Sem-III ETRX, CBSGS 29/11/17 / Electronics Devices

(02)

Q.P. Code :10592

[Time: 3 Hours] **[Marks:80]**

Please check whether you have got the right question paper.

N.B:
1. **Question -1 is compulsory.**
2. **Solve any THREE from remaining questions.**
3. Assume suitable data it necessary.

1 a) Explain two terminal Mos structure. (05)

b) Calculate width of the space charge region in a PN junction when a reverse bias voltage is applied consider a P-N junction at T = 300 k, Na = $10^{16}cm^{-3}$ and Nd = $10^{15}cm^{-3}$, ni = $1.5\times10^{10}cm^{-3}$ and VR = 5V, Vbi = 0.635V, Vbi is the built in potential barier voltage. (05)

c) Write note on HBT. (05)

d) Explain differences between FET and MESFET. (05)

2 a) Explain construction working and characteristics of Tunnel diode. (10)

b) Draw and explain hybrid π (pi) model of BJT. (10)

3 a) Calculate Vbi in a silicon P–N junction at T = 300 K for Nd = $10^{15}cm^{-3}$ and Na = $10^{16}cm^{-3}$ and ni = $1.5 \times 10^{10}cm^{-3}$. (10)

b) Explain constructions working and characteristics of E MOSFET (10)

4 a) Explain construction, working and characteristics of FET (10)

b) Explain following effects in FET – (1) Channel length modulation (10)
(2) Velocity saturation effects.

5 a) Draw and explain energy band diagram for MOSFET for different gate bias conditions. (10)

b) Explain working and characteristics of SCR. (10)

6 Write notes on any four of the following (20)

a) Zener diode voltage regulator
b) Triac
c) Solar Cell
d) Photo diode
e) UJT relaxation oscillator

S.E. Sem-III - CBSGS ETRX & EXTC

Applied Mathematics - III 29/11/17

Q.P. Code : 13606

(3 Hours) [Total marks : 80

Note : - 1) Question number **1** is **compulsory.**
2) Attempt any **three** questions from the remaining **five questions**.
3) **Figures** to the **right** indicate **full** marks.

Q.1 a) Find the angle between the surfaces 05
$x \log z + 1 - y^2 = 0, \quad x^2 y + z = 2$ at $(1, 1, 1)$.

b) Show that the functions $f_1(x) = 1, f_2(x) = x$ are orthogonal on $(-1, 1)$. Determine the constants a and b such that the function $f_3(x) = -1 + ax + bx^2$ is orthogonal to both f_1 and f_2 on that interval. 05

c) Find the Laplace transform of $\int_0^t u^{-1} e^{-u} \sin u \, du$. 05

d) Prove that $f(z) = (x^3 - 3xy^2 + 2xy) + i(3x^2y - x^2 + y^2 - y^3)$ is analytic and find $f'(z)$ and $f(z)$ in terms of z. 05

Q.2 a) Obtain half- range sine series of $f(x) = x(\pi - x)$ in $(0, \pi)$ and hence, find the value of $\sum \frac{(-1)^n}{(2n-1)^3}$. 06

b) Prove that 06
$\bar{F} = (y^2 \cos x + z^3) i + (2y \sin x - 4) j + (3xz^2 + 2) k$
is a conservative field. Find the scalar potential for $\bar{F}$.

c) Find the inverse Laplace transform of 08

(i) $\dfrac{s+2}{s^2 - 4s + 13}$

(ii) $\dfrac{1}{(s-a)(s-b)}$

Q. 3 a) Prove that $J_{5/2}(x) = \sqrt{\frac{2}{\pi x}} \left(\frac{3 - x^2}{x^2} \sin x - \frac{3}{x} \cos x \right)$. 06

b) Find the analytic function $f(z) = u + iv$ if 06
$3u + 2v = y^2 - x^2 + 16xy$.

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c) Expand $f(x) = \begin{cases} \pi x, & 0 < x < 1 \\ 0, & 1 < x < 2 \end{cases}$ period 2 into a Fourier Series. 08

Q. 4 a) Prove that
$\int x^3 \cdot J_0(x)\,dx = x^3 \cdot J_1(x) - 2x^2 \cdot J_2(x)$. 06

b) Use Stoke's Theorem to evaluate $\int_C \bar{F} \cdot d\bar{r}$ 06
where $\bar{F} = yz\,i + zx\,j + xy\,k$
and C is the boundary of the circle $x^2 + y^2 + z^2 = 1,\ z = 0$.

c) Solve using Laplace transform $(D^2 - 3D + 2)y = 4e^{2t}$ with $y(0) = -3$ and $y'(0) = 5$. 08

Q. 5 a) Prove that $2J_0''(x) = J_2(x) - J_0(x)$. 06

b) Use Laplace transform to evaluate 06
$\int_0^\infty e^{-t}\left(\int_0^t u^2 \sin hu\ \cos hu\ du\right)dt$.

c) Obtain complex form of Fourier Series for $f(x) = e^{ax}$ in $(-\pi, \pi)$ where a is not an integer. Hence deduce that when a is a constant other than an integer 08

$$\cos ax = \frac{\sin \pi a}{\pi} \sum \frac{(-1)^n a}{(a^2 - n^2)} e^{inx}$$

Q. 6 a) Express the function 06

$$f(x) = \begin{cases} -e^{kx} & for\ x < 0 \\ e^{-kx} & for\ x > 0 \end{cases}$$

as Fourier Integral and hence, prove that

$$\int_0^\infty \frac{\omega \sin \omega x}{\omega^2 + k^2}\,d\omega = \frac{\pi}{2} e^{-kx} \quad if \quad x > 0, k > 0.$$

b) Using Green's theorem evaluate 06

$$\oint_C \left(e^{x^2} - xy\right)dx - (y^2 - ax)\,dy$$

where C is the circle $x^2 + y^2 = a^2$.

c) Under the transformation $w = \frac{z-1}{z+1}$, show that the map of the straight line $y = x$ is a circle and find its center and radius. 08

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