

(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) Show that $u = y^3 - 3x^2y$ is a harmonic function. Also find its harmonic conjugate. (5)

B) Find half range Fourier sine series for $f(x) = x^3$, $-\pi < x < \pi$. (5)

C) If $\vec{F} = xye^{2z}i + xy^2\cos zj + x^2\cos xyk$ find $\text{div}\vec{F}$ and $\text{curl}\vec{F}$ (5)

D) Evaluate $\int_0^\infty e^{-2t} \sin^3 t dt$. (5)

Q.2) A) Prove that $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \cos x$ (6)

B) Find an analytic function $f(z)$ whose imaginary part is $e^{-x}(y \sin y + x \cos y)$ (6)

C) Obtain Fourier series for $f(x) = 1 + \frac{2x}{\pi} \quad -\pi \leq x \leq 0$
 $= 1 - \frac{2x}{\pi} \quad 0 \leq x \leq \pi$

Hence deduce that $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots$ (8)

Q.3) A) Show that $\vec{F} = (2xyz^2)i + (x^2z^2 + z\cos yz)j + (2x^2yz + y\cos yz)k$, is a conservative field. Find its scalar potential φ such that $\vec{F} = \nabla\varphi$ and hence, find the work done by \vec{F} in displacing a particle from $A(0,0,1)$ to $B(1,\pi/4,2)$ along straight line AB (6)

B) Show that the set of functions $f_1(x) = 1, f_2(x) = x$ are orthogonal over $(-1, 1)$. 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 (6)

TURN OVER

C) Find (i) $L^{-1}\left\{\log\left[\frac{s^2+a^2}{\sqrt{s+b}}\right]\right\}$

(ii) $L\{(e^{-t}\cos t.H(t-\pi))\}$ (8)

Q.4) A) Prove that $\int J_5(x) dx = -J_4(x) - \frac{4}{x}J_3(x) - \frac{8}{x^2}J_2(x)$ (6)

B) Find inverse Laplace of $\frac{s}{(s^2-a^2)^2}$ using Convolution theorem. (6)

C) Expand $f(x) = \frac{3x^2-6x\pi+2\pi^2}{12}$ in the interval $0 \leq x \leq 2\pi$ as a Fourier series.

Hence, deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots$ (8)

Q.5) A) Using Gauss Divergence theorem, prove that $\iint_S (y^2z^2i + z^2x^2j + z^2y^2k) \cdot \bar{N} ds = \frac{\pi}{12}$

where S is the part of the sphere $x^2 + y^2 + z^2 = 1$ and above the xy-plane. (6)

B) Prove that $J_3(x) + 3J_0(x) + 4J_0'''(x) = 0$ (6)

C) Solve $(D^3-2D^2+5D)y = 0$, with $y(0)=0$, $y'(0)=0$ and $y''(0)=1$, (8)

Q.6) A) Evaluate by Green's theorem for $\int_C \left(\frac{1}{y} dx + \frac{1}{x} dy\right)$ where C is the

the boundary of the region define by $x = 1$, $x = 4$, $y = 1$ and $y = \sqrt{x}$ (6)

B) Find the bilinear transformation which maps the points $z = 1, i, -1$ onto points $w = i, 0, -i$ (6)

C) Find Fourier cosine integral representation for $f(x) = e^{-ax}$, $x > 0$

Hence, show that $\int_0^\infty \frac{\cos\omega x}{1+\omega^2} d\omega = \frac{\pi}{2} e^{-x}$, $x \geq 0$ (8)

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Q.P. Code :10591

[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 if it is required.

