

E.D

QP Code : NP-18616

(3 Hours)

[Total Marks : 80

- N. B. : (1) Question No. 1 is compulsory and solve any three questions from remaining questions.
 (2) Assume suitable data if necessary.
 (3) Draw neat and clean figures.

Given Data —

- (1) $q = 1.6 \times 10^{-19} \text{ C}$
 (2) $k = 1.38 \times 10^{-23} \text{ J/K}$
 (3) $n_i = 1.5 \times 10^{10} \text{ cm}^{-3}$
 (4) $\epsilon_{si} = 11.7 \times 8.854 \times 10^{-14}$



1. (a) What is Non-ideal effects in BJT and hence explain Base width modulation in brief. 5
1. (b) Justify how phototransistor is more practical than photo diode. 5
1. (c) Explain in brief TWO Terminal MOS structure. 5
1. (d) Explain construction and characteristics of UJT. 5
2. (a) Explain concepts, construction, characteristics and working of Gunn diode. 10
2. (b) Explain basic principle of operation of BJT with the help of construction, minority carrier distribution and energy band diagrams. 10
3. (a) Explain structure and operation of MOSFET considering different cases of threshold voltage V_T . 10
- (b) An abrupt PN junction has dopant concentrations of $N_a = 2 \times 10^{16} \text{ cm}^{-3}$ and $N_d = 2 \times 10^{15} \text{ cm}^{-3}$ at $T = 300 \text{ K}$
 Calculate: (a) V_{bi}
 (b) W at $V_R = 0$ and $V_R = 8V$
 (c) E maximum at $V_R = 0$ and $V_R = 8V$ 10

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4. (a) What is photovoltaic effect. Explain in detail Solar Cell with working, characteristics and practical applications. 10
4. (b) For an n-channel MOS transistor with $\mu_n = 600 \text{ cm}^2/\text{V.S}$, $C_{ox} = 7 \times 10^{-8} \text{ F/cm}^2$, $W = 20 \mu\text{m}$, $L = 2 \mu\text{m}$ and $V_{TO} = 1.0 \text{ V}$. Examine the relationship between the Drain current and terminal voltages. 10
5. (a) Explain construction, working and characteristics of TRIAC & DIAC. 10
5. (b) Explain schottky-barrier diode with the help of energy band diagram. 10
6. (a) What is HBT, Explain construction and energy band diagram of HBT. 10
6. (a) Explain difference between N-channel and P-channel JFET, Also explain characteristics (Drain and Transfer) for N-channel JFET. 10
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(3 Hours)

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- N. B. : (1) Question No. 1 (one) is compulsory.
 (2) Attempt any 3 (three) questions from the remaining questions.
 (3) Assume suitable data, if necessary.

1. (a) Evaluate $\int_0^{\infty} \frac{(\cos 6t - \cos 4t)}{t} dt$ 5
- (b) Obtain complex form of fourier series for $f(x) = e^{ax}$ in $(-1, 1)$ 5
- (c) Find the work done in moving a particle in a force field given by $\vec{F} = 3xy\hat{i} - 5z\hat{j} + 10x\hat{k}$ along the curve $x = t^2 + 1$, $y = 2t^2$, $z = t^3$ from $t = 1$ to $t = 2$. 5
- (d) Find the orthogonal trajectory of the curves $3x^2y + 2x^2 - y^3 - 2y^2 = \alpha$, where α is a constant. 5
2. (a) Evaluate $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} - 3y = \sin t$, $y(0) = 0$, $y'(0) = 0$, by Laplace transform 6
- (b) Show that $J_{5/2} = \sqrt{\frac{2}{\pi x}} \left[\frac{3-x^2}{x^2} \sin x - \frac{3}{x} \cos x \right]$ 6
- (c) (i) Find the constants a, b, c so that $\vec{F} = (x + 2y + az)\hat{i} + (bx - 3y - z)\hat{j} + (4x + (y + 2z))\hat{k}$ is irrotational. 4
- (ii) Prove that the angle between two surfaces $x^2 + y^2 + z^2 = 9$ and $x^2 + y^2 - z = 3$ at the point $(2, -1, 2)$ is $\cos^{-1}\left(\frac{8}{3\sqrt{21}}\right)$ 4
3. (a) Obtain the fourier series of $f(x)$ given by $f(x) = \begin{cases} 0 & -\pi \leq x \leq 0 \\ x^2 & 0 \leq x \leq \pi \end{cases}$ 6
- (b) Find the analytic function $f(z) = u + iv$ where $u = r^2 \cos 2\theta - r \cos \theta + 2$ 6
- (c) Find Laplace transform of $(i) te^{-3t} \cos 2t \cdot \cos 3t$ 8
- (ii) $\frac{d}{dt} \left[\frac{\sin 3t}{t} \right]$

Con. 11456-14.

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