SE | EXTC | III 15 May 2012
Applied Mathematics - III

Con. 3638-12.

GN-7409

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Solve any **four** questions out of the remaining from Question Nos. **2** to **7**.

1. (a) Prove that $\int_0^\infty e^{-t}\frac{\sin^2 t}{t}\,dt = \frac{1}{4}\log 5$. **20**

(b) Is the matrix orthogonal ? If not then can it be converted to an orthogonal matrix :—

$$A = \begin{bmatrix} -8 & 1 & 4 \\ 4 & 4 & 7 \\ 1 & -8 & 4 \end{bmatrix}$$

(c) Obtain the complex form of Fourier series for $f(x) = e^{ax}$ in $(-l, l)$

(d) Find the z-transform of $f(k) = a^k$, $k \geq 0$.

2. (a) Find the Fourier sine transform of f(x) if $f(x) = \sin kx, \quad 0 \leq x < a$
$= 0 \quad , \quad x > a$ **6**

(b) Find the Matrix A if— **6**

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

(c) $(D^2 - 3D + 2)\,y = 4e^{2t}$, with $y(0) = -3$, $y'(0) = 5$ solve using Laplace transform. **8**

3. (a) Reduce the matrix to normal form and find its rank :— **6**

$$\begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$$

(b) Find the inverse Laplace transform of— **6**

(i) $\frac{e^{-2s}}{s^2+8s+25}$ (ii) $\frac{e^{-3s}}{(s+4)^3}$

(c) If $f(x) = \pi x \; 0 \leq x \leq 1$
$= \pi(2 - x) \; 1 \leq x \leq 2$ } with Period 2. **8**
Find the Fourier series expansion.

4. (a) Show that the set of functions $\sin\left(\frac{\pi x}{2l}\right), \sin\left(\frac{3\pi x}{2l}\right), \sin\left(\frac{5\pi x}{2l}\right)$ ..... is orthogonal over $(0, l)$. **6**

(b) If $f(k) = 4^k U(K)$, $g(k) = 5^k U(k)$, then find the z-transform of $f(k) * g(k)$. **6**

(c) Solve the following equations by Gauss-Seidel Method. **8**
$28x + 4y - z = 32$, $2x + 17y + 4z = 35$,
$x + 3y + 10z = 24$.

[TURN OVER

5. (a) Obtain Fourier series for— 6

$$f(x) = x + \frac{\pi}{2}, \quad -\pi < x < 0$$

$$= \frac{\pi}{2} - x, \quad 0 < x < \pi \text{ and}$$

hence deduce that, $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots$

(b) State Convolution theorem and hence find the inverse Laplace transform of the funciton using the same :— 6

$$f(s) = \frac{(s+3)^2}{(s^2+6s+5)^2}.$$

(c) For what value of λ the equations $3x - 2y + \lambda z = 1$, $2x + y + z = 2$, $x + 2y - \lambda z = -1$ will have no unique solution ? Will the equations have any solution for this value of λ ? 8

6. (a) Show that every square matrix A can be uniquely expressed as P + iQ when P and Q are Hermitian matrices. 6

(b) If $L(f(t)) = f(s)$, then prove that $L(t^n f(t)) = (-1)^n \frac{d^n}{ds^n} f(s)$, hence, find Laplace transform of $f(t) = t\cos^2 t$. 6

(c) Obtain the half range sine series for f(x) when $f(x) = x \quad 0 < x < \frac{\pi}{2}$ 8

$$= \pi - x \quad \frac{\pi}{2} < x < \pi$$

hence, find the sum of $\sum_{2n-1}^{\infty} 1/n^4$.

7. (a) Find the Fourier transform of— 6

$f(x) = (1-x^2), \quad |x| \le 1$

$= 0 \quad , \quad |x| > 1, \quad$ then $f(s) = -2\sqrt{\frac{2}{\pi}}\left[\frac{s\cos s - \sin s}{s^3}\right]$

(b) Find the inverse z transform of $F(z) = \frac{z}{(z-1)(z-2)}, |z| > 2.$ 6

(c) Find the non-singular matrices P and Q such that— 8

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

is reduced to normal form. Also find its rank.

