(3 hours) **Total Marks-80**

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

2) Attempt any THREE questions from Q.No.2 to Q.No.6

3) Figures to the right indicate full marks

Q1 a) Find $L[\frac{\cos 2t \sin t}{e^t}]$ [5]

b) Determine the constants a,b,c,d if $f(z) = x^2 + 2axy + by^2 + i(cx^2 + 2dxy + y^2)$ is analytic. [5]

c) Find Half range cosine series for $f(x) = x(\pi - x), 0 < x < \pi$ [5]

d) Find the directional derivative of $f(x, y, z) = xy^2 + yz^3$ at the point(2,-1,1) in the direction of the vector $i + 2j + 2k$ [5]

Q2) a) Show that the function $u = 3x^2y + 2x^2 - y^3 - 2y^2$ is harmonic. Find its harmonic conjugate and corresponding analytic function. [6]

b) Find the Fourier series for $f(x) = 1 - x^2$ in (-1,1). [6]

c) Find $i)$ $L^{-1}[\frac{e^{-\pi s}}{s^2-2s+2}]$ [8]

$ii)$ $L^{-1}[tan^{-1}\left(\frac{s+a}{b}\right)]$

Q3) a) Find the angle between the surfaces $xlogz + 1 - y^2 = 0$, $x^2y + z = 2$ at (1,1,1) [6]

b) Prove that $J'_2(x) = \left(1 - \frac{4}{x^2}\right)J_1(x) + \frac{2}{x}J_0(x)$ [6]

c) Obtain Fourier series for [8]

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

Hence deduce that $\frac{\pi^4}{96} = \frac{1}{1^4} + \frac{1}{3^4} + \cdots \ldots$

Q4) a) Using Gauss's Divergence theorem, prove that [6]

$\iint_S (y^2z^2 i + z^2x^2 j + z^2y^2\, k).\bar{N}ds = \frac{\pi}{12}$ where S is the part of the sphere $x^2 + y^2 + z^2 = 1$ above the xy- plane.

b) Prove that $J_{-\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}.\, cosx$ [6]

c) Solve using Laplace Transform $(D^2 + 2D + 5)y = e^{-t} sint$, [8]

when $y(0) = 0, y'(0) = 1$

Q5) a) Find inverse Laplace Transform using convolution theorem for [6]

$\frac{1}{(s-a)(s+a)^2}$

b) Prove that $J_3(x) + 3J_0(x) + 4J_0'''(x) = 0$ [6]

c) Obtain the complex form of Fourier Series for $f(x) = e^{ax}$ in $(-l, l)$ [8]

Q6) a) Using Green's Theorem in the plane evaluate $\oint (x^2 - y)dx + (2y^2 + x)dy$ around the boundary of the region defined by $y = x^2$, $y = 4$ [6]

b) Show that the map of real axis of the Z-plane is a circle under the transformation $w = \frac{2}{z+i}$. Find its centre and the radius. [6]

c) Find Fourier Integral Representation for [8]

$$f(x) = \begin{cases} 1 - x^2 & for\ |x| \le 1 \\ 0 & for\ |x| > 1 \end{cases}$$

(3 Hours) **(Total 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 **five** questions.
3) **Figures** to the **right** indicate **full marks**.
4) Assume suitable **data** if **necessary** and **mention the same** in **answer sheet**.

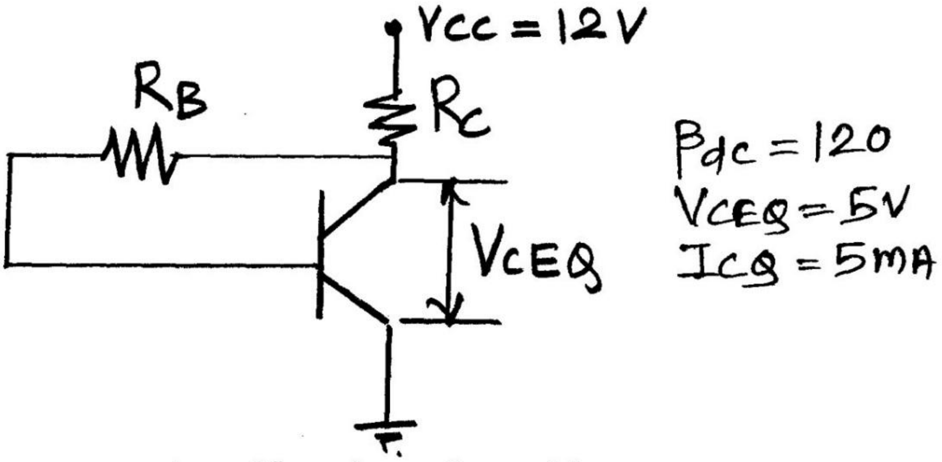
1. Attempt **any Four** questions : **(20)**

