

Q.P. Code : 4812

(3 Hours)

[Total Marks : 80

- N.B. : (1) Questions No.1 is compulsory and Solve any three questions from the remaining questions.
(2) Assume suitable data if necessary.
(3) Draw neat and clean Figures.

- (a) What are nonideal effects in BJT? Explain any one nonideal effect in BJT. 5

(b) Determine the ideal reverse saturation current density in silicon P-N diode at 300°k Given $N_A=N_D=10^{16} \text{ cm}^{-3}$, $n_i=1.5 \times 10^{10} \text{ cm}^{-3}$
 $D_n=25 \text{ cm}^2/\text{s}$ $\epsilon_r=11.7$, $D_p=10 \text{ cm}^2/\text{s}$ $\tau_{p0}=\tau_{n0}=5 \times 10^{-7} \text{ s}$ 5

(c) With neat diagram explain the operation of UJT relaxation oscillator. 5

(d) Compare photodiode with phototransistor. 5
- (a) Draw energy band diagram of P-N junction for zero, forward, reverse bias clearly showing junction diagram, depletion width, fermi energy level and barrier potential. 10

(b) Calculate the theoretical barrier height, built in potential barrier and maximum electric field in a metal semiconductor diode for zero applied bias. Consider a contact between tungsten and n type silicon doped to $N_D=10^{16} \text{ cm}^{-3}$ at $T=300 \text{ K}$.
The metal work function for tungsten is $\phi_m=4.55 \text{ V}$ and electron affinity for silicon is $\chi=4.01 \text{ V}$.
 $N_c=2.8 \times 10^{19} \text{ cm}^{-3}$, $K=1.38 \times 10^{-23} \text{ J/K}$, $\epsilon_s=11.7 \times 8.85 \times 10^{-14}$, $e=1.6 \times 10^{-19} \text{ C}$
- (a) Calculate the threshold voltage V_{TO} at $V_{SB}=0$, for a polysilicon gate n channel MOS transistor with the following parameters -
substrate doping density $N_A=10^{16} \text{ cm}^{-3}$ polysilicon gate doping density $N_D=2 \times 10^{20} \text{ cm}^{-3}$ gate oxide thickness $t_{ox}=500 \text{ \AA}$ oxide interface fixed charge density $N_{OX}=4 \times 10^{10} \text{ cm}^{-2}$ 10

(b) Derive the drain current equation I_D for MOSFET in ohmic and saturation regions. 10
- (a) Draw and explain construction, working, characteristics of JFET. Explain 10
frequency limitation factors.

(b) Explain, schottky effect. Derive the position of maximum barrier X_m . 10

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5. (a) Draw and explain, construction and working of : 10
(i) HEMT (MODFET)
(ii) MESFET
- (b) Explain basic structure and characteristics of : 10
(i) SCR (ii) DIAC
6. Solve any **four** of the following : 20
- (a) Draw and explain Ebers-moll model of transistor.
- (b) With the help of circuit diagram and characteristics explain application of zener diode as a voltage regulator.
- (c) What are optocouplers? Explain any one application of optocoupler.
- (d) Sketch and explain V-I and C-V characteristics of MOSFET
- (e) Explain channel length modulation with cross section of MOSFET. Write equation associated with this effect.
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