Q.P. Code: 25012

(3 Hours) *Total Marks :80*

Note: 1) Question No.1 is compulsory
2) Attempt any Three from the remaining

Q1

A) Evaluate using Laplace transform $\int_0^t e^{-\sqrt{2}\,t}\ \frac{sintSinht}{t}\,dt$ 5

B) Prove that f(z) = z^n is analytic hence find f′(z) 5

C) Find a Fourier series to represent f(x) = $\sqrt{1-cosx}$ in (-π , π) . 5

D) Find f(r) ,so that f(r)$\bar{r}$ is solenoidal 5

Q2

A) Find analytic function f(z)=u+iv ,if u = e^x(xcosy –ysiny) 6

B) Find the Bilinear transformation which maps the points z = ∞ , i , 0 onto the points w = 0, i ,∞ 6

C) Obtain the fourier series for f(x) = $\begin{cases} 2\pi - x & , \ \pi < x < 2\pi \\ x & , \ 0 < x < \pi \end{cases}$ 8

With period Hence deduce that $\frac{\pi^2}{96} = \frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \ldots\ldots$

Q3

A) Find inverse Laplace transform of (i) $\log(\frac{s^2+a^2}{s^2+b^2})$ (ii) $\frac{e^{-2s}}{s^2+8s+25}$ 6

B) Find Complex form of Fourier Series of e^{ax} in (-a , a) 6

C) Verify Greens Theorem for $\int_C (x^2 - y)dx + (2y^2 + x)dy$ where C is the closed curve of the region bounded by y = 4 and y = x^2 8

Q4

A) Prove that $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\,.\,sinx$ 6

B) Use Gauss's Divergence theorem to evaluate $\iint_S \bar{N}.\bar{F}ds$ where $\bar{F}$=x^2i+zj +yzk and S is the surface of the cube bounded by x=0 ,x=1,y=0 ,y=1,z= 0 ,z=1 6

C) Solve using Laplace transform(D^2 +2D+5)y =e^{-t} sint ,given y(0)=0 and y′(0)=1 8

Q5

A) Find half range sine series for f(x)=x(π-x) in (0 , π) Hence find value of $\sum \frac{(-1)^n}{(2n-1)^3}$ 6

B) Find the image of |z|<1 under the bilinear transformation w = $\frac{i-z}{z+i}$ also find the fixed point. 6

c) Prove that y =x^{-n}.J_n(x) is a solution of the equation , 8

$x\frac{d^2y}{dx^2}$ +(1+2n)$\frac{dy}{dx}$ + xy = 0

Q6

A) Find the directional derivative of $\emptyset = x^2 y\cos z$ at $(1, 2, \frac{\pi}{2})$ in the direction of $(2i + 3j + 2k)$ 6

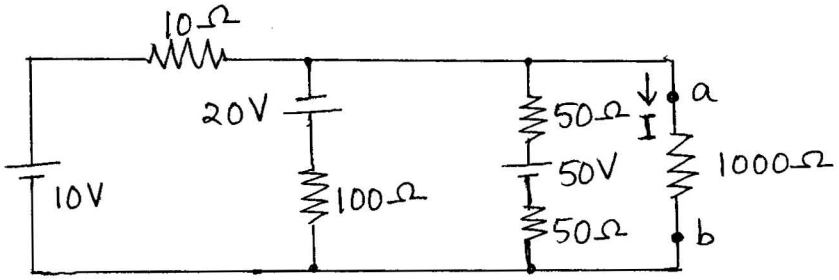
B) Find inverse Laplace transform of $\frac{1}{(s^2+4s+13)^2}$ using convolution theorem 6

C) Express the function $f(x) = \begin{cases} -e^{kx} & , \quad x < 0 \\ e^{-kx} & , \quad x > 0 \end{cases}$ as Fourier integral .Hence evaluate $\int_0^\infty \frac{w.sinwx}{w^2+k^2}\, dw$ 8