a) Explain Various types of Resistors.

b) Give the equation for the current in semiconductor diode. With the help of this equation explain in detail the V-I characteristics of a semiconductor diode.

c) Explain Zener as a Voltage regulator.

d) Find Values for R_B and R_C :



e) Compare BJT CE Amplifier and JFET CS Amplifier.

f) Draw and explain high frequency model of BJT for CE configuration.

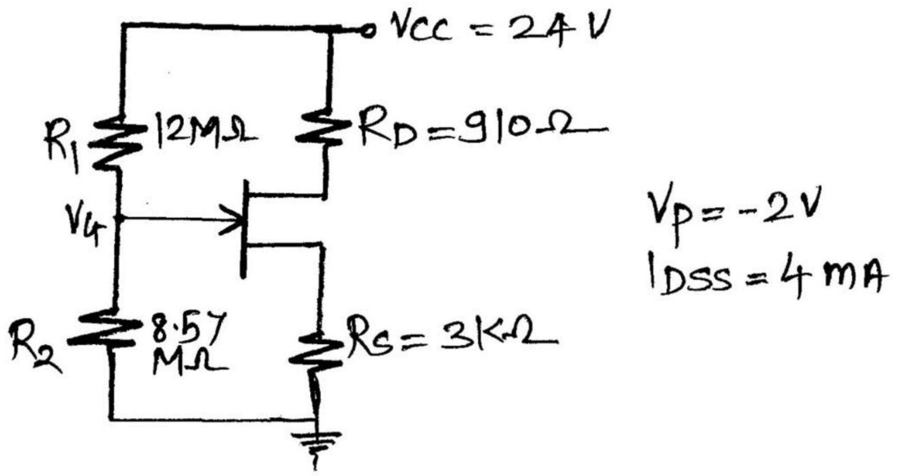
2. Design a single stage CE amplifier suitable for low frequencies up to 10Hz to give voltage gain Av 70 and the output voltage of 4.5 Volts; employing transistor type BC147A.Calculate the expected Av and maximum output voltage with negligible distortion that can be obtained from the designed circuit. Also, calculate the input resistance of the amplifier. Specify clearly the supply voltage Vcc for the designed circuit. **(20)**

3. a) A dc voltage of 350 Volts with peak ripple voltage not exceeding 5 Volts is required to supply a 500 Ω load. Determine following if inductor filter and full wave rectifier is used **(10)**

1) Inductance required
2) Input voltage required.

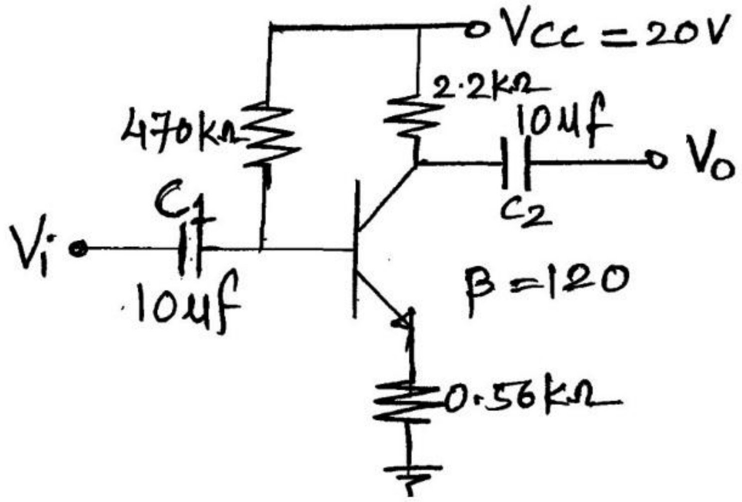
b) Explain and derive the expression for ripple factor for capacitor filter with full wave rectifier. **(10)**