SE | EXTC | III (REV) 24/5/2012
Digital Logic Design

30-1st Half-12 mins (e)

Con. 3897-12. GN-5360

(3 Hours) [Total Marks : 100

N. B. : (1) Question No. **1 is compulsory.**
(2) Attempt any **four** questions from **remaining** questions.
(3) **All** questions carry **equal** marks.

1. (a) Calculate $(-6)_{10} - (-2)_{10}$ using 2's complement method. 5
(b) What is difference between combinational circuits and sequential circuits ? 5
(c) Explain in brief 'state tables' and 'state graphs'. 5
(d) What are salient features of CMOS logic family ? 5

2. (a) Design a mod 6 ripple counter using T type flip-flop. Draw the circuit designed and output waveforms. 12
(b) What is FPGA ? What are its salient features ? 8

3. (a) Design a full adder using 2 half adders. Explain its working. 10
(b) Minimize $y = \Sigma m\ (1, 5, 7, 9, 11, 13, 15)$ and realise using universal gates. 10

4. (a) Minimize the following function using Quine McCluskey method : 12
$f(A, B, C, D) = \pi\ m\ (2, 7, 8, 9, 10, 12)$
(b) Design a full adder using two 4:1 mux. 8

5. (a) Convert $(0{\cdot}42)_{10}$ into binary. 4
(b) Solve $111110{\cdot}1 \div 0101$. 4
(c) Convert $(11011)_2$ into gray code. 4
(d) List various characteristics of digital ICs and explain their significance in brief. 8

6. (a) Design a 4 bit universal shift register and explain its working. 12
(b) Implement the following boolean expression using 8:1 mux 8

$$f(A, B, C, D) = \overline{A}\,\overline{B}\,\overline{D} + ABC + \overline{B}CD + \overline{A}CD.$$

7. (a) Design a 3 bit up/down ripple counter. 10
(b) What is half subtractor ? Explain its working. 10

SE | EXTC | III (Rev) 19|5|2012
Electronic Devices & Circuits-I

Con. 3753–12. GN–5354

(3 Hours) [Total Marks : 100

N.B. : (1) Question Nos. 1 and 2 are compulsory.
(2) Out of remaining questions attempt any three questions.
(3) In all five questions to be attempted.
(4) Figures to the right indicate full marks.

1. a. Design single stage R-C coupled CE audio frequency amplifier employing BC147B BJT to satisfy the following requirements. [15]
$|Av| \geq 100$, $S_{ICO} \leq 10$, Load resistor RL = 10KΩ and Output voltage Vo=3volts.

b. For the designed amplifier in part (a) determine; expected voltage gain, input impedance, output impedance and current supplied by source voltage V_{CC} [05]
{Use complete h-model for part (a) and (b)}

2. a. Design single stage R-C coupled CS audio frequency amplifier employing JFET BFW-11 to satisfy the following requirements. [12]
$|Av| \geq 10$, $V_{GSQ} = 0.3Vp$, RL = 120 KΩ, $V_{DD} = 20$ volts and Output peak voltage Vo = 4.5volts.

b. For the above designed circuit with source resistor 'Rs' unbypassed determine; voltage gain, input impedance, output impedance and output voltage for input voltage of 20Vpp. [08]

3. a. For the circuit shown in Fig A. determine the following :
i. Voltage at collector terminal VC [02]
ii. Voltage at base terminal VB [02]
iii. Stability S_{ICO} [02]
iv. Voltage gain [04]

