Electronic Device and Circuits

Duration: 40 Minutes **Maximum marks: 30**

Q.1 - Q.10 Carry One Mark each.

1. A Junction FET can be used as voltage variable resistor
   (A) At pinch off condition
   (B) Beyond pinch off condition
   (C) Well below pinch off condition
   (D) At any value of V_{DS}

2. Which of the following statements is correct? For a MOS capacitor fabricated on a p-types semiconductor , strong inversion occurs when surface potential is
   (A) Equal to Fermi potential
   (B) Zero
   (C) Negative and equal to Fermi potential in magnitude
   (D) Positive and equal to Fermi potential in magnitude

3. Consider an abrupt $P - n$ junction. Let V_{bi} be the built-in potential of this junction and V_R be the applied reverse bias. If the junction capacitance(C_j) is 1pF for $V_{bi} + V_R = 1V$, then for $V_{bi} + V_R = 4V$, C_j will be
   (A) 0.5 pF
   (B) 2 pF
   (C) 1 pF
   (D) 0.25 pF

4. The critical wavelength (μm) the radiation corresponding to the forbidden energy of 1.2 eV of Si material is _________(up to 2 decimal)

5. Fill factor is the realized power factor of
   (A) LED
   (B) P-I-N diode
   (C) Solar cell
   (D) Laser

Q.6 - Q. 10 Carry Two Mark each.

6. Let an n-channel JFET have $V_P = -4V$ and $I_{DSS} = 10mA$. For $V_{GS} = -2V$. The minimum V_{DS} Required for device to operator in pinch off
   (A) 4V
   (B) 2V
   (C) 3V
   (D) 1V

7. A p-n Junction biased with drop across diode as 0.72V and DC bias current $I_D = 2$ mA. Given the minority carrier lifetime is 1μs in both n and p regions and $V_T = 25$ mV. The diffusion capacitance (in nF) is _________ (Assume $\eta = 2$)

8. A thick oxide layer is grown on the surface of a uniformly doped p-type silicon sample with $N_A = 1.25 \times 10^{15}$ cm^{-3} and $n_i = 1.5 \times 10^{10}$ cm^{-3}. A positive charge present in oxide layer raised the electron concentration to 3×10^{15} cm^{-3} find the surface potential developed due to the process of oxidation
   (A) 0.306
   (B) 0.424
   (C) 0.706
   (D) 0.612

9. The drain current (in μA) in a NMOS transistor with
$V_T = 1V,\ \mu_n C_{ox}\left(\frac{W}{L}\right) = 0.003\ A/V^2$ width $V_{GS} = 1.2$ V and $V_{DS} = 0.1V$ is ________

10. Consider the ideal long silicon $P - n$ junction diode shown below. The n-region is doped with 10^{16}atoms/cm^3 of phosphorous and the P-region is doped with 5×10^{16} atoms/cm^3 of Boron. The hole carrier life time is 1×10^{-8}sec.
[Assume $D_P = 8\ cm^2/sec$, $V_T = 0.0259$ V and $q = 1.6 \times 10^{-19}C$]
The hole diffusion current density at $x = 3$ μm is
(A) $0.6\ A/cm^2$
(B) $0.6 \times 10^{-3} A/cm^2$
(C) $0.4\ A/cm^2$
(D) $0.4 \times 10^{-3} A/cm^2$