4. a) For the circuit shown below determine I_{DQ} and verify if the FET will operate in pinch off region : **(10)**



b) State and explain Miller theorem. **(10)**

5. a) Determine Zi ,Zo and A v for the circuit shown below : **(10)**



b) Draw small Signal hybrid parameter equivalent circuit for CE amplifier and define the same .What are the advantages of h-parameters? **(10)**

6 Write short note on : **(20)**

a) Hybrid Parameter
b) Regions of operation of FET
c) Stability factor of biasing circuits
d) DC load line concept in BJT. Why Q point should be at the middle of load line and fixed?

Transistor type	$P_{d}max$ @ 25°C Watts	$I_{c}max$ @ 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_{EBO} 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_{jc} °C/W	Derate above 25°C W/°C
2N 3055	115·5	15·0	1·1	100	60	70	90	7	200	20	50	70	15	50	120	1·8	1·5	0·7
ECN 055	50·0	5·0	1·0	60	50	55	60	5	200	25	50	100	25	75	125	1·5	3·5	0·4
ECN 149	30·0	4·0	1·0	50	40	—	—	8	150	30	50	110	33	60	115	1·2	4·0	0·3
ECN 100	5·0	0·7	0·6	70	60	65	—	6	200	50	90	280	50	90	280	0·9	35	0·05
BC147A	0·25	0·1	0·25	30	45	50	—	6	125	115	180	220	125	220	260	0·9	—	—
2N 525(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	θja
BC 147A	2·7 K Ω	18μ ℧	$1·5 \times 10^{-4}$	0·4°C/mw
2N 525 (PNP)	1·4 K Ω	25μ ℧	$1·2 \times 10^{-4}$	—
BC 147B	4·5 K Ω	30μ ℧	2×10^{-4}	0·4°C/mw
ECN 100	500 Ω	—	—	—
ECN 149	250 Ω	—	—	—
ECN 055	100 Ω	—	—	—
2N 3055	25 Ω	—	—	—

BFW 11—JFET MUTUAL CHARACTERISTICS

$-V_{GS}$ 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
I_{DS} 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
I_{DS} 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
I_{DS} 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} (typical)	$-V_p$ Volts	r_d	Derate above 25°C	θ_{ja}
2N3822	50	50	50	300 mW	175°C	2 mA	3000 μ ℧	6	50 KΩ	2 mW/°C	0·59°C/mW
BFW 11 (typical)	30	30	30	300 mW	200°C	7 mA	5600 μ ℧	2·5	50 KΩ	—	0·59° C/mW

Time: 3 Hours **Max Marks: 80**

N:B: 1. Question No. 1 is compulsory.
2. Out of remaining questions, attempt any three questions.
3. Assume suitable additional data if required.
4. Figures in brackets on the right hand side indicate full marks.

Q.1 (A) The Gray code for decimal number 6 is equivalent to **(01)**
i) 0100 ii) 0001
iii) 0101 iv) 0110
Prove it. **(04)**

(B) Which of the following is correct statement: **(01)**
i) PLA contains a fixed AND array and a programmable OR array.
ii) PLA contains a programmable AND array and a programmable OR array.
iii) PAL contains a fixed AND array and a programmable OR array.
iv) PAL contains a programmable AND array and a programmable OR array.
Draw the structure of correct statement. **(04)**

(C) Which of the following expression is equivalent to $Z = A\overline{B} + C$ where A represents MSB and C represents LSB of the binary numbers? **(01)**
i) $Z = \sum m(0, 2, 6)$. ii) $Z = \Pi M(1, 3, 4, 5, 7)$.
iii) $Z = \sum m(1, 3, 4, 5, 7) + d(6)$. iv) $Z = \Pi M(0, 2, 6)$.
Prove it. **(04)**