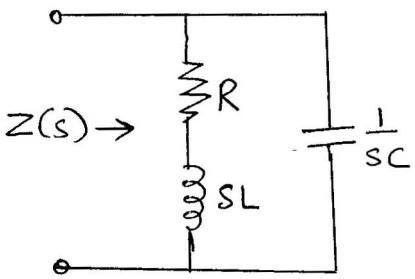
(3 Hours) Total Marks: 80

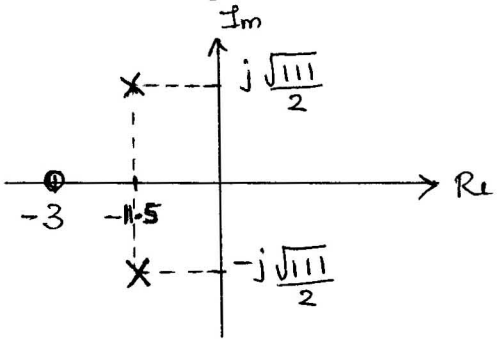
NB: (1) Question **No. 1** is compulsory.
(2) Attempt any **three** questions from the remaining.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if required.

1. (a) By constructing Millman's equivalent voltage source at the left of terminals *a* and *b* in the given circuit, find the current *I*. **(5)**



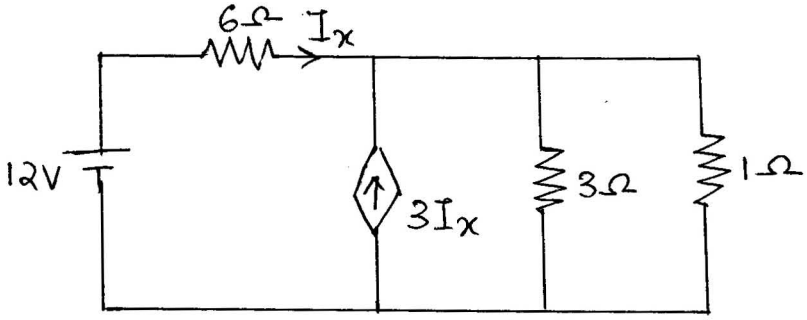
(b) A network and its pole zero diagram are shown in the figure. Determine the values of R, L, C if Z(0)=1. **(5)**





(c) Obtain *Z*- parameters in terms of *ABCD* parameters. **(5)**
(d) Explain various types of filters. **(5)**

2. (a) Find the current through the 1 Ω resistor in the given network **(8)**



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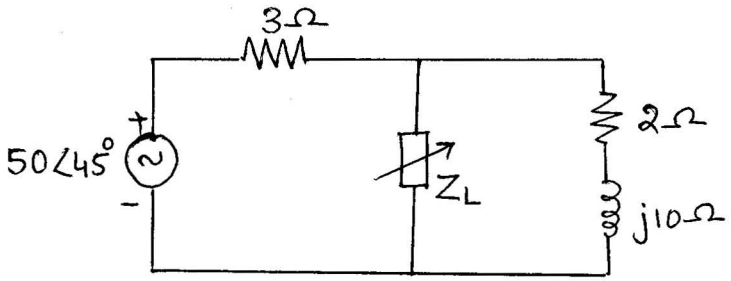
(b) Find the value of load impedance Z_L so that maximum power can be transferred to it in the network of figure. Find maximum power. **(6)**

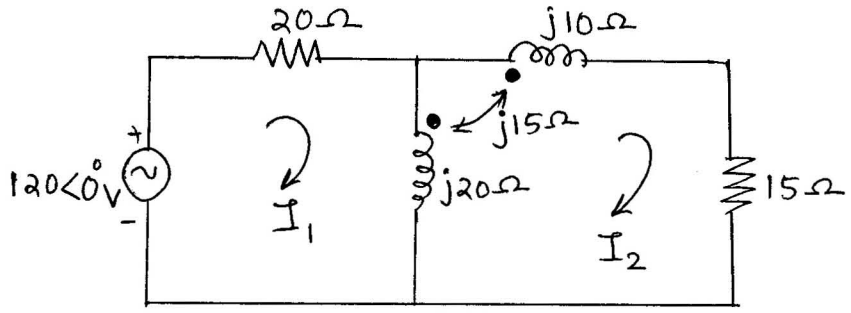


(c) Design a constant-k low-pass *T* and π section filters having cut-off frequency of 4kHz and nominal impedance of 500 Ω. **(6)**

3. (a) Check whether the following polynomials are Hurwitz polynomials: **(10)**

(i) $F(s) = s^4+s^3+4s^2+2s+3$
(ii) $F(s) = (s+2)^3$

(b) Find the voltage across the 15 Ω resistor in the given network using mesh analysis. **(10)**