- 1 a) How Zener diode is different than normal diode? (5)
b) Explain nonlinear effects in MOSFET? (5)
c) Draw and explain Ebers. moll model of BJT (5)
d) Compare BJT and IGBT (5)
- 2 a) Draw the graph of built in potential V_{bi} for a symmetrical si diode ($N_a = N_d$) at $T = 300^\circ\text{k}$. over the range $10^{14} \leq N_a \leq 10^{19} \text{ cm}^{-3}$. (10)
b) Explain working of BJT considering all possible modes of operation. (10)
- 3 a) Derive the equation of threshold Voltage V_{Th} of n-channel Enhancement MOSFET (10)
b) Neatly sketch all FET characteristics. Explain how various parameters can be determined from the characteristics. State drain current equation of FET. (10)
- 4 a) Sketch and explain Tunnel diode characteristics. Explain applications of this diode (10)
b) Explain construction, working and characteristics of D – MOSFET. (10)
- 5 a) Explain how optical device are classified? Explain any one photodetector in detail. (10)
b) Draw and explain construction and characteristics of UJT. State its applications. (10)
- 6 Write notes on any TWO of the following. (20)
 - a) HBT
 - b) Solar Cell.
 - c) SCR
 - d) Diac and Triac

St - 24/5/2017

SE/ELX / Sem III / CBSGS

Q.P. Code :10402

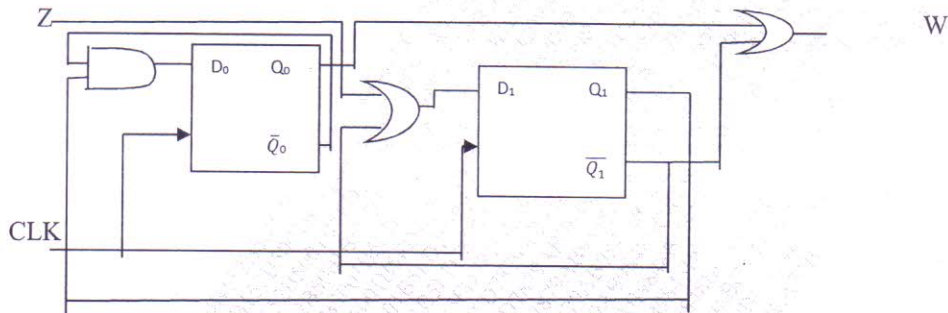
[Time: 3 Hours]

[Marks:80]

Please check whether you have got the right question paper.

- N.B:
1. Question No.1 is **Compulsory**
 2. Solve any **three** from the remaining **five** questions.
 3. Draw neat **logic diagram** and assume **suitable data** wherever necessary.

- Q.1**
- a. Two inputs TTL NAND gate 05
 - b. Explain ring counter 05
 - c. Draw truth table and logic diagram of Full Subtractor using half Subtractors and gates 05
 - d. Explain the characteristics parameters of logic families 05
- Q.2**
- a. Analyze the clocked synchronous machine given below. Write excitation equations, excitation/transition table and state/ output table (Use state names A-D for Q1-Q2=00-11) 10



- b. Design 1 digit BCD adder using IC 7483 and perform $(1010)_{BCD} + (1100)_{BCD}$ 10
- Q.3**
- a. Design a mealy sequence detector to detect 0100 using D flip-Flops and logic gates 10
 - b. Design a circuit with optimum utilization of PLA to implement the following functions 10
 $P = \sum m(1,3,8,10,10,15)$
 $Q = \sum m(0,1,5,7,9,12,14)$
 $R = \sum m(0,2,5,8,9,11)$
- Q.4**
- a. Implement following function using 4:1 MUX and NAND gates 10
 $P(A,B,C,D) = \sum m(1,2,6,7,8,10,13,14)$
 - b. Explain IC 74194 working in detail with applications 10
- Q.5**
- a. Use K-map to reduce following function and then implement it by NOR gates. 10
 $F = \pi M(0,1,4,7,8,11,12,14) + d(2,5,6)$
 - b. Eliminate redundant states and draw the reduced state diagram 10

Present state	Next State		Output Y
	X=0	X=1	
A	B	C	1
B	D	C	0
C	F	E	0
D	E	B	1
E	B	C	1
F	C	E	0
G	F	G	0

Q.P. Code :10402

Q.6 Write short notes on any three

20

1. Master slave JK Flip Flop
2. Write a VHDL code for full adder
3. Stuck at '0' and '1' faults
4. CPLD and FPGA architecture block diagram

