

(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 $\cos t \cos 2t \cos 3t$. 05
 b) Construct an analytic function whose real part is $e^x \cos y$. 05
 c) Find the directional derivative of $\emptyset = x^4 + y^4 + z^4$ at point $A(1, -2, 1)$ in the direction of AB where B is $(2, 6, -1)$. 05
 d) Expand $f(x) = lx - x^2$, $0 < x < l$ in a half-range sine-series. 05
- Q.2** a) Find the angle between the normals to the surface $xy = z^2$ at the points $(1, 4, 2), (-3, -3, 3)$. 06
 b) Find the Fourier series for

$$f(x) = \begin{cases} -c & -a < x < 0 \\ c, & 0 < x < a \end{cases}$$
 c) Find the inverse Laplace transform of 08
 (i) $\frac{4s+12}{s^2+8s+12}$
 (ii) $\log\left(\frac{s^2+a^2}{\sqrt{s+b}}\right)$
- Q.3** a) State true or false with proper justification "There does not exists an analytic function whose real part is $x^3 - 3x^2y - y^3$ ". 06
 b) 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
 c) Expand $f(x) = 4 - x^2$ in the interval $(0, 2)$. 08
- Q.4** a) Use Gauss's Divergence theorem to evaluate $\iint_S \bar{N} \cdot \bar{F} dS$ where $\bar{F} = 4x i + 3y j - 2z k$ and S is the surface bounded by $x = 0, y = 0, z = 0$ and $2x + 2y + z = 4$. 06

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b) Prove that

$$\int x^3 \cdot J_0(x) dx = x^3 \cdot J_1(x) - 2x^2 \cdot J_2(x). \quad 06$$

c) Solve using Laplace transform $\frac{dy}{dt} + 3y = 2 + e^{-t}$ with $y(0) = 1.$ 08

Q. 5 a) Find Laplace transform of $(1 + 2t - 3t^2 + 4t^3)H(t - 2)$ where 06

$$H(t - 2) = \begin{cases} 0, & t < 2 \\ 1, & t \geq 2 \end{cases}$$

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

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

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

Q. 6 a) Using Green's theorem evaluate

$$\oint_C (e^{x^2} - xy) dx - (y^2 - ax) dy \quad 06$$

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

b) Express the function

$$f(x) = \begin{cases} 1 & \text{for } |x| < 1 \\ 0 & \text{for } |x| > 1 \end{cases} \quad 06$$

as a Fourier Integral.

c) Under the transformation $w = (1 + i)z + (2 - i),$ find the region in the w -plane into which the rectangular region bounded by $x = 0, y = 0, x = 1, y = 2$ in the z -plane is mapped. 08

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Electrical Network Analysis & Synthesis

[Time: Three Hours]

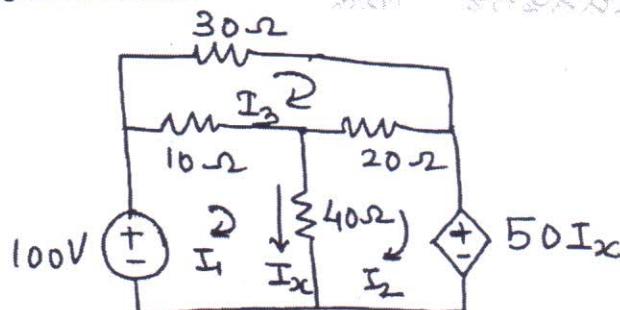
[Marks: 80]

Please check whether you have got the right question paper.

- N.B:
1. Question no. 1 is compulsory.
 2. Solve any three questions from the remaining.
 3. Assume suitable data wherever necessary.

Q.1 Attempt any four.

- (a) Find current through $20\ \Omega$ branch.



(20)

- (b) Discuss the initial and steady state conditions in relationship with voltage and current for the following circuit elements.