(D) A single 4-bit magnitude comparator IC 7485 can compare maximum **(01)**
i) two 4-bit numbers ii) two 5-bit numbers
iii) two 8-bit numbers iv) two 10-bit numbers
Draw its corresponding diagram **(04)**

Q.2 (A) Implement the following Boolean equation using single 4:1 MUX and few logic gates: $F(A, B, C, D) = \sum m(0, 2, 5, 6, 7, 9, 12, 15)$. **(10)**

(B) Write the VHDL code for Fibonacci Series Generator sequential circuit. **(10)**

Q.3 (A) Design synchronous counter using D type flip flops for getting the following sequence: 0 → 2 → 4 → 6 → 0. **(10)**
Take care of lockout condition.
(B) Compare SRAM with DRAM. **(05)**
(C) What are the Universal Gates? Why are they so called? Design any one Basic Logic Gate using only Universal Gates. **(05)**

Q.4 (A) Draw a neat circuit of BCD adder using IC 7483 and explain. **(10)**
(B) Using Quine Mc'Clusky method, minimize the following: **(10)**
$F(A, B, C, ,D) = \sum m(0, 3, 5, 7, 8, 11, 13, 15)$.

Q.5	(A)	With neat diagram, explain the working of Universal Shift Registers. Give its applications.	**(10)**
	(B)	Analyze the circuit given in Figure 5(B). Assume initial state as A=0, B=0. Complete a state table that shows the behavior of this state machine. Is this a Moore or Mealy machine? (Explain with a sentence)	**(10)**

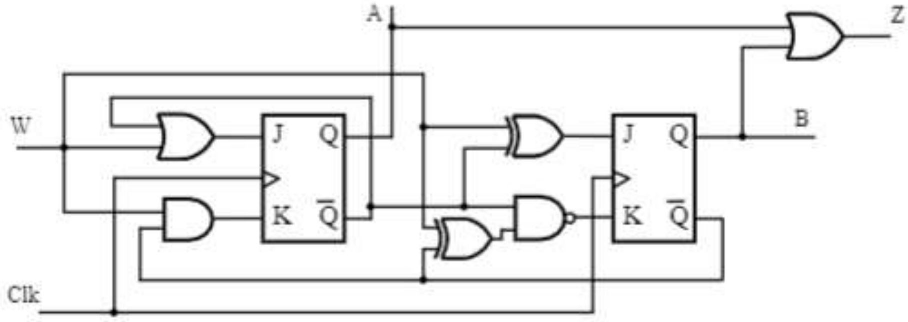


Fig. 5(B)

6.	(A)	Convert T type flip flop into D type flip flop.	**(05)**
	(B)	Compare Moore with Mealy circuits.	**(05)**
	(C)	Compare PAL with PLA.	**(05)**
	(D)	Compare FPGA with CPLD.	**(05)**

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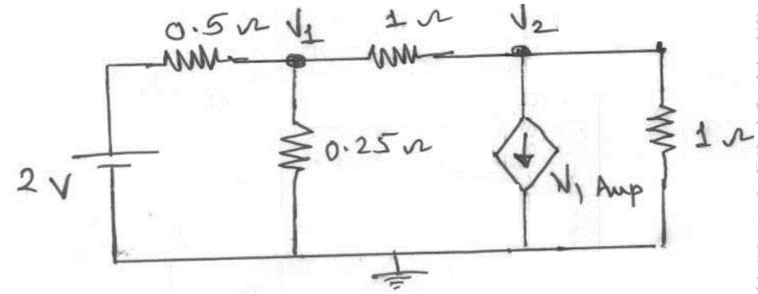
[Time: 3 Hours] **[Total Marks: 80]**

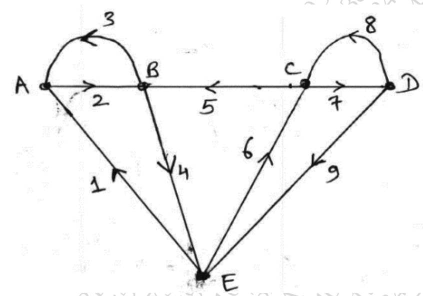
N.B.: **1. Question no.1 is compulsory.**

