Printed Pages : 7 **TEC-301**

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

PAPER ID : 3073 Roll No.

B. Tech.

(SEM. III) EXAMINATION, 2007-08

SOLID STATE DEVICES & CIRCUITS

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** questions.*

*(2) All questions carry **equal** marks.*

(3) Be precise in your answer.

(4) No second answer book will be provided.

1 Attempt any **two** parts of the following : **10×2=20**

(a) (i) Draw and explain the characteristics of a tunnel diode and its symbol. What is tunneling ? Explain.

(ii) What is a varactor diode ? Explain its working with applications.

(b) Measurement of V_{BE} and two terminal currents taken on a number of npn transistor are tabulated below. For each calculate the missing current value as well as α, β and I_s as indicated by table :

Transistor	*a*	*b*	*c*	*d*	*e*
$V_{BE}\ (mV)$	690	690	580	780	820
$I_C\ (mA)$	1.000	1.000		10.10	
$I_B\ (\mu A)$	50		7	120	1050
$I_E\ (mA)$		1.070	0.137		75.00
α					
β					
I_s					

(c) We wish to design the bias network of **Fig. 1** to establish a current $I_E = 1\,mA$ using a power supply $V_{CC} = +12\,V$, $\beta = 100$.

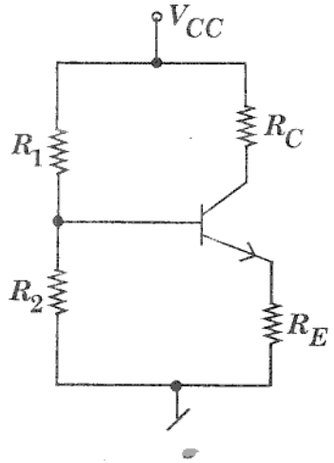

Fig. 1

2 Attempt any **two** parts of the following : **10×2=20**

(a) Explain the MOSFET structure and operation with neat sketch. Also show that it can be used as voltage controlled linear resistor.

(b) Analyze the circuit of **Fig. 2** to determine the voltage gain :

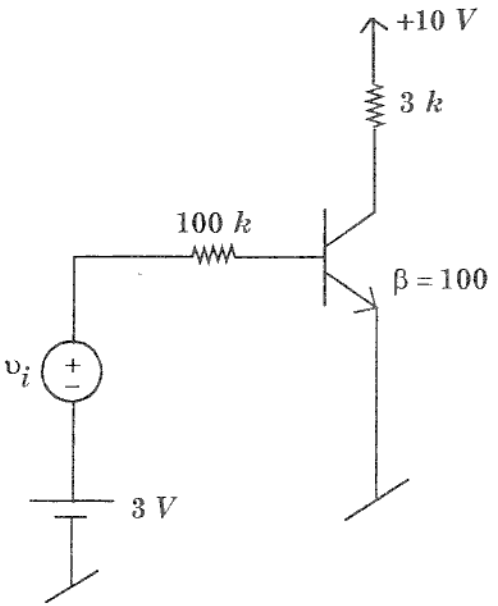

Fig. 2

(c) Explain the working of BJT as switch with neat sketch.

3 Attempt any **two** parts of the following : **10×2=20**

(a) Compute the mid band gain and upper 3-dB frequency f_H of a CS amplifier fed with a single source having an internal resistance $R_{sig} = 100\ k\Omega$. The amplifier has $R_G = 4.7\ M\Omega$, $R_D = R_L = 15\ k\Omega$, $g_m = 1\ mA/V$, $r_0 = 150\ k\Omega$, $C_{gs} = 1\ pF$ and $C_{gd} = 0.4\ pF$ for the **Fig. 3**.