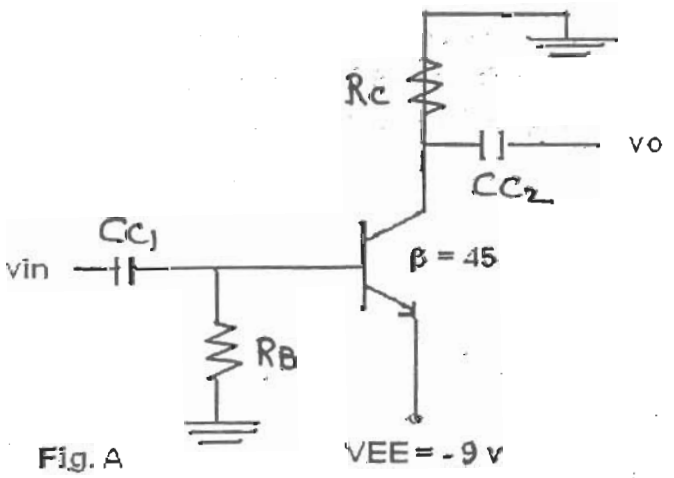


Fig. A

[TURN OVER

b, For the network of Fig B. with RD = 2k2, RS = 0.68KΩ and V_{DD} = 20volts determine the following :

i. I_{DQ} and V_{GSQ} [03]

ii. V_{DSQ} and V_D [03]

iii. V_G and V_S [02]

iv. I_{DQ} if R_S is bypassed by capacitor C_S [02]

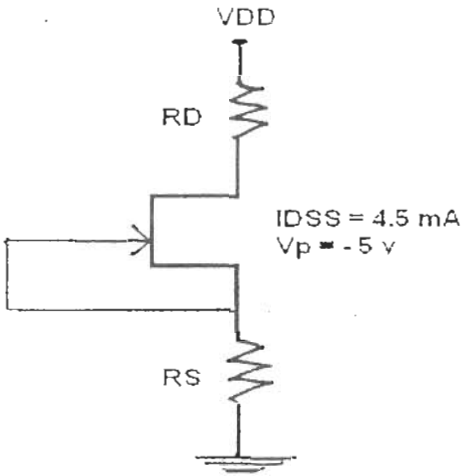


Fig.B

4, Compare the following (Any four) [5x4]

i. Output characteristic of common emitter (CE) and common source (CS) amplifier

ii. BJT series and BJT shunt voltage regulator

iii. D-MOSFET and E-MOSFET

iv. SCR and TRIAC

v. LC and C-L-C filter

5. a. Design a full wave rectifier dc supply using centre tapped transformer with two diodes to give dc output voltage at 300 volts to a variable resistive load. The load current expected is 75 ± 25 mA with ripple factor not to exceed 0.07. Use C-L-C filter. [12]

b. For the network of Fig C with RD=2KΩ, RG=10MΩ, and VDD=12volts. Determine the following : [04]

i. I_{DQ} [04]

ii. V_{DSQ}

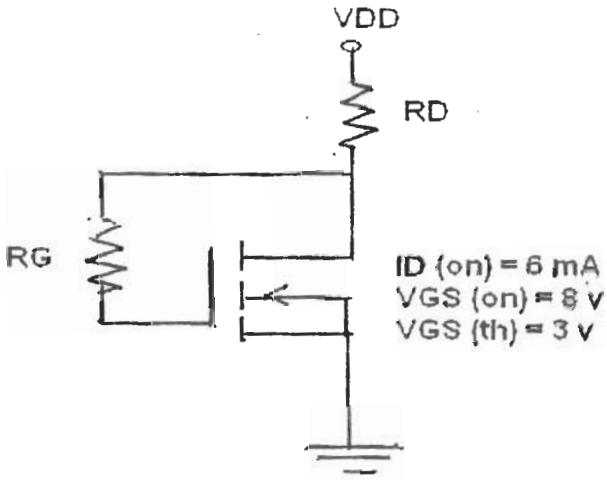


Fig C

6. a. Describe the operation of BJT series regulator and derive an expression for line regulation(Sv) and load regulation (Ro) [12]

b. Explain with the help of a circuit diagram the working of a UJT relaxation oscillator. [08]