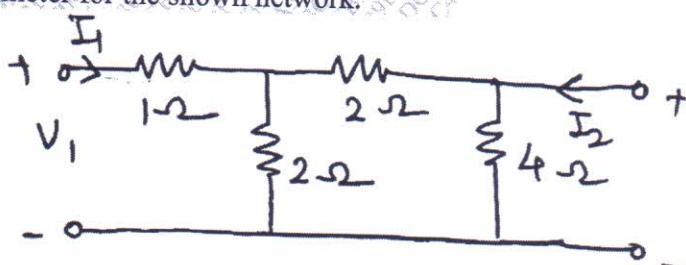
- i) Resistor ii) Inductor iii) Capacitor

- (c) Draw the oriented graph of a network with f-cutset matrix as shown.

	Twigs						
	1	2	3	4	5	6	7
1	0	0	0	0	-1	0	0
2	1	0	0	1	0	0	1
3	0	1	0	0	0	1	1
4	0	0	1	0	0	1	0
5	0	0	0	1	0	0	0

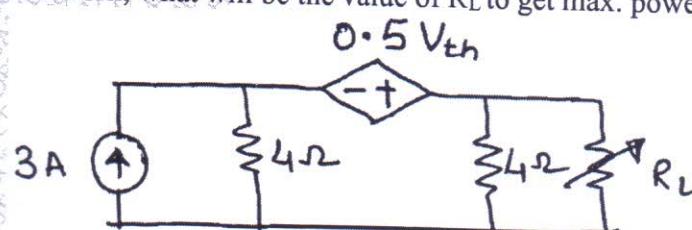
- (d) Write the properties of positive real function.

- (e) Find Y-parameter for the shown network.



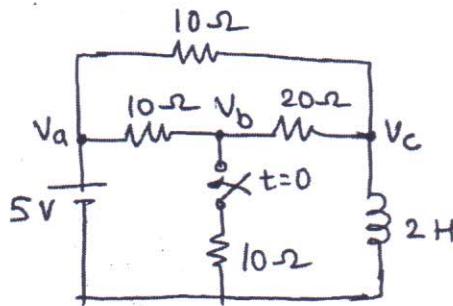
- (a) In the given network, what will be the value of R_L to get max. power delivered to it.

(10)



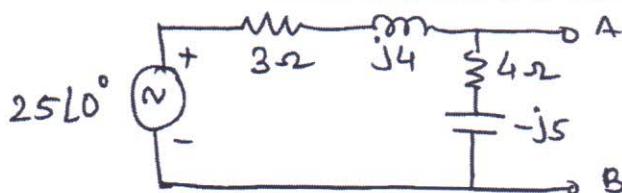
Q. P. Code : 50743

- (b) In the network shown; a steady state is reached with switch open. At $t=0$ the switch is closed. For the element values given; determine the $V_a(0^-)$ $V_b(0^-)$ and $V_a(0^+)$ and $V_b(0^+)$ (10)



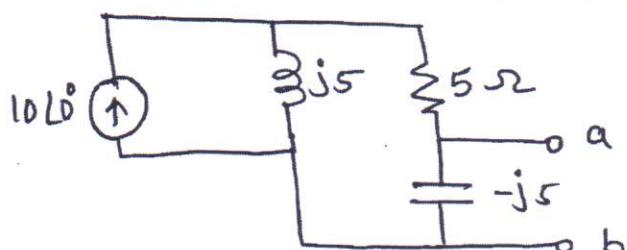
Q.3

- (a) Obtain Norton's equivalent circuit of the shown network.



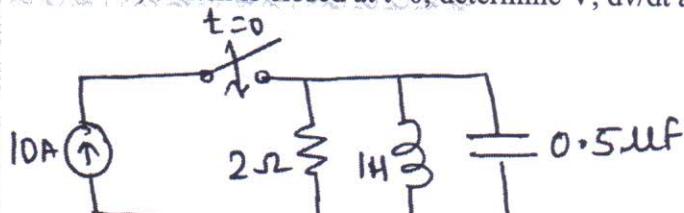
(05)

- (b) Obtain thevenins equivalent source.



