Duration: 3 Hours   **Max. Marks 80**

N.B.

1. **Q.1** is compulsory. Attempt **any three** from the remaining questions.
2. All questions carry equal marks.
3. Figures to the Right indicate full marks.
3. Assume suitable data if necessary

Q.1   Attempt **any five**   **20**
  a.   Explain concept of Duality.
  b.   Design 2-bit magnitude comparator.
  c.   Explain the concept of state machine.
  d.   What is race around condition? How it can be avoided ?
  e.   Explain 4-bit Johnson counter.
  f.   Give difference between encoder and decoder.

Q.2 A.   Perform the following operations :   **10**

  (i) Subtract (141) from (171) using 10's complement.
  (ii) Convert (79.97) into its binary, octal and hexadecimal equivalent.

  B.   Reduce the following function using Karnaugh Map technique and implement it   **10**
    using logic gates:

$$f(A, B, C, D) = \sum m(2, 3, 5, 13, 14) + \sum d(8, 9, 10, 11)$$

Q.3 A.   Design and implement Gray to Binary code converter.   **10**
  B.   Design a combinational circuit for priority checker.   **10**

Q.4 A.   Convert D flip flop into SR and JK flip flop.   **10**
  B.   Design an Up-Down asynchronous counter using JK flip flop.   **10**

Q.5 A.   Design a 4 - bit Universal Shift register.   **10**
  B.   Explain basic parameters of logic families in detail..   **10**

Q.6   Write short notes on the following   **20**
  a. Comparison between different types of PLDs.
  b. Hazards in Digital circuits.
  c. Arithmetic and Logic Unit (ALU).
  d. BCD to Seven Segment Display.

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(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 Laplace transform of cost cos2t cos3t 05

b) Show that the set of functions cosnx, n= 1,2,3,……. is orthogonal over $(0 , 2\pi)$ 05

c) Prove that $f(z) = (x^3 - 3xy^2 + 2xy) + i(3x^2y - x^2 + y^2 - y^3)$ is analytic and find $f^l(z)$ 05

in terms of z .

d) Find the directional derivative of $\varphi = x^2+y^2+z^2$ in the direction of the line $\frac{x}{3} = \frac{y}{4} = \frac{z}{5}$ 05

at (1, 2, 3)

Q.2 a) Find the fourier series for $f(x) = x^2$ in $(0 , 2\pi)$ 06

b) Show that the vector $\bar{F} = (x^2 + xy^2) i + (y^2 + x^2y) j$ is irrotational and find its scalar

potential 06

c) Prove that the transformation $w = \frac{1}{z+i}$ transforms real axis of z- plane into a circle 08

of w – plane

Q.3 a) Using convolution theorem, find inverse Laplace transform of $\frac{s^2}{(s^2+2^2)^2}$. 06

b) Prove that $J_{5/2}(x) = \sqrt{\frac{2}{\pi x}} (\frac{3- x^2}{x^2} sinx - \frac{3}{x} cosx)$ 06

c) Find half range cosine series for $f(x) = x(\pi - x)$, 0<x< π. Hence show that $\sum_1^\infty \frac{1}{n^4} = \frac{\pi^4}{90}$ 08

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Q.4 a) Evaluate by Green's theorem $\int_c (e^{x^2} - xy)\,dx - (y^2 - ax)\,dy$ where c is   06

the circle $x^2 + y^2 = a^2$.

b) Prove that $2\,J_0''(x) = J_2(X) - J_0(x)$.   06

c) i) Evaluate $\int_0^\infty \frac{e^{-t} - e^{-3t}}{t}\,dt$ 08

ii) Find Laplace transform of $t\sqrt{1 + sint}$

Q.5 a) Find the orthogonal trajectory of the family of curves $x^3 y - xy^3 = c$.   06

b) Prove that $\int x \cdot J_{2/3}\ (x^{3/2})\,dx = -\frac{2}{3} x^{-1/2} J_{-1/3}\ (x^{3/2})$.   06

c) Obtain complex form of Fourier Series for $f(x) = e^{2x}$ in (0, 2).   08

Q.6 a) Use stoke's Theorem to evaluate $\int_c \bar{F} \cdot d\bar{r}$ where $\bar{F} = yz\,i + zx\,j + xy\,k$ 06

and C is the boundary of the circle $x^2 + y^2 + z^2 = 1$ and $z = 0$.