7. Explain the following **(Any** four) [5x4]

i. Self thermal **stability of** JFET

ii. **Utility of** h-parameter

iii. Graphical determination of FET parameters

iv. Features of IGBT

v. BJT as a switch

vi. Power MOSFET

DBEC DATA SHEET

Transistor type	Pdmax @ 25°C Watts	Icmax @ 25°C Amps	$V_{CE}^{(sat)}$ volts d.c.	V_{CBO} volts d.c.	V_{CEO} (Sus) volts d.c.	V_{CER} (Sus) volts d.c.	V_{CEX} volts d.c.	V_{BEO} volts d.c.	T_j max °C	D.C. current gain min	typ.	max.	Small Signal h_{fe} min.	typ.	max.	V_{BE} max.	θ_{j-c} °C/W	Derate above 25°C W/°C
2N3055	115·5	15·0	1·1	100	60	70	90	7	200	20	50	70	15	50	120	1·8	1·5	0·7
ECN055	50·0	5·0	1·0	60	50	55	60	5	200	25	50	100	25	75	125	1·5	3·5	0·4
ECN149	30·0	4·0	1·0	50	40	—	—	8	150	30	50	110	33	60	115	1·2	4·0	0·3
ECN100	5·0	0·7	0·6	70	60	65	—	6	200	50	90	280	50	90	280	0·9	35	—
BC147A	0·25	0·1	0·25	50	45	50	—	6	125	115	180	220	125	220	260	0·9	—	—
2N525(PNP)	0·225	0·5	0·25	85	30	—	—	—	100	35	—	65	—	45	—	—	—	—
BC147B	0·25	0·1	0·25	50	45	50	—	6	125	200	290	450	240	330	500	0·9	—	—

Transistor type	hie	hoe	hre	oja
BC 147A	2·7 K Ω	18μ ℧	1·5 × 10⁻⁴	0·4°C/mw
2N 525 (PNP)	1·4 K Ω	25μ ℧	3·2 × 10⁻⁴	—
BC 147B	4·5 K Ω	30μ ℧	2 × 10⁻⁴	0·4°C/mw

BFW·11—JFET MUTUAL CHARACTERISTICS

−Vgs volts	0·0	0·2	0·4	0·6	0·8	1·0	1·2	1·6	2·0	2·4	2·5	3·0	3·5	4·0
Ios max. mA	10	9·0	8·3	7·6	6·8	6·1	5·4	4·2	3·1	2·2	2·0	1·1	0·5	0·0
Ios typ. mA	7·0	6·0	5·4	4·6	4·0	3·3	2·7	1·7	0·8	0·2	0·0	0·0	0·0	0·0
Ios min. mA	4·0	3·0	2·2	1·6	1·0	0·5	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0

N-Channel *JFET*

Type	V_{DS} max. Volts	V_{DG} max. Volts	V_{GS} max. Volts	P_d max. @25°C	T_j max.	I_{DSS}	g_{mo}	$-V_p$ Volts	r_d	Derate above 25°C	θ_{j-a}
2N3822	50	50	50	300 mW	175°C	2 mA	3000 μΩ	6	50 KΩ	2 mW/°C	0·59°C/mW
BFW 11 (typical)	30	30	30	300 mW	200°C	7 mA	5000 μΩ	2·5	50 KΩ	—	0·59° C/mW

UJT type	P_d max. @25°C	I_g max. @25°C	I_p peak pulse current max.	V_{BB} Volts max.	V_{BB0} Volts	T_j max	η min.	η max.	R_{BB}KΩ min.	R_{BB}KΩ typ.	Max.	I_p max. μA	I_v min. mA	I_{EO} μA
2N2646	300mW	50mA	2Amp.	30	35	125°C	0·56	0·75	4·7	7·0	9·1	5·0	4·0	−2·0

SE/EXTC/III (Rev) 29/5/2012 Electronic Instrumentation

Con. 4474-12. GN–8369

(3 Hours) [Total Marks : 100

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

(2) Attempt any **four** questions from the remaining **six** questions.

1. Attempt any **four**questions :– **20**

(a) Why delay line is used in the vertical section of the oscilloscope?

(b) What is universal counter?

(c) Explain capacitive sensors.

(d) Explain various sources of error in measurement system.

(e) Explain the significance of 3½ and 4½ digit displays.

2. (a) Explain the elements of a digital FFT analyzer with a suitable block diagram. **10**

(b) What is the basic principle of ADC ? Explain the operation of successive approximation type of ADC. **10**

3. (a) Explain the principle of working of LVDT. How do stray magnetic fields effect the performance and how it can be protected? **10**

(b) Draw and explain the block diagram of a general purpose CRO. **10**

4. (a) Derive an expression for vertical deflection of electron beam in CRT. **10**

What is the minimum distance that will allow full deflection of 4cm at oscilloscopescreen with deflection factor of 100V/cm and with accelerating potential of 2k.

