(Time: 3 hours) **[Total marks: 80]**

Note: - (1) Question No. 1 is compulsory.

(2) Answer any three question from Q 2 to Q 6.

(3)Figures to the right indicate full marks.

1 (a) Find the Laplace Transform of $e^{-t}\sin 2t\cos 3t$. **05**

1 (b) Construct an analytic function whose real part is $y^3 - 3x^2y$ **05**

1 (c) Find Eigen values of $A^2 - 2A + I$ where $A = \begin{bmatrix} 2 & -1 & -2 \\ 0 & 1 & 4 \\ 0 & 0 & -3 \end{bmatrix}$. **05**

1 (d) Find Fourier series for $(x) = x^2 \quad in \quad 0 < x < 2\pi$. **05**

2 (a) If $\bar{F} = xye^{2z}i + xy^2coszj + x^2$cosxyk find div$\bar{F}$ and curl $\bar{F}$ **06**

2 (b) Find Fourier series of $f(x) = x^3$, $-\pi < x < \pi$. **06**

2 (c) Find Inverse Laplace Transform of (i) $\frac{2s+3}{s^2+2s+2}$ (ii) $\frac{s+2}{s(s+3)}$. **08**

3 (a) Find Eigen Values and Eigen Vector of the following matrix **06**

$$A = \begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$$

3 (b) Determine the Constants a, b, c, d if

$f(z) = x^2 + 2axy + by^2 + i\,(dx^2 + cxy + y^2)$ is analytic **06**

3 (c) Find Fourier series for $f(x) = \begin{cases} 1 + {}^{2x}/_{\pi}, & -\pi < x < 0 \\ 1 - {}^{2x}/_{\pi}, & 0 < x < \pi \end{cases}$ and hence deduce that **08**

$$\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots \ldots \ldots$$

4 (a) Prove that $\bar{F} = (ysinz - sinx)i + (xsinz + 2yz)j + (xycosz + y^2)k$ is solenoidal and irrotational . **06**

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4 (b) Evaluate $\int_0^\infty e^{2t} t \cos t \ dt$. **06**

4 (c) Show that the matrix

$$A = \begin{bmatrix} -9 & 4 & 4 \\ -8 & 3 & 4 \\ -16 & 8 & 7 \end{bmatrix}$$ diagonalizable and find transforming matrix and Diagonal matrix. **08**

5 (a) Find the inverse Laplace Transform of $\frac{s+4}{(s+1)(s+2)(s+3)}$ by using Partial fraction method. **06**

5 (b) Construct an analytic function $f(z) = u + iv$, where **06**

$v = (x - y)(x^2 + 4xy + y^2)$.

5 (c) i) Show that $\bar{F} = (2xyz^2)i + (x^2z^2 + zcosyz)j + (2x^2yz + ycosyz)k$ is a conservative field. **04**

ii) If $\bar{F} = (x + 3y)i + (y - 2z)j + (az + x)k$ is solenoidal, find the value of a **04**

6 (a) Find Eigen Values and Eigen Vector of the following matrix **06**

$$A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -5 & -2 \end{bmatrix}$$

6 (b) Find inverse Laplace transform

i) $\frac{1}{s^2+3s+5}$ ii) $log\left[\frac{s^2+4}{s+4}\right]$ **06**

6 (c) Evaluate $\int_0^\infty e^{-2t}\left(\int_0^t e^{-u} u \ sin\ 2u \ du\right) dt$ **08**

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(3 Hours) **Total Marks: 80**

N.B: (1) Question No. 1 is compulsory.

(2) Attempt any three from the remaining questions.

(3) Figures to the right indicate full marks.

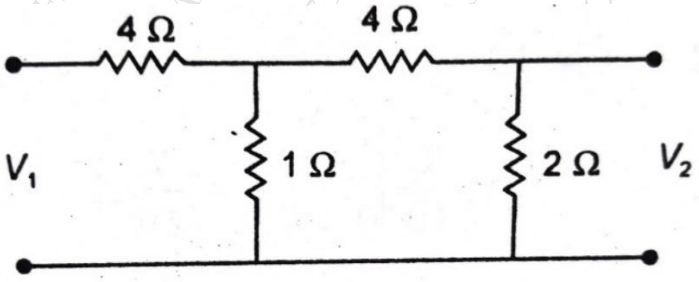
(4) Each question is of 20 Marks.