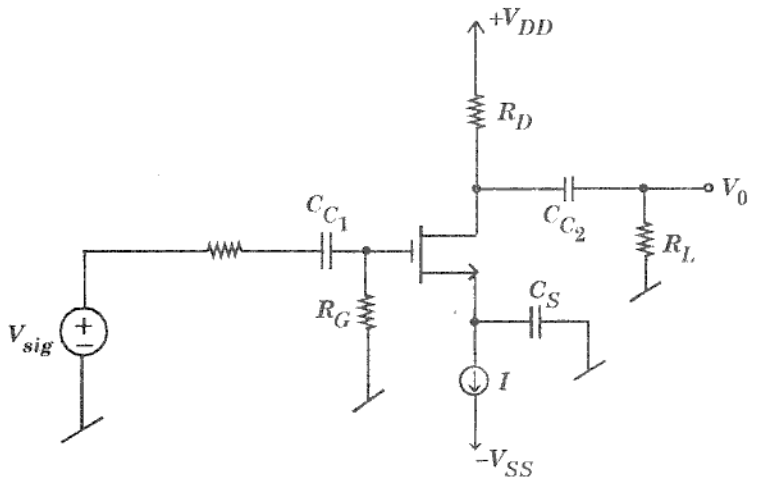

Fig. 3

(b) Using the BJT high frequency hybrid π model with $r_x = 0$ and $r_0 = \infty$ derive an expression for Z_i as a function of r_e and c_π. Find the frequency at which the impedance has a phase angle of 45° for the case in which the BJT has $f_T = 400\ MHz$ and the bias current is relatively high using **Fig. 4**. Assume $\alpha = 1$.

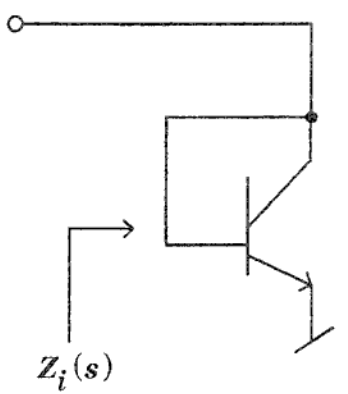

Fig. 4

(c) Draw and explain the working of common base and common gate cascade. Explain the advantages.

(b) Using the BJT high frequency hybrid π model with $r_x = 0$ and $r_0 = \infty$ derive an expression for Z_i as a function of r_e and c_π. Find the frequency at which the impedance has a phase angle of 45° for the case in which the BJT has $f_T = 400\ MHz$ and the bias current is relatively high using **Fig. 4**. Assume $\alpha = 1$.

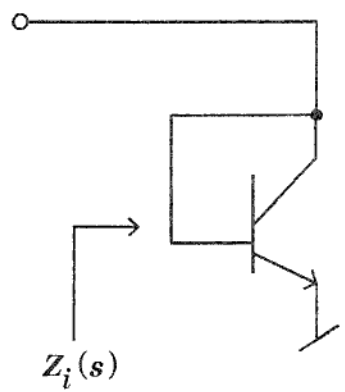

Fig. 4

(c) Draw and explain the working of common base and common gate cascade. Explain the advantages.

3 (d) The following measurements are made for a given transistor at $I_c = 5\ mA$, $V_{CE} = 10\ V$ and at room temperature : $h_{fe} = 100$, $h_{ie} = 600\ \Omega$, $A_{ie} = 10\ at\ 10\ MHz$, $C_c = 3\ pF$; find f_β, f_T, C_e, r'_{be}.

4 Attempt any **two** of the following : **10×2=20**

(a) Draw and explain the general feedback structure. Enlist and explain the properties of negative feedback.

(b) Explain how would you determine the loop gain of an amplifier and determine that whether the amplifier is stable or not.

(c) In a series-shunt feed back amplifier, using an ideal basic current amplifier operates with $I_s = 100\ \mu A$, $I_f = 95\ \mu A$ and $I_0 = 10\ mA$. Determine the corresponding values of A and B.

5 Write short notes on any **four** of the following : **5×4=20**

(a) Basic principles of sinusoidal oscillator

(b) Crystal oscillator

(c) Clap oscillator

(d) Hartley oscillator

(e) Phase shift oscillator

(f) Wein bridge oscillator.