(b) Explain PAM telemetry system. **10**

5. (a) With a block diagram explain the elements of Network analyzer with its applications.

(b) Draw and explain the block diagram of DSO. Describe the various modes of operation.

6. (a) Explain the need of data transmission and telemetry. What are the differentmodulation methods used in RF telemetry systems?

(b) Write a note on Automatic test equipment. A coil with resistance of 5Ω is directly connected to test terminals of Q-meter, for a 130 PF capacitance of a tuning capacitor, resonance is obtained at oscillator frequency of 1MHz. Calculate % error introduced in calculated value of Q by 0·01Ω insertion resistance.

7. (a) Draw and explain true RNS voltmeter with thermocuple. Why there is error in reading a voltmeter calibrated to read RMS values when it is used to read signals other than sine wave.

(b) Explain briefly the different pulse modulation techniques. **10**

SE | III EXTC | (REV) 7 | 6 | 12
EN

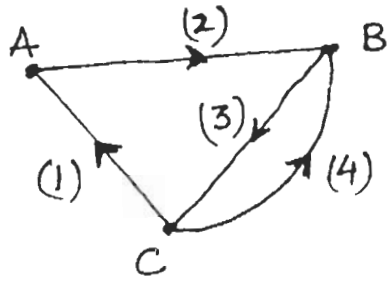
AGJ 1st half 1

Con. 4801-12. **GN–9746**

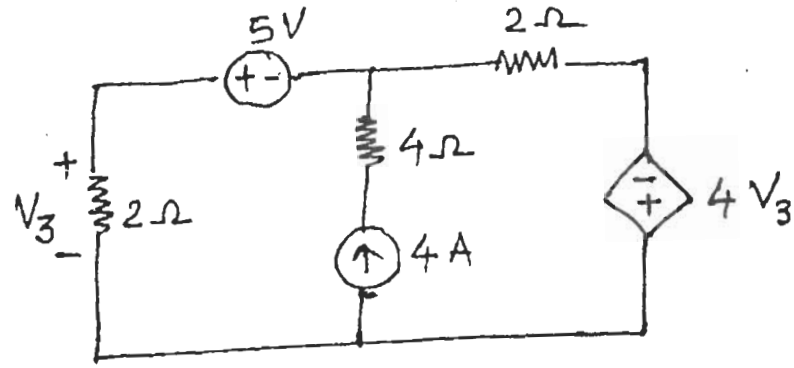
(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory** and solve any **four** from **remaining** questions **2** to **7**.
(2) In all **five** questions to be **attempted**.
(3) **Figures** to the **right** indicate **full** marks.
(4) Assume **suitable** data if any.

1. (a) How many trees are possible for the graph given below :– **5**

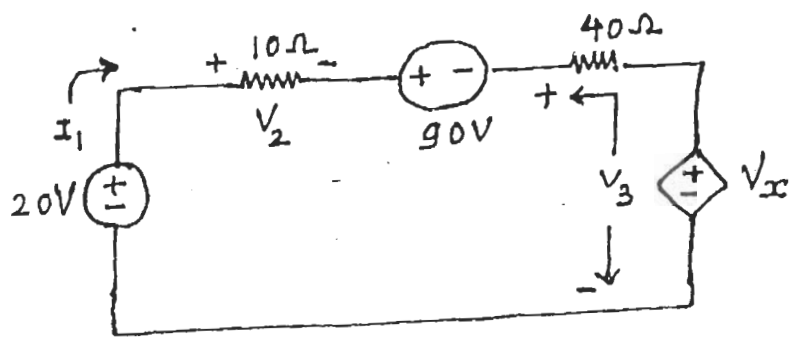


(b) By mesh analysis determine the current through 2 Ω resistor. **5**



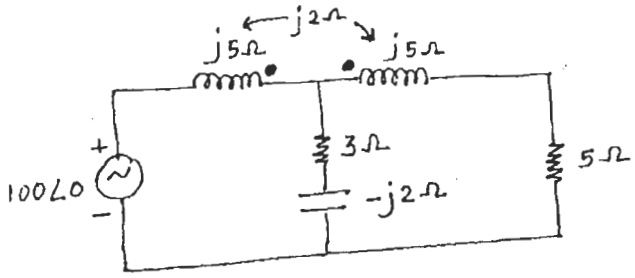
(c) Find the condition of reciprocity for Z-Parameters. **5**

(d) Find I, in the circuit shown in the **Figure** if the dependent voltage source is
(i) $2V_2$ (ii) $1{\cdot}5V_3$.