Q1. Answer ANY FOUR.

a) Define pole and zero for a network function and draw a pole zero plot for, **05**

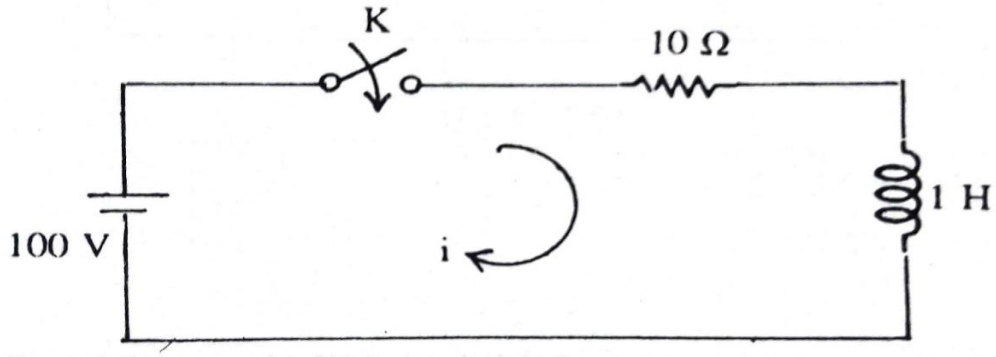
$$I(s) = \frac{4(s+4)}{(s+1)(s^2+5s+6)}$$

b) For the given network, determine the open circuit impedance parameters 05



c) Derive condition for symmetry and reciprocity for transmission (A-B-C-D) parameters. **05**

d) In the given network switch is closed at *t=0.* With zero current in the inductor, find i *and* $\frac{di}{dt}$ at *t=0+*. **05**



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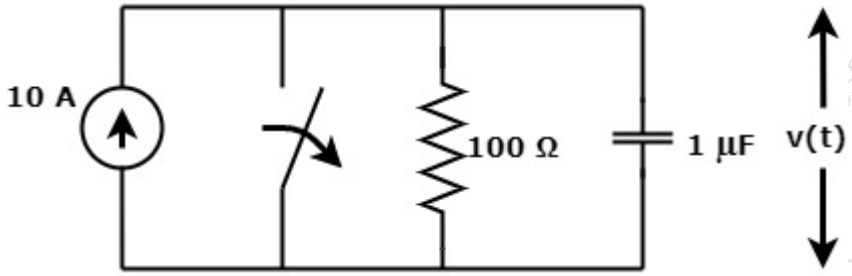
Q 2a) Derive ABCD parameters in terms of Y parameters and hybrid parameters

b) In the circuit shown, the switch was closed for long time and at t=0 it is opened. Determine $v(t), \frac{dv(t)}{dt}$ and $\frac{d^2v(t)}{dt^2}$ for $t = 0^+$. **10**