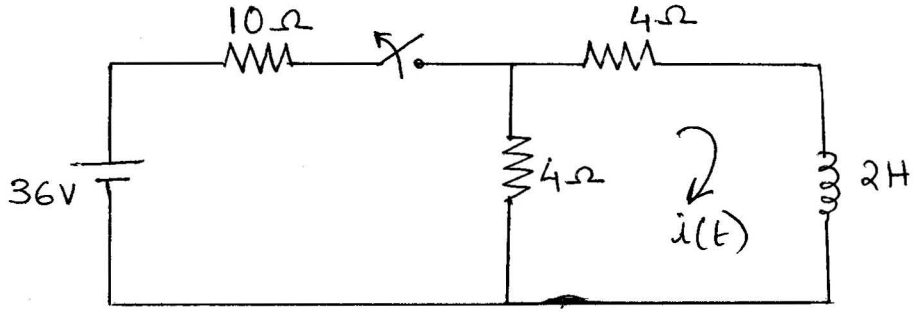


4. (a) Test whether the following functions are positive real functions: **(10)**

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

(ii) $F(s)=\dfrac{s(s+3)(s+5)}{(s+1)(s+4)}$

(b) The network shown in figure has attained steady state with the switch closed for $t < 0$. At $t=0$, the switch is opened. Obtain $i(t)$ for $t > 0$. **(10)**



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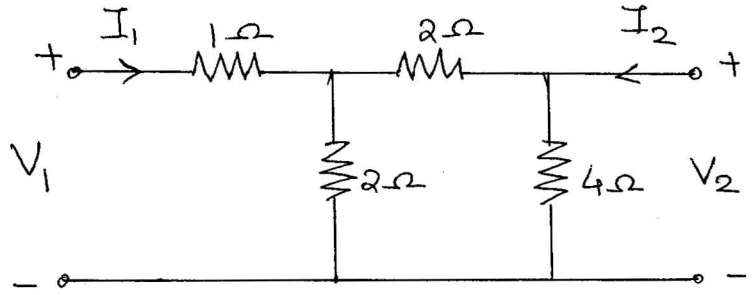
5. (a) Realize Cauer Form I and Cauer Form II of the following LC impedance function. **(8)**

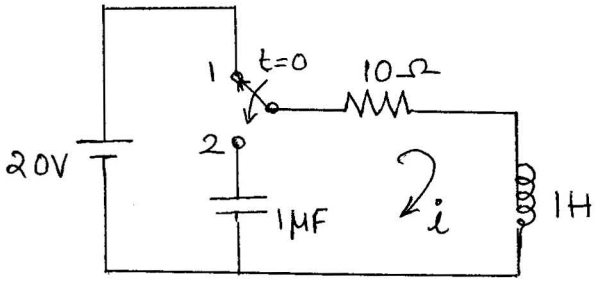
$$Z(s)=\frac{(s+1)(s+3)}{s(s+2)}$$

(b) Determine *Y*-parameters for the circuit given in figure. **(6)**

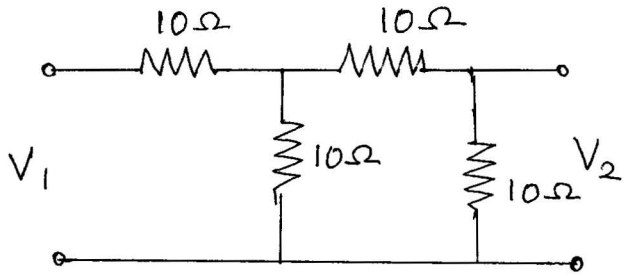


(c) The voltage V(s) of a network is given by $V(s)=\frac{3s}{(s+2)(s^2+2s+2)}$. Plot its pole-zero diagram and hence obtain v(t). **(6)**

6. (a) In the circuit given, switch is changed from position *1* to position *2* at time *t=0*. Find *i*, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at time $t=0^+$. **(10)**



(b) Find the transmission parameters of the resulting circuit when both are in cascade connection. **(10)**



Time :- 03 Hours **Max. Marks :- 80**

(i) Question No. 1 is compulsory & attempt any three out of the remaining five questions.
(ii) Assume suitable data if required but justify it logically wherever applicable.
(iii) Figures to the right indicate full marks & every sub-question from Q.2 to Q.6 have equal weightage and have 10 marks each.