b) Find the fourier integral representation for   06

$f(x) = e^{ax}$, $x \le 0$, $a > 0$

$= e^{-ax}$, $x \ge 0$, $a > 0$

Hence show that $\int_0^\infty \frac{\cos wx}{w^2 + a^2}\,dx = \frac{\pi}{2a}\,e^{-ax}$, $x > 0$, $a > 0$

c) Solve using Laplace transform $(D^2 + 2D + 5)y = e^{-t}sint$, where $y(0) = 0$, $y^|(0) = 1$.   08

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Time:3Hrs   Marks:80

NB.: 1) Question 1 is compulsory.
   2) Attempt any 3 questions from remaining 5 questions.
   3) Assume suitable data wherever necessary.
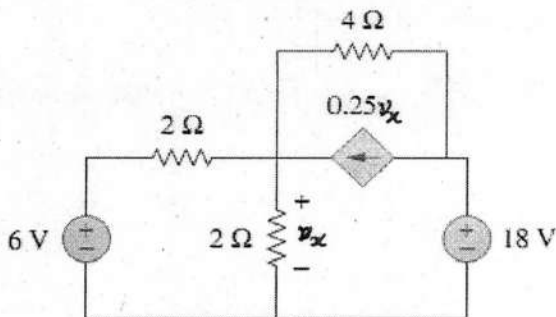   4) Figure to the right indicate full marks.

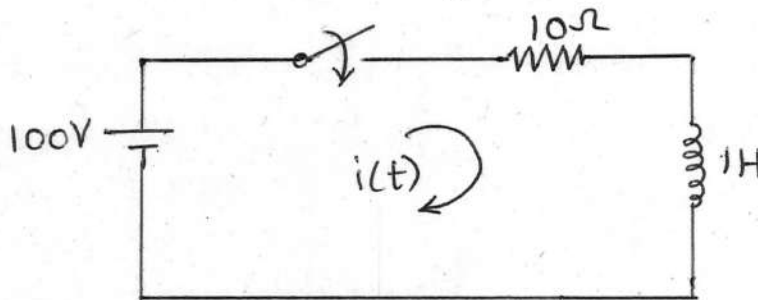Q1   20

a)   Test whether the polynomial P(s)= $s^5 + 3s^3 + 2s$ is Hurwitz.

b)   Obtain the pole-zero plot of the following function

$$F(s) = \frac{s(s+2)}{s^2 + 2s + 2}$$

c)   Explain the maximum power transfer theorem

d)   Find V_x using source transformation.

e)   The switch is closed at t=0. Find i, $\frac{di}{dt}$ at t=0$^+$

Q2

a)   Test whether the polynomial is Hurwitz   10

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

b)   Test whether the following functions are positive real functions or not   10
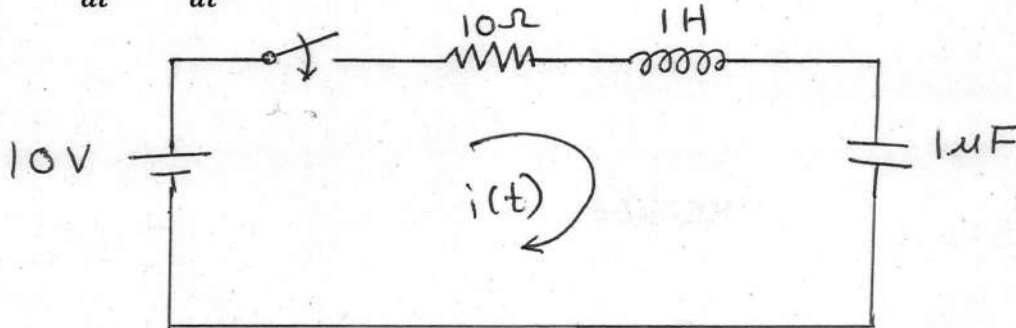
$$F(s) = \frac{3s^2 + 5}{s(s^2 + 1)}$$