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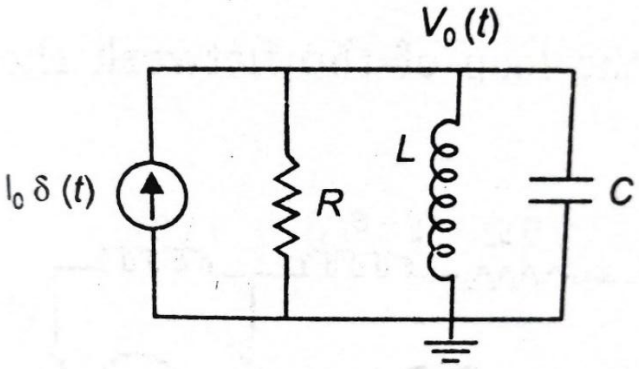
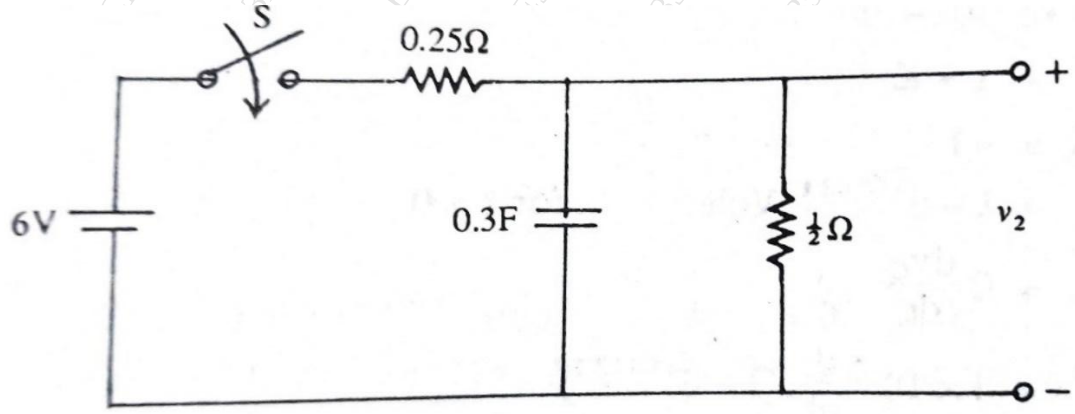
Q3 a) Determine the voltage across the parallel combination in the given circuit when it is connected across a current source $I_0\delta(t)$



b) For the given network switch 's' is open for a long time and at t=0 it is closed. Determine V_2 using the analysis in time domain.



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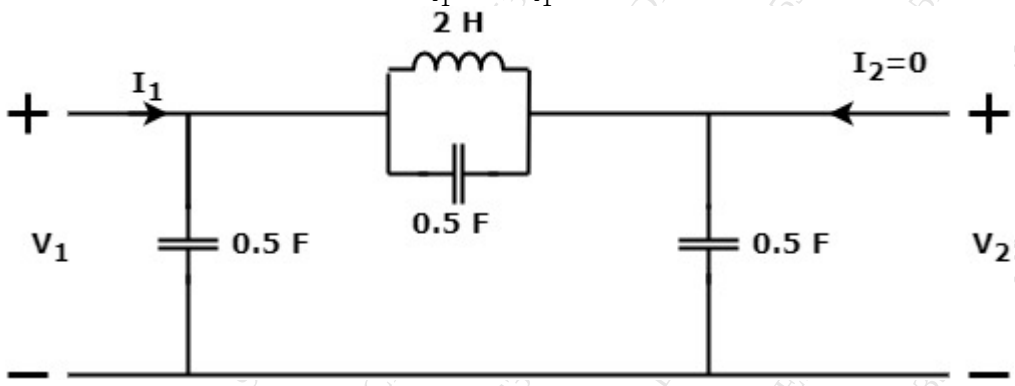
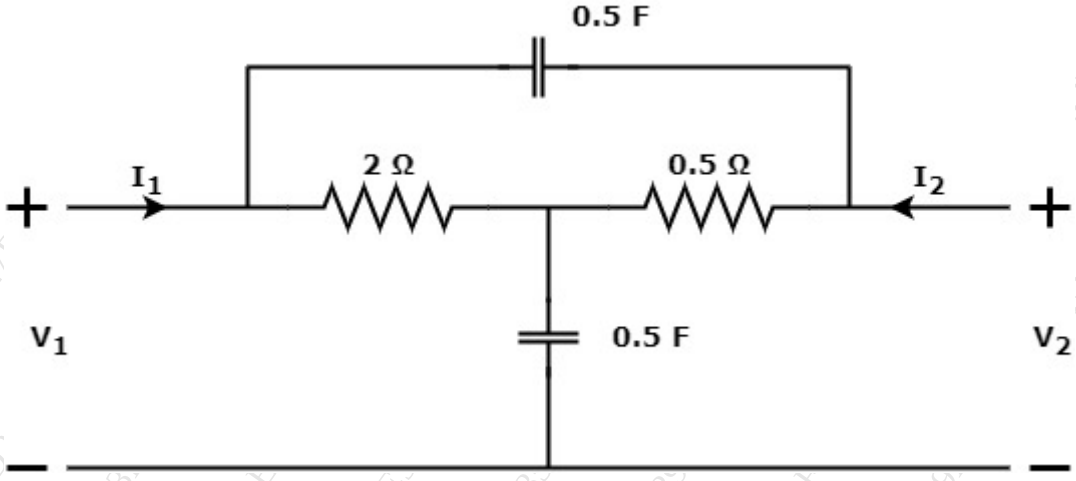
Q 4

a) For the circuit shown, determine $\frac{V_1}{I_1}$ and $\frac{V_2}{I_1}$. **10**