2. Attempt any three from remaining 5 questions.

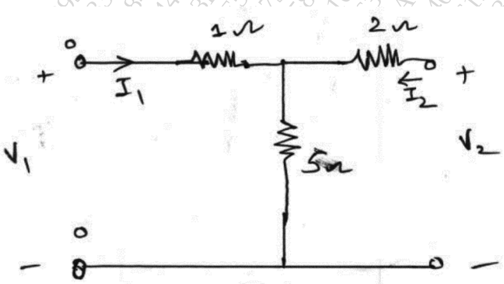
Q1 **a)** Determine the node voltages V1 and V2 by Nodal Analysis. **5**



b) Find incidence Matrix (A) for the graph shown in figure. **5**



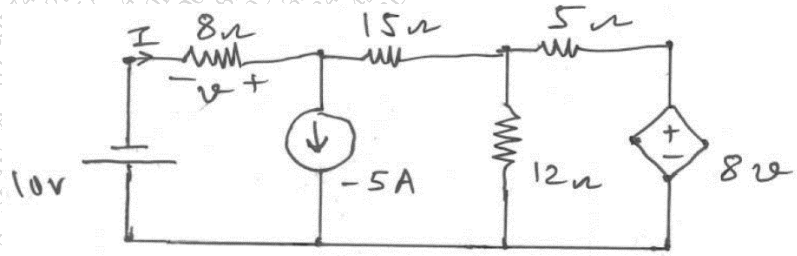
c) Find the transmission parameters [A, B, C, D] for the network shown in the fig. **5**



d) Test whether F(s) is a positive real function **5**

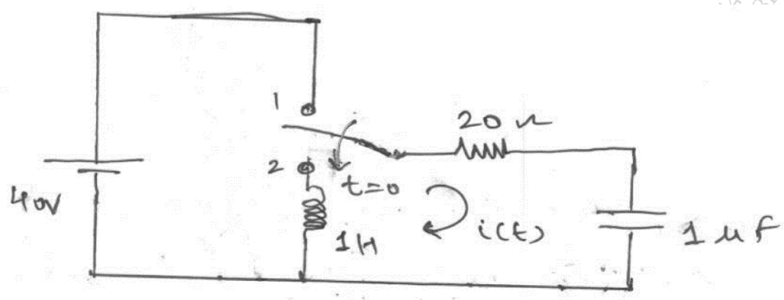
$$F(s)=\frac{s^3+6s^2+7s+3}{s^2+2s+1}$$

Q2 **a)** Find the current 'I' in 8Ω resistor by superposition theorem. **10**

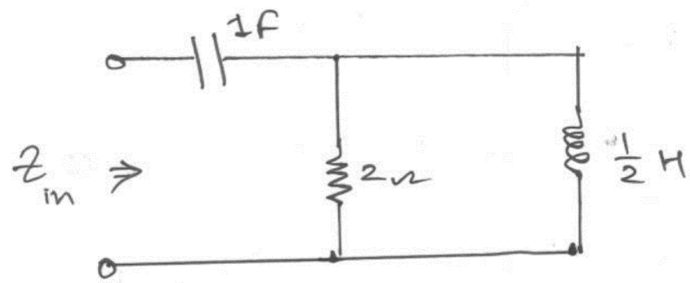


b) The switch in the circuit shown is changed from position '1' to position '2' at t=0. Steady state conditions having reached before switching. Find the values of **5**

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



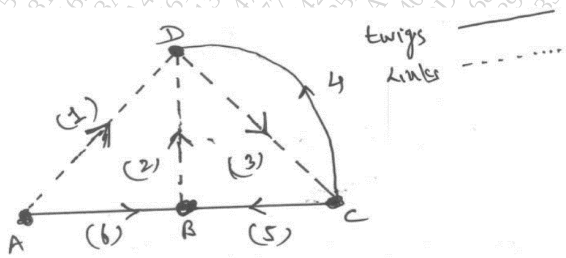
c) Determine the driving point impedance function $z_{in}(s)$ for the Network shown in fig. and also draw pole-zero plot. **5**