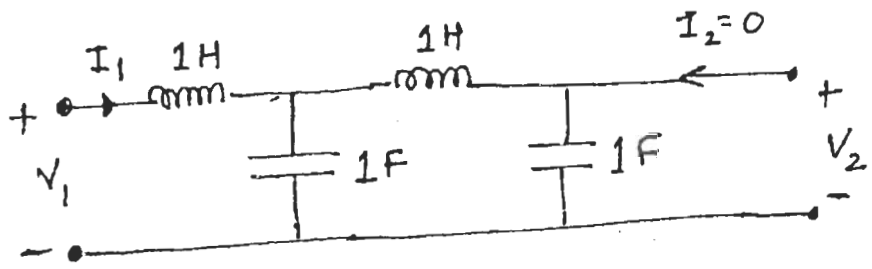


[TURN OVER

2. (a) Find the current through 5Ω resistor. **10**

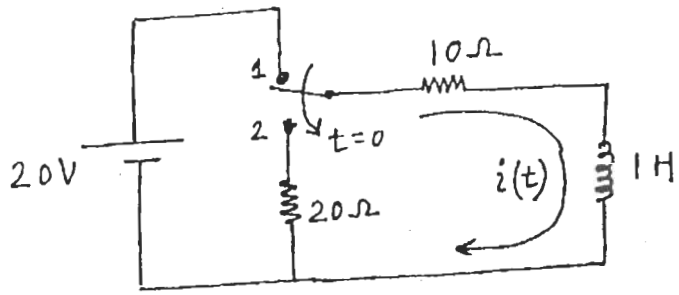


(b) Find the network functions $\frac{V_1}{I_1}$, $\frac{V_2}{V_1}$ and $\frac{V_2}{I_1}$ for the network shown. **10**

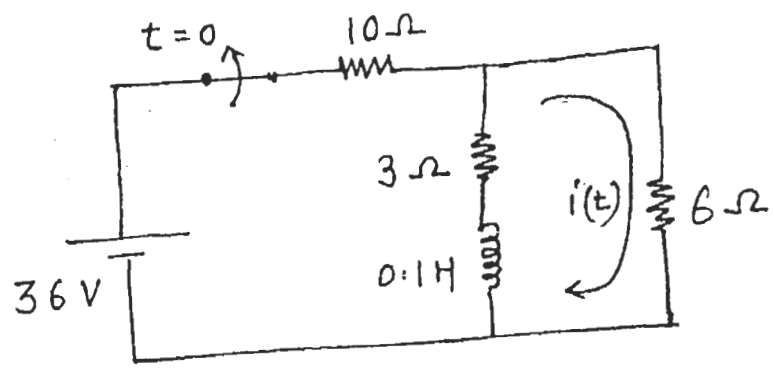


3. (a) In the network, the switch is changed from position 1 to the position 2 at t =0, steady condition having reached before switching. Find the values of **10**