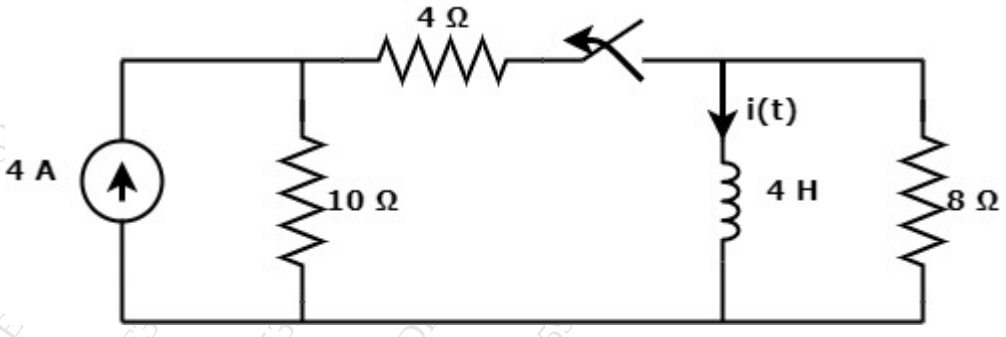


b) Determine admittance parameters for network shown below. **10**



Q 5

a) In the below circuit, switch was closed for a long time and at t=0 it is opened. Calculate i(t) using Laplace Transform. **10**



b) Write down restrictions on Pole and Zero Locations for Driving-Point Functions and Transfer Functions. **10**

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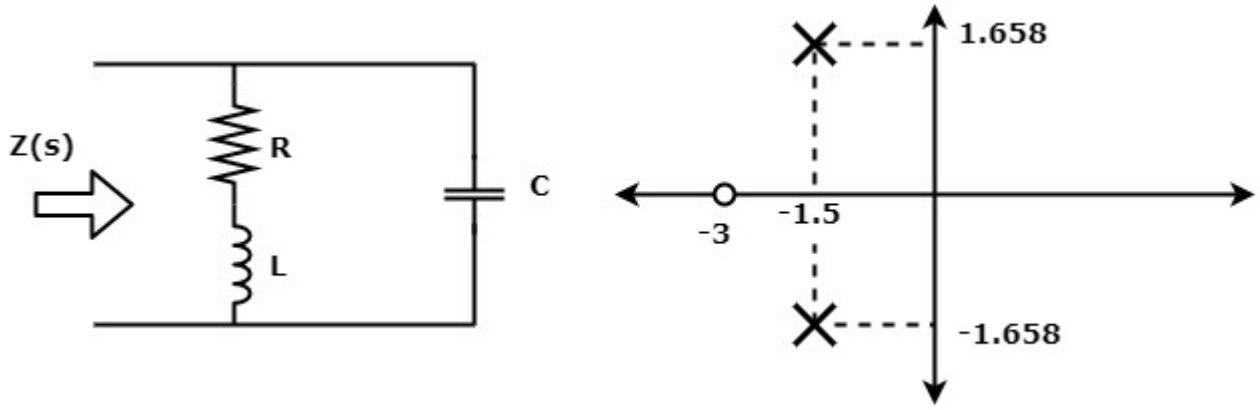
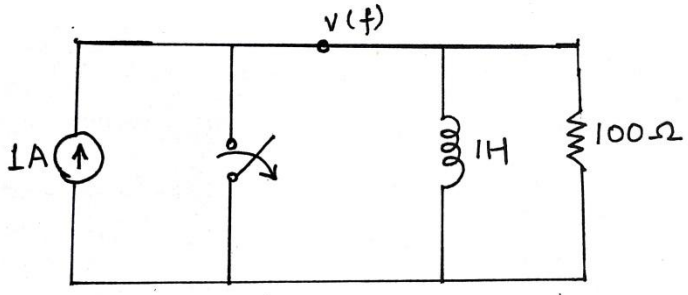
Q 6

