

(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 $\bar{F} = xye^{2z}i + xy^2\cos z j + x^2\cos y k$ find $\operatorname{div}\bar{F}$ and $\operatorname{curl}\bar{F}$ (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 $e^{-x}(ys\sin y + x\cos y)$ (6)

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

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 $\bar{F} = (2xyz^2)i + (x^2z^2 + z\cos yz)j + (2x^2yz + y\cos yz)k$, is a

conservative field. Find its scalar potential φ such that $\bar{F} = \nabla\varphi$ and hence, find the

work done by \bar{F} in displacing a particle from A(0,0,1) to B(1,π/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)

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Q.P. Code : 13608

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

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

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

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

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 $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots$

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

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

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[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

Q.P. Code :10402

[Time: 3 Hours]

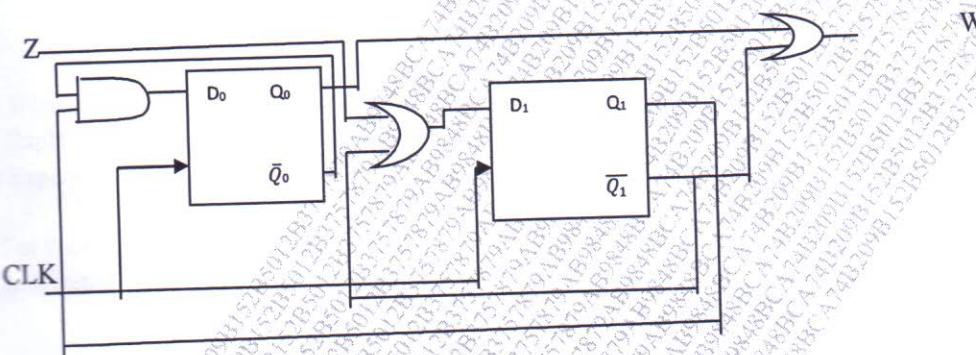
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Please check whether you have got the right question paper.

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
 - b. Explain ring counter
 - c. Draw truth table and logic diagram of Full Subtractor using half Subtractors and gates
 - d. Explain the characteristics parameters of logic families
- 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-Q-2=00-11)



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

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

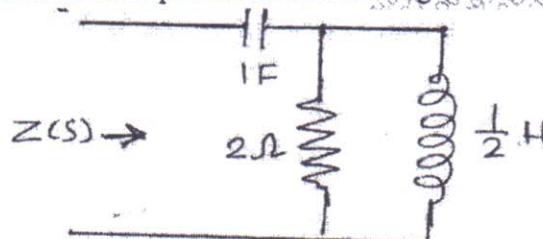
1. Master slave JK Flip Flop
2. Write a VHDL code for full adder
3. Stuck at '0' and '1' faults
4. CPLD and FPGA architecture block diagram

Total Marks: 80

REVISED COURSE
(03 Hours)

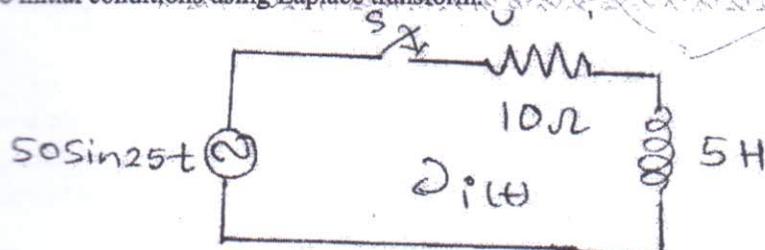
- N.B.: 1) Question number one is compulsory.
 2) Attempt any three questions out of remaining five questions.
 3) Figures to the right indicate full marks.
 4) Assume suitable data if required.
 5) Use Smith chart for transmission line problem

1. a) Find poles and zeros of the impedance of the following network.



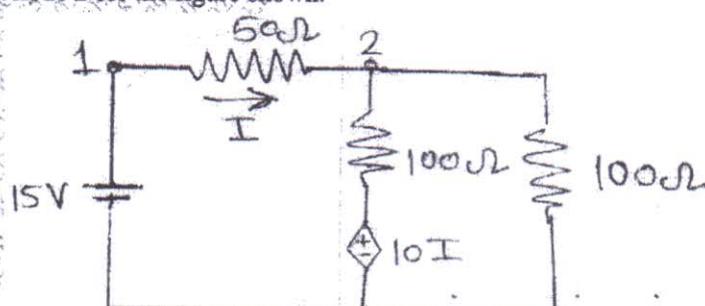
- b) What are standing waves? Define reflection coefficient and VSWR of a transmission line. 5)
 c) Explain various types of filters in circuit theory. 5)
 d) Explain the graphical representation of series resonance circuit. 5)

2. a) For the network shown determine the current i(t) when the switch s is closed at t=0 with zero initial conditions using Laplace transform. 10)



- b) The impedance parameters of two port network are $Z_{11} = 6\Omega$, $Z_{22} = 4\Omega$, $Z_{12} = Z_{21} = 3\Omega$. Compute the Y parameters. 5)

- c) Find the voltage at node 2 for the figure shown. 5)