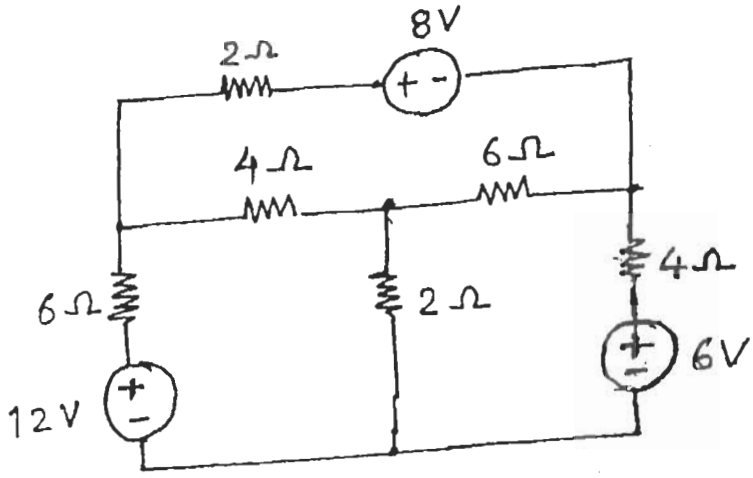
i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at $t = 0^+$.



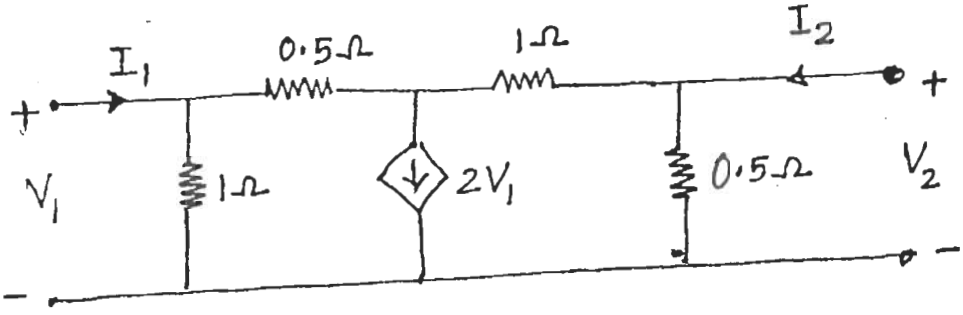
(b) In the network, the switch is opened at t = 0. Find i(t). **10**



4. (a) For the network, write down the tieset matrix and obtain the network equilibrium equation in Matrix form using KVL. Calculate loop currents. **10**



(b) Determine the Y and Z-parameters for the given network. **10**



5. (a) Synthesize the following function :– **8**

$$Z(s) = \frac{6(s+2)(s+4)}{s(s+3)}$$

Use Foster-II Method.

(b) A driving point R–L admittance function is given by– **6**

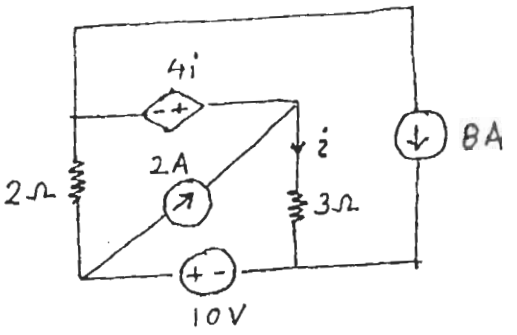
$$Y_{RL}(s) = \frac{s^2+6s+8}{s^2+4s+3}$$

Realize the given function as R–L form using Cauer –I

(c) Synthesize the following $Y_{RL}(s)$ using Cauer–II term– **6**

$$Y_{RL}(s) = \frac{(s+1)(s+4)}{s(3s+4)}.$$

6. (a) Find the current i in the network shown in **figure,** using superposition theorem. 10

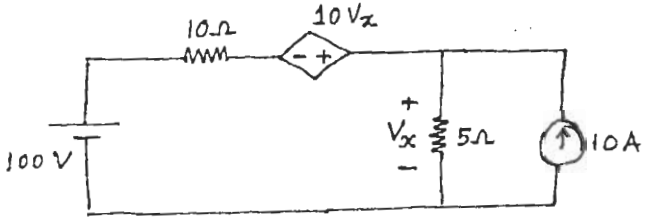


(b) (i) Check the given polynomial for Hurwitz or not– 10

$$P(s) = s^5 + 8s^4 + 24s^3 + 28s^2 + 23s + 6$$

(ii) Test whether $F(s) = \dfrac{5(s+1)^2}{s^3+2s^2+2s+40}$ is positive real function.

7. (a) Find the current in 10Ω resistor of the network, using Thevenin's theorem. 10



(b) Determine the hybrid parameter of the network. 10