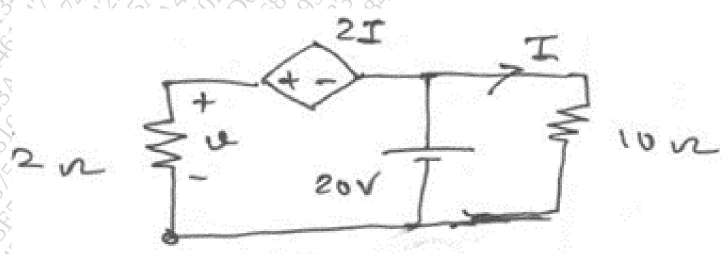
Q3 a) Synthesize z(s) into Foster -1 and cauer-1 forms. **10**

$$z(s) = \frac{s^2 + 12s^2 + 32s}{s^2 + 7s + 6}$$

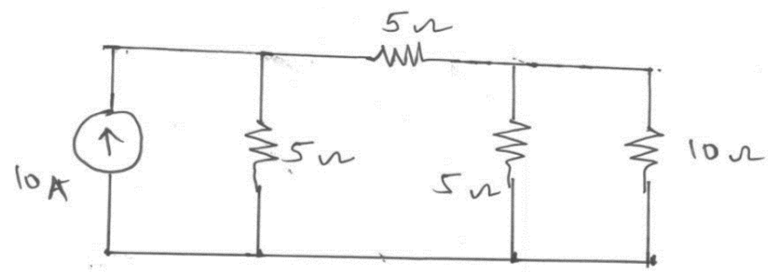
b) Determine f-loop matrix for the graph shown in fig. **5**



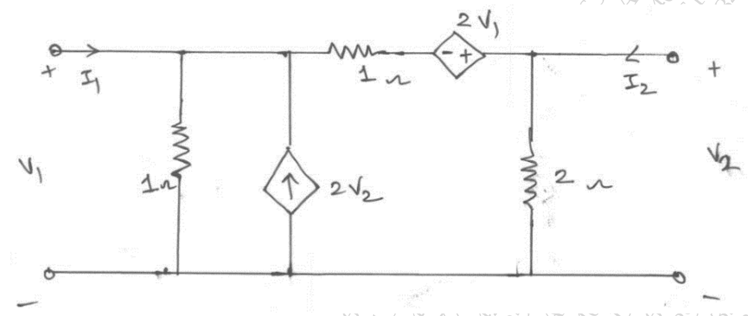
c) Find voltage across 2Ω resistor. **5**



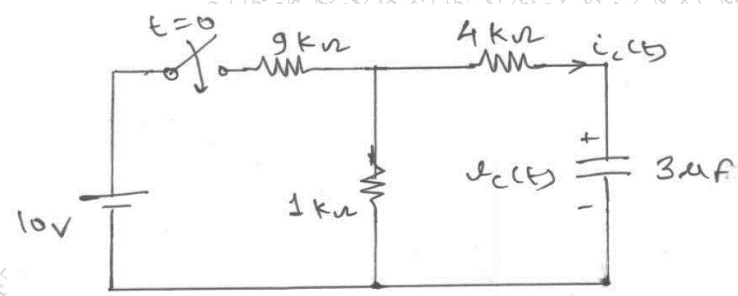
Q4 a) Write f-cut set matrix for the circuit shown and hence obtain matrix Node equation using Graph Theory. **10**



b) For the Network shown in the figure determine z and y parameters. **10**



Q5 a) In the figure shown the switch is closed at t=0 with no initial charge on the capacitor. Determine $v_c(t)$ and $i_c(t)$ for $t \geq 0$ **10**