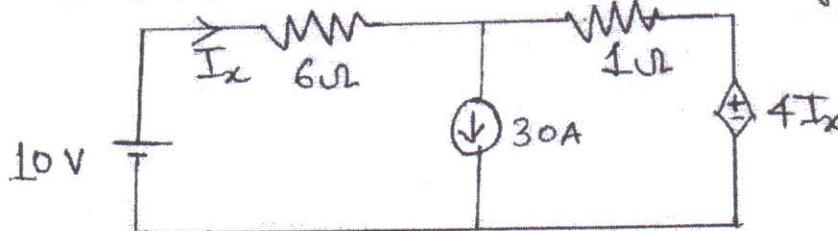
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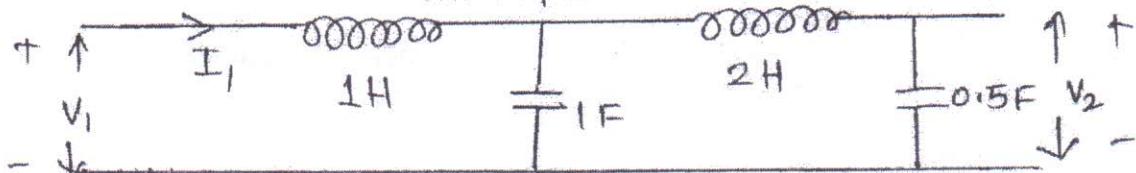
3. a) Design a short circuit shunt stub match for $Z_L = 150 - 200j \Omega$ for a line of $Z_0 = 100 \Omega$ and Frequency at $f = 20$ MHz using Smith chart. 10)

Frequency at $f = 20$ MHz using Smith chart.

- b) Find the current I_x using superposition theorem. 5)



- c) Determine $\frac{V_1}{I_1}$ and $\frac{V_2}{I_1}$ for the given network. 5)



4. a) Test whether following functions are a positive real function. 10)

$$\text{i) } F1(s) = \frac{s^2 + 1}{s^3 + 4s}$$

$$\text{ii) } F2(s) = \frac{2s^3 + 2s^2 + 3s + 2}{s^2 + 1}$$

- b) Use continued fraction expansion method to check whether the given polynomials is Hurwitz or not. 5)

$$P(s) = s^7 + 2s^6 + 2s^5 + s^4 + 4s^3 + 8s^2 + 8s + 4$$

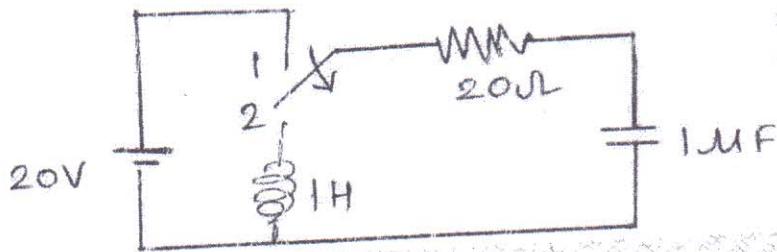
- c) Realize Cauer first form of the following L C impedance function. 5)

$$Z(s) = \frac{10s^4 + 12s^2 + 2}{2s^3 + 2s}$$

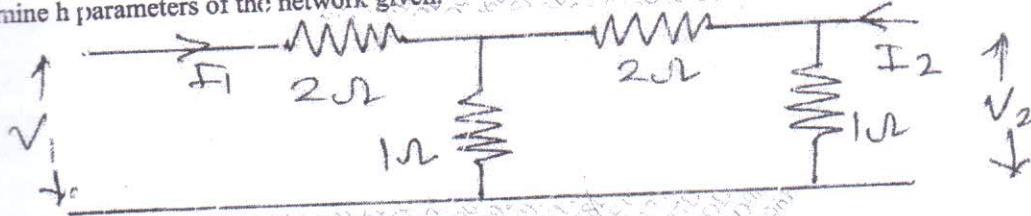
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5. a) In the network shown, the switch is changed from position 1 to position 2 at $t=0$.
 Steady state condition having reached before switching. Find the value of i , $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at $t=0^+$ 10)



- b) Determine h parameters of the network given. 5)



- c) The constants of a transmission line are $R = 6 \Omega/\text{Km}$, $L = 2.2 \text{ mH}/\text{km}$, $G = 0.25 \times 10^{-6} \text{ mho}/\text{km}$, $C = 0.005 \mu\text{F}/\text{km}$. Determine the characteristic impedance and propagation constant of the line at a frequency of 1 kHz. 5)

6. a) Design an m-derived T-section high pass filter with a cut off frequency of 2KHz.
 Design impedance of 700Ω and $m = 0.6$. 5)

- b) What are scattering parameters. State their properties. 5)

- c) Explain characteristics and applications of Smith chart. 5)

- d) List the types of damping in a series R-L-C circuit and mention the condition for each damping. 5)

Q.P. Code :10761

[Time: 3 Hours]

[Marks:80]

Please check whether you have got the right question paper.

- N.B: 1. Question no.1 is compulsory.
2. From Q2 to Q6 solve any three.

Q1. Attempt any four.

- a. Draw Maxwell Bridge and list applications.
b. List different thermocouples and their typical range.
c. Short note on Q meter.
d. Define transfer. List different types of transducers.
e. Draw a neat and labeled diagram for LVDT.

20

Q2. a. Explain FET electronic voltmeter with neat diagram.

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- b. Explain single channel and multichannel data acquisition system with neat labeled separate block diagrams.

Q3. a. Explain following approaches of temperature measurements: RTD, Thermisters, and Thermocouples.

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- b. Draw block diagram of CRO. Also draw block diagram of DSO. No explanation needed. List applications of DSO.

Q4. a. Explain in detail Dead Weight Testing with neat labeled diagram.

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- b. Draw and explain Schering bridge.

Q5. a. Explain frequency and phase measurement with oscilloscope.

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- b. Explain in detail types of errors in measurement system.

Q6. Short note on

20

- a. Strain Gauges
b. Electromagnetic flow meter
c. Rota meter
d. Lissajous Figures