6411BAACBDB111F71B9C4DB43E5CED18

Q3

a) Obtain Y and ABCD parameters for the two-port network having currents I_1 and I_2 entering port 1 and port 2 respectively of a network   10
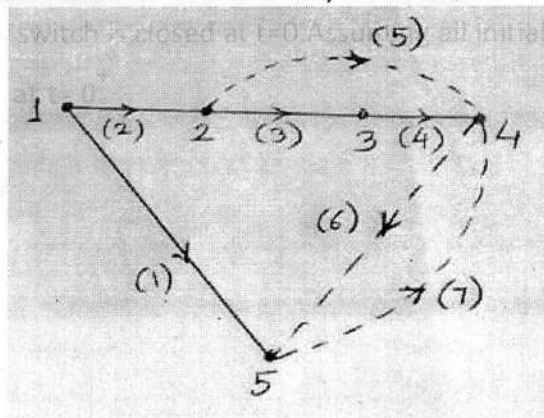
$$I_1 = 0.5V_1 - 0.2V_2$$

$$I_2 = -0.2V_1 + V_2$$

b) In the network the switch is closed at t=0. Assuming all initial conditions zero, find i, $\frac{di}{dt}$, and $\frac{d^2i}{dt^2}$ at t= 0^+ 10
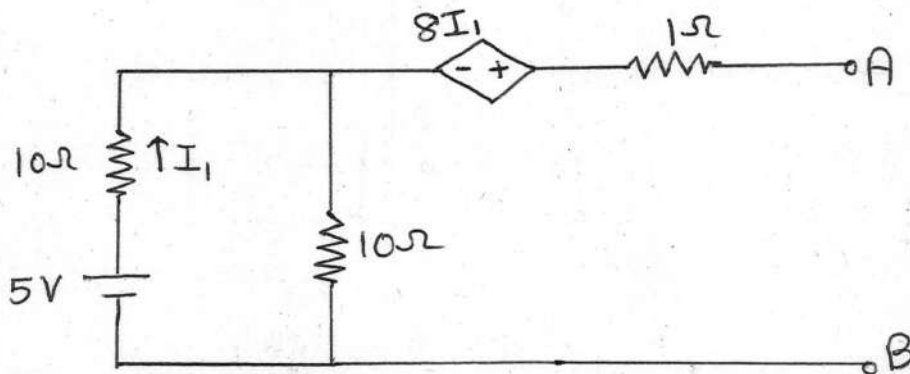

Q4

a) For the graph shown below write incidence, tieset and f-cutset matrix   10

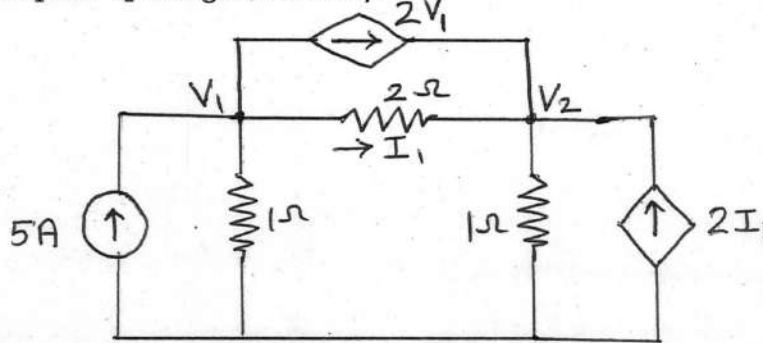b) Find the Thevenin's equivalent circuit for the given network   10

Q5

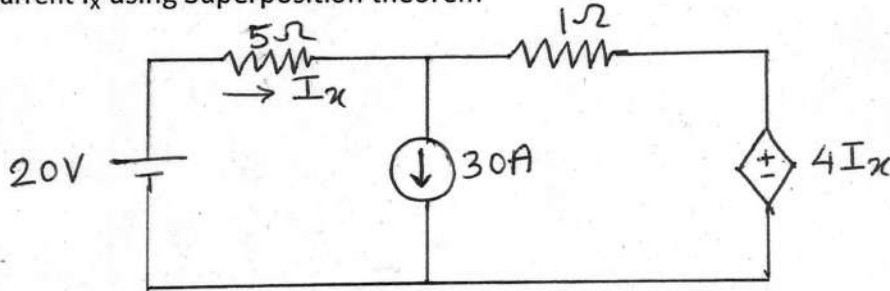a) Realize the Foster I and II forms of the following impedance function   10

$$Z(s) = \frac{4(s^2 + 1)(s^2 + 9)}{s(s^2 + 4)}$$

b) Find voltages V_1 and V_2 using Nodal analysis   10

Q6

a) Find current I_x using Superposition theorem   10

b) What will be the value of R_L to get maximum power delivered to it? What is the value of this power?   10

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