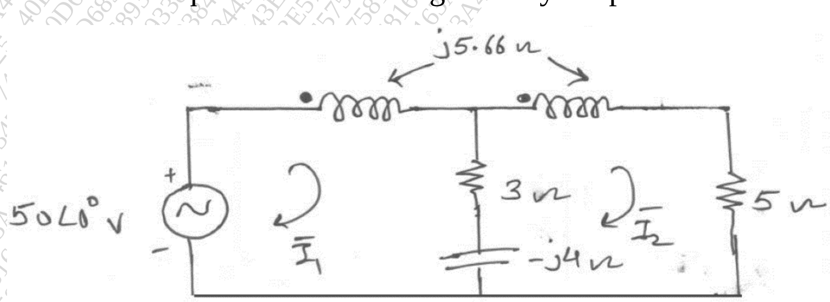


b) Test the following for Hurwitz polynomial **5**

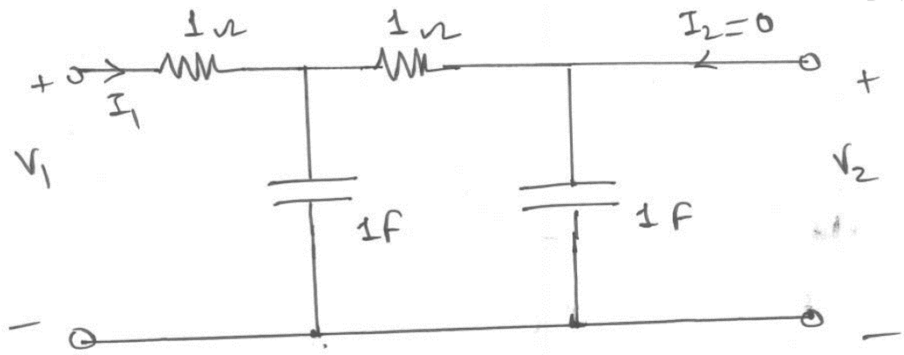
i. $P(s) = s^6 + 3s^5 + 8s^4 + 15s^3 + 17s^2 + 12s + 4$

ii. $P(s) = s^5 + s^3 + s$

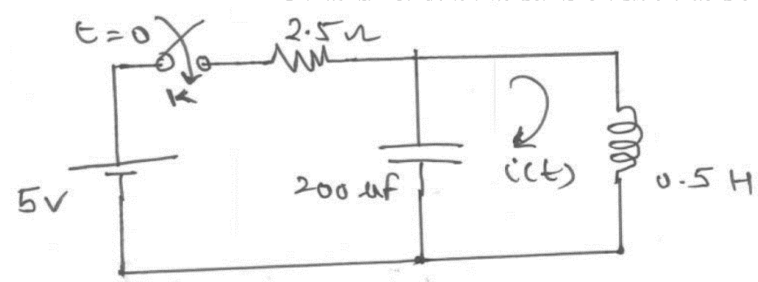
c) Write Mesh equations for the magnetically coupled circuit shown in fig. **5**



Q6 a) Determine $\frac{V_2}{I_1}$, $\frac{V_2}{V_1}$ for the network shown in the figure. **10**



b) For the circuit shown in the figure, the switch 'K' is closed at t =0 and steady state is attained before closing the switch. By using 'Laplace Transform' techniques determine i(t) for t ≥ 0. **5**



c) Derive the condition of Reciprocity and symmetry for ABCD parameters. **5**

(3hours) Marks:80

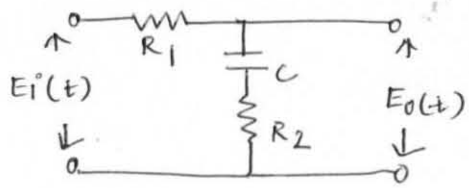
N.B:

(1) Attempt **four** questions, question **no:1** is Compulsory.
(2) Assume suitable data wherever required.
(3) Answers to the questions should be grouped together.
(4) Figure to the **right** of question indicates **full** marks.

1. Attempt **all:** **20M**

(a) Derive an expression for the resistance using Wheatstone bridge for balanced condition

(b) Find the transfer function of the given electrical network



(c) Explain various criteria for selection of transducers

(d) Compare analog and digital Data Acquisition system.

