

D. J. SANGHVI COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRONICS ENGINEERING
ELECTRONIC DEVICES SEM III
Assignment A

N.B. :

1) This assignment is based on **university exam** questions.

1. Derive the expression of built-in potential V_{bi} for a pn junction under zero-bias and hence calculate V_{bi} at $T=300$ K for $N_D = 10^{15}/cm^3$ and $N_D = 10^{15}/cm^3$. [10]
2. Describe the time delay factors in the frequency limitation of the bipolar transistor. Hence, calculate the emitter-collector transit time, cut-off frequency and the beta cut-off frequency, with the following parameters. [10]
$$I_E = 50\mu A \quad C_{je} = 0.4pf \quad C_\mu = 0.05pf$$
$$X_B = 0.5\mu m \quad D_n = 25cm^2/s \quad X_{dc} = 2.4\mu m$$
$$r_C = 20\Omega \quad C_S = 0.1pf$$
3. What are various non-ideal effects in BJT and hence explain base width modulation in brief. [5]
4. Explain basic principle of operation of npn BJT with help of construction, minority carrier distribution and energy band diagram. [10]
5. An abrupt PN junction has dopant concentration of $N_D = 2 \times 10^{16}/cm^3$ and $N_D = 2 \times 10^{15}/cm^3$ at $T = 300$ K. Calculate: [10]
 - a) Built-in potential V_{bi}
 - b) W at $V_R = 0$ and $V_R = 8$ V
 - c) E_{max} at $V_R = 0$ and $V_R = 8$ V
6. For the diode, define forward voltage drop, maximum forward current, dynamic resistance, reverse saturation current and reverse breakdown voltage. [5]
7. Draw the energy band diagram of PN junction in thermal equilibrium and explain it. [5]
8. What is space charge width? Derive an expression for it, when the diode is forward biased and reverse biased. [10]
9. List the ideal-conditions of BJT and explain any two non-ideal effects. [10]
10. Draw Eber's Moll equivalent circuit of BJT and derive necessary expressions for current and voltages. [10]
11. Determine the ideal reverse saturation current density in Si pn diode at 300K. [10]
Given: $N_A = N_D = 10^{16}/cm^3$, $n_i = 1.5 \times 10^{10}/cm^3$, $D_n = 25cm^2/s$, $D_p = 10cm^2/s$,
 $\tau_p = \tau_n = 5 \times 10^{-7}s$

12. Draw the energy band diagram of PN junction for zero, forward and reverse bias, clearly showing junction diagram, depletion width, fermi energy level and barrier potential. [10]
13. With the help of circuit diagram and characteristics, explain application of zener diode as a voltage regulator. [05]
14. Draw small signal model of pn junction diode and explain its main use. [05]
15. What do you mean by different transistor models, explain Hybrid pi model. [05]
16. Explain the working of BJT considering all possible current density components in an NPN transistor operating in active mode. [10]
17. Derive equation of electric field for a pn junction under zero bias and hence derive equation of maximum electric field. [10]
18. Explain the types of junction breakdown in case of zener diode. [10]