Q.1 **ATTEMPT ANY FOUR (04) :-** **20**

a) Explain precision and resolution for electronic equipments.
b) Draw a neat circuit diagram of LCR – Q meter & explain its operating principle.
c) Explain specifications of dual trace and dual beam CRO.
d) Describe operating principle of harmonic distortion analyzer with a neat block diagram.
e) With a neat diagram, explain the principle of digital time measurement.

Q.2 (a) A set of independent current measurements were recorded as 10.03,10.10,10.11,10.08 A .Calculate a)Average current b) Range of error. **20**

(b) List and discuss operation and applications of Kelvin bridge

Q.3 (a) Draw the block diagram of CRO and explain its operation. State specifications of CRO. **20**

(b) Explain how Lissajous patterns / figures are used for measurement of an unknown frequency & phase shift using a cathode ray oscilloscope (CRO).

Q.4 a) Draw the circuit diagram and explain the operation of bridge used to measure capacitance. **20**

b) Explain various features of digital storage oscilloscope.

Q.5 (a)Draw the neat diagram and explain the operation of dual slope type DVM.

(b) In a food processing unit, a highly acidic solution is stored in a storage tank where its level has to be continuously monitored round the clock. Your supervisor suggests that due to highly acidic nature of the solution, a non-contact transducer should be used for the level measurement. Which transducer will you use for above application? Describe its operation with a neat diagram. **20**

Q.6 (a)Draw the diagram and explain the operation of Rotameter.

(b)Explain the operation of linear variable differential transformer. What is residual voltage? **20**

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

N.B: (1) Question No.1 is compulsory.
(2) Solves any three out of remaining question.
(3) Assume suitable data if necessary.

Q.1 Solve **any Four**

a. Draw characteristics of PN junction in thermal equilibrium and explain. **05**

b. For a BJT amplifier, show with the help of a voltage divider bias circuit, how to draw A.C. load line? Draw graph. **05**

c. Explain the operation of MOSFET as amplifier. **05**

d. Explain construction, working principle and characteristics of Photodiode. **05**

e. Compare HWR, FWR and Bridge rectifier. **05**

Q.2 a. Draw and explain positive and negative clamper circuit. **10**

b. Explain common base configuration of BJT as an Amplifier. **10**

Q.3 a. Draw and explain VI and CV characteristics of P-channel enhancement type MOSFET with symbol. **10**

b. Explain operation and characteristics of Schottkey diode. **10**

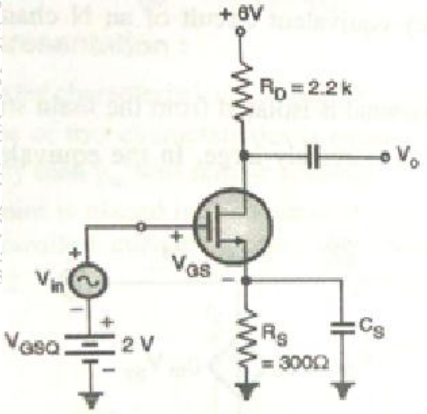
Q.4 a. Explain the operation of fullwave rectifier and draw the output waveform for V_{Ldc} and I_{Ldc}. **10**

b. Explain working of BJT considering all possible current density components in an NPN transistor operation in active mode. **10**

Q.5 a. Design single stage RC coupled amplifier to give a voltage gain of 80 with stability factor better than 11 and output voltage of 3 Vrms. Use NPN transistor with specifications h_{fe} – 110-800, h_{ie} =4.5 kΩ, V_{CE}=45 V, $I_{c(max)}$ =100 mA, f_L=300Hz, V_{CC} = 18V. **15**

b. Draw small signal model of PN junction diode. What is the main use of this model? **05**

Q.6 a. What is the small signal voltage gain of the MOSFET amplifier shown in diagram, if V_T = 1 V, K = 0.82mA/V^2 and λ = 0.022/V. **10**



b. Explain hybrid model of BJT. **10**

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	D.C. current gain typ.	D.C. current gain max.	Small Signal h_{fe} min.	Small Signal h_{fe} typ.	Small Signal h_{fe} 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	50	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 ℧	$3·2 \times 10^{-4}$	—
BC 147B	4·5 K Ω	30μ ℧	2×10^{-4}	0·4°C/mw
ECN 100	50 Ω	—	—	—
ECN 149	15 Ω	—	—	—
ECN 055	12 Ω	—	—	—
2N 3055	6 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