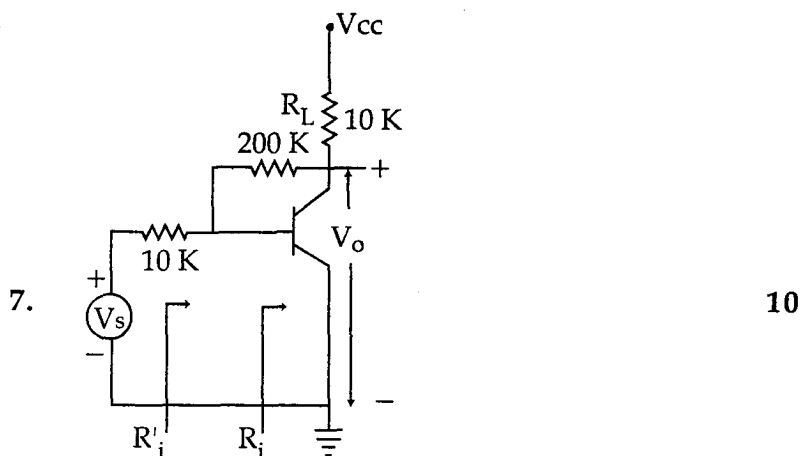
For the amplifier shown in above fig. Calculate

R_i, R_i', A_v, A_{vs} and $A_I' = \dfrac{-I_2}{I_1}$

[Given $h_{fe} = 50$, $h_{oe} = \dfrac{1}{40} \mho'$ $h_{ie} = 1.1K$, $h_{re} = -250 \times 10^{-6}$]

8. (a) Draw and explain the small signal equivalent circuit for an emitter-follower stage at high frequencies. **5**

   (b) Explain, why the 3-dB frequency for current gain is not the same as f_H and for voltage gain ? **5**

9. (a) Define f_β and f_τ and what is the relationship between f_β and f_τ. **5**

   (b) Derive the expression for the CE short circuit current gain A_i as a function of frequency. **5**

10. Explain short and narrow channel MOSFETs with suitable diagram. What is the difference between JFET and MESFET modelling ? **6+4**

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