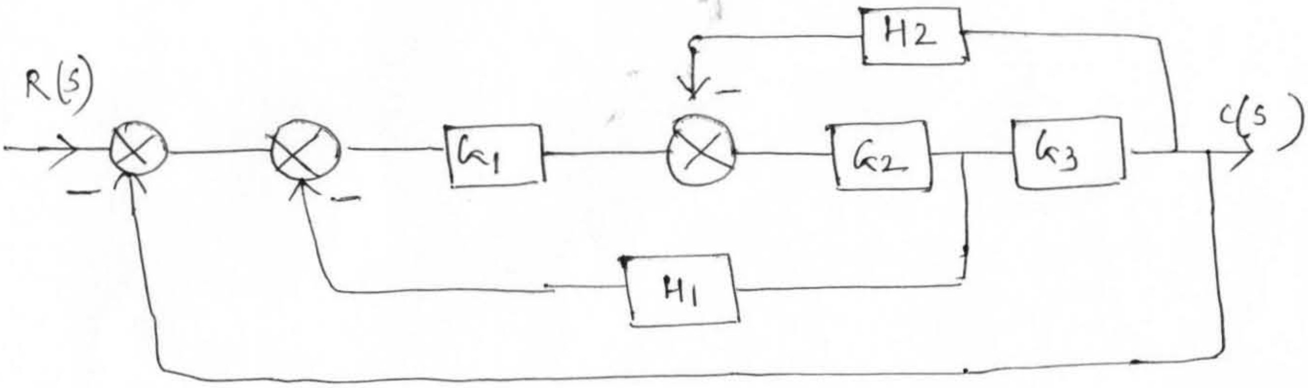
(e) Check whether the given system is stable

$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 15 = 0$

2.

(a) Describe how Q meter is used for measurement of low impedance. Also List the various sources of errors in Q meter. **10**

(b) Using Block diagram reduction techniques, find closed loop transfer function **10**



3

(a) Sketch the root locus of a unity feedback control system with $G(s) = \frac{K}{s(s+4)(s+6)}$ and determine the value of k for marginal stability **10**

(b) A Unity feedback control system has $G(S) = \frac{10}{s(1+0.4s)(1+0.1s)}$, H(s)=1 **10**

Draw the bode plot and predict stability

4

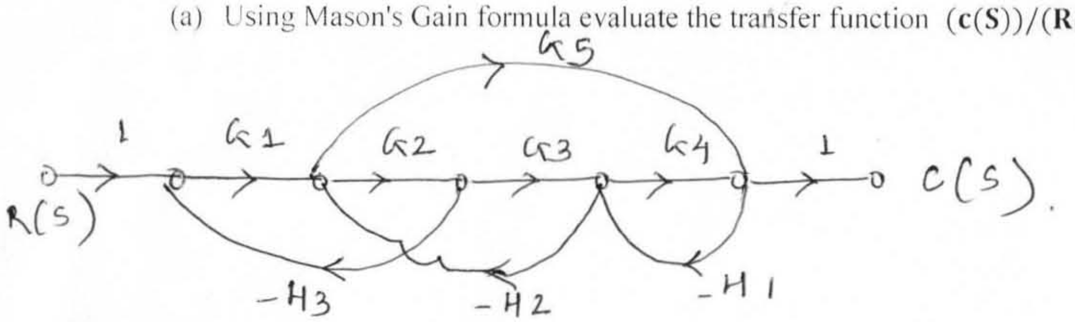
(a) Explain basic telemetry system. **05**

(b) For Unity Feedback system $G(s) = \frac{k}{s(1+0.4s)(1+0.25s)}$, find range of K ,marginal value of K and frequency of sustained oscillation . Using Routh's criterion. **05**

(c) Explain with neat diagram working principle of LVDT and Explain advantages and disadvantages of LVDT **10**

5

(a) Using Mason's Gain formula evaluate the transfer function $(\mathbf{c(S)})/(\mathbf{R(s)})$ **10**



(b) Explain Kelvin's double Bridge and its application for measurement of low resistance and derive expression for unknown resistance. **10**

6

(a)

(i) Compare the temperature transducers with respect to their characteristics and measurement range **05**

(ii) How stability of the system can be analyzed using Nyquist criterion **05**

(iii) Explain Digital Data Acquisition system **05**

(iv) A unity feedback systemhas open loop transfer function as $\frac{(1+0.4s)}{s(s+0.6)}$. Obtain Unit step Response, Rise Time and Peak overshoot **05**

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