a) For the impedance function of the network shown, the pole zero plot is as given with $z(j0) = 1$. Determine values of R, L and C. **10**



b) In the network shown in figure at t=0, the switch is opened. calculate v, dv/dt and d^2v/dt^2 at $t=0^+$ **10**



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(3 Hours) **Total Marks: 80**

N.B: (1) Question No. 1 is compulsory.
(2) Attempt any three from the remaining questions.
(3) Figures to the right indicate full marks.
(4) Each question is of 20 Marks

Q.1	Attempt **any 4** questions	**Marks**
A	Draw Speed torque relationship for DC Shunt and Dc Series motor.	**5**
B	Give classification of transducers.	**5**
C	Explain i) Magnetic flux ii) Leakage Flux iii) Magnetic saturation.	**5**
D	Draw Wheatstone bridge and write balancing equation.	**5**
E	Write difference between Resolution & sensitivity of digital meters	**5**

Q.2		**Marks**
A	Derive torque equation of singly excited system.	**10**
B	Explain Basic potentiometer circuit and how it is used for the calibration of ammeter.	**10**

Q.3		**Marks**
A	Explain working principles of any digital Voltmeter.	**10**
B	A 250 V, 4 pole, wave wound dc series motor has 782 conductors on its armature. It has armature and series field resistance of 0.75 ohm. It takes current of 40 A. estimate its speed and gross torque developed if it has flux per pole of 25 m wb.	**10**

Q.4		**Marks**
A	Draw and explain Kelvin's Double bridge.	**10**
B	Draw and explain Hall effect and optical transducer with example.	**10**

Q.5		**Marks**
A	Explain working principle of digital Tachometer.	**10**
B	Explain in brief the principle of electro-mechanical energy conversion and develop a model of electro-mechanical energy conversion device.	**10**

Q.6		**Marks**
A	Write a short note on: Swinburne's test on DC Machine	**10**
B	Write a short note on: Energy and co energy stored in magnetic field.	**10**

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

Instructions:

1. Question No.1 is compulsory.
2. Attempt any three from the rest.
3. Figure to the right indicates full marks.
4. Assume suitable data if it is necessary.

1 **(5 x 4)**

a) Explain the need of biasing in BJT amplifiers.
b) Interpret the drain-source characteristics of n-channel depletion type MOSFET for $V_{GS} = 0V$ and $V_{GS} = -2$ V.
c) Explain diode as positive shunt clipper.
d) Demonstrate the block diagram of op-amp with the function of each block.

2 a) Briefly discuss the different biasing techniques employed in BJT Amplifiers. **(10)**

b) Draw the hybrid equivalent model of voltage divider bias CE amplifier and derive the expression for voltage gain. **(10)**

3 a) Draw the small signal equivalent circuit of an n-channel MOSFET amplifier derive the expression of voltage gain. **(10)**

b) Determine the values of I_{DQ} and V_{GSQ} for the Common Source n-channel Depletion type MOSFET in voltage divider bias configuration. R_{G1} = 91MΩ, R_{G2} = 15MΩ, R_D = 6.8KΩ, R_S = 3.3KΩ, V_{DD} = 18V, I_{DSS} = 12mA, V_P = -3V. **(10)**

4 a) Explain op-amp as an inverting amplifier and design an inverting amplifier for voltage gain of -10. **(10)**

b) Explain the working of astable multivibrator using IC 555. **(10)**

5 a) Explain the construction and working of optoisolators. **(10)**

b) Explain op-amp as voltage summing amplifier and derive the expression of output voltage. **(10)**

6 Write short notes on **ANY TWO** **(20)**

a) Monostable Multivibrator using IC555
b) Op-amp as Integrator
c) LM317 as Adjustable voltage Regulator

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