(05)

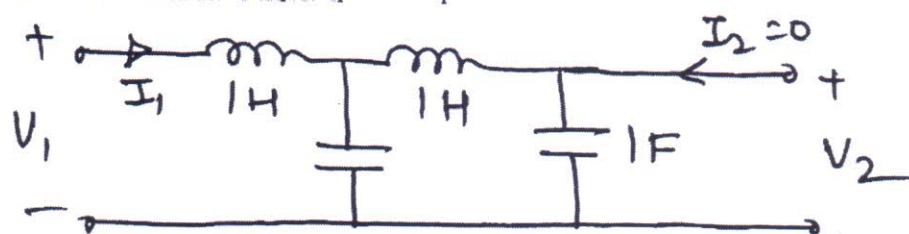
- (c) For the shown network, switch is closed at $t=0$, determine V , dV/dt and d^2V/dt^2 at $t=0^+$ (10)



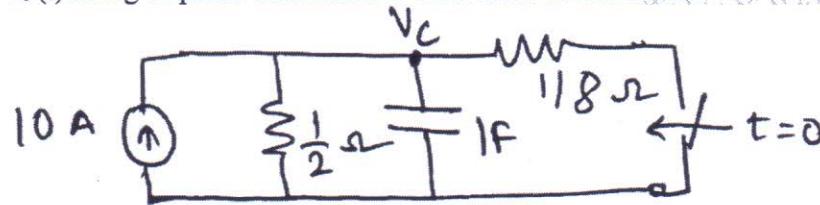
(10)

Q.4

- (a) Find network functions $\frac{V_1}{I_F}$, $\frac{V_2}{I_F}$ and $\frac{V_2}{V_1}$ for the shown network (10)



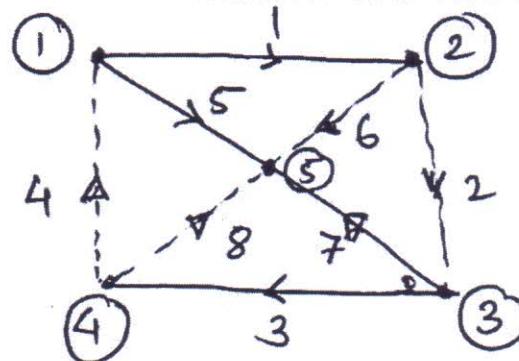
(b) Find $V_c(t)$ using Laplace transform. If the switch is closed at $t=0$.



(10)

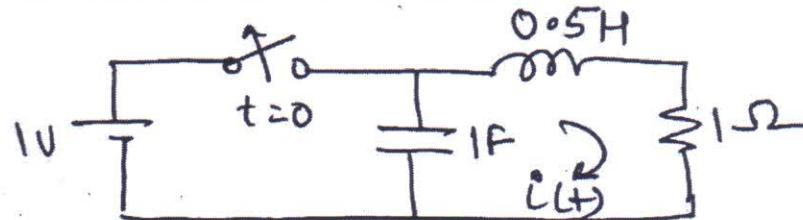
(a) Linear graph of a network is shown in figure. Obtain

- Incidence matrix
- Fundamental cutset matrix
- Fundamental tieset matrix.



(10)

(b) In the network shown. Switch is opened at $t = 0$. Steady state condition is achieved before $t = 0$ find $i(t)$.



(10)

(a) Check whether the following polynomials Hurwitz's or not.

(10)

- $P(s) = 2s^6 + s^5 + 135^4 + 6s^3 + 56s^2 + 25s + 25$
- $P(s) = s^4 + 7s^3 + 6s^2 + 21s + 8$

(b) Realize the Foster forms of the impedance function

(10)

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

Duration: 03 Hours

Total Marks assigned to paper: 80 Marks

Instruction to candidate:-

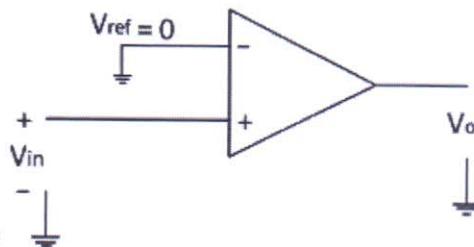
1. Question 1 is compulsory.
2. Attempt any three from remaining five questions.
3. All questions carry equal marks.
4. Assume suitable data wherever necessary.

Q1. Attempt all

[20 Marks]

Q1.a Determine the common mode output voltage for an OpAmp circuit with CMRR = 65db, $A_d = 10$ and $V_{cm} = 5 \text{ mV}$

Q1.b Explain operation of following comparator circuit. Consider input as sine wave of 10 V.

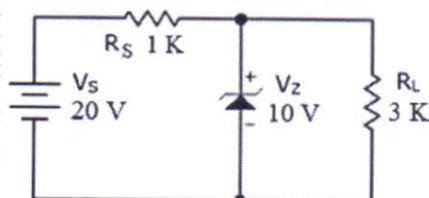


Q1.c Explain centre tapped full wave rectifier.

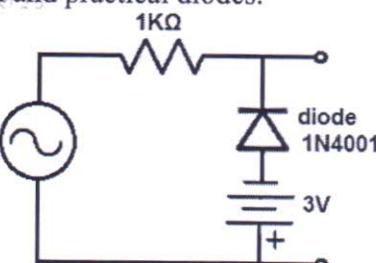
Q1.d With an example explain operation of transistor as a switch.

Q1.e Explain crossover distortion in class B power amplifier. How it is overcome.

Q2.a For the Zener diode network, determine V_L , V_R , I_Z , and P_Z . [8 Marks]



Q2.b Determine output voltage. Assume, input to be sine wave of 5 V peak. Draw waveform considering ideal and practical diodes. [8 Marks]



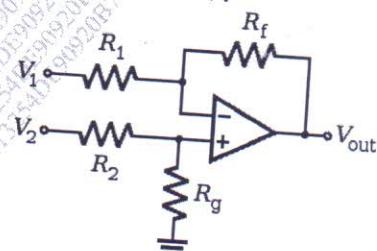
Q2.c Compare BJT and FET.

[4 Marks]

Q. P. Code: 39715

- Q3.a Determine operating point and V_{DS} for an FET self biasing circuit with $V_{DD} = 12$ V, $R_D = 2.2$ K, $R_S = 1.6$ K, $R_G = 1$ M, $I_{DSS} = 6$ mA and $V_P = -6$ V [8 Marks]
- Q3.b BJT transistor with voltage divider bias circuit has following values, $V_{CC} = 20$ V, $R_1 = 68$ K, $R_2 = 10$ K, $R_C = 6.2$ K, $R_E = 1.1$ K, $\beta = 50$. Determine operating point and V_{BC} . [8 Marks]
- Q3.c Explain working of D-MOSFET [4 Marks]
- Q4.a Explain working of Schmitt trigger. [8 Marks]
- Q4.b Explain Weinbridge oscillator. [8 Marks]
- Q4.c Give typical values for OpAmp IC 741.
1. Open loop gain
 2. Input impedance
 3. Slew rate
 4. Offset voltage
- [4 Marks]

- Q5.a Derive the expression of stability factor for emitter stabilized biasing circuit. [8 Marks]
- Q5.b Draw and explain series voltage regulator. [8 Marks]
- Q5.c Compare class A, class B and class C power amplifier based on,
- a) Output waveform for collector current
 - b) Linearity
 - c) Distortion
 - d) Efficiency
- [4 Marks]
- Q6.a Derive the expression for output and hence determine the output voltage. Consider, $R_1 = R_2 = R_f = R_g = 10$ K and $V_1 = V_2 = 2$ V. [5 Marks]

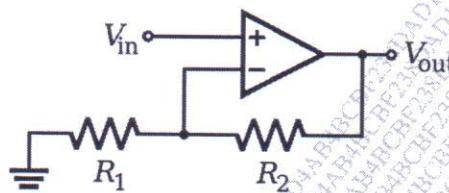


- Q6.b Explain weighted summation amplifier using OpAmp. [5 Marks]

Q. P. Code: 39715

- Q6.c** Identify the circuit diagram. Derive the expression for output voltage. Consider, $R_2 = 30\text{ K}$, $V_{IN} = 100\text{ mV}$, $V_O = 3.1\text{ V}$. What value of input resistance is needed in the given circuit to produce the given output voltage?

[5 Marks]



- Q6.d** Identify the circuit diagram. Derive the expression for output voltage. [5 Marks]

