B.E. Electronics & Telecommunication

SEM III

Con. 3015-10. Electronic Instrumentation AN–2542

(3 Hours) [Total Marks : 100

N. B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from remaining **six** questions.
(3) Assume data if **required** but justify the **same**.

1. Answer any **four** questions:— **20**
   (a) Explain the functions of delay line in CRO.
   (b) What are the criteria for selection of a transducer ?
   (c) What are the various sources of error in a Q-meter ?
   (d) Which is the fastest ADC and why ?
   (e) A voltmeter reading 70 V on its 100 V range and an ammeter reading 80mA on its 150mA range are used to determine power dissipated in a resistor. Both these instruments are guaranteed to be a accurate within ± 1·5% at full scale deflection. Determine the limiting error of power.

2. (a) How does a Digital Storage oscilloscope differ from a conventional CRO using storage CRT. Explain the principle and block diagram of DSO. **10**
   (b) A 4½ digit voltmeter is used for voltage measurement. Find the resolution. How would values 12·98 V and 0·6973 displayed on 10 V ranges. **6**
   (c) Write a short note on Automatic Test Equipment. **4**

3. (a) What is the need of modulation in data transmission? Explain with waveforms the various digital modulation techniques. **10**
   (b) Explain the function of timebase generator in a CRO. **6**
   (c) A stream gauge with a gauge factor of 2 is fastened to a metallic member subjected to a stress of 1000 kg/cm^2. The modulus of elasticity of metal is 2 x 10^6 kg/cm^2. Calculate the percentage change in resistance of strain gauge. What is the value of Poisson's ratio. **4**

4. (a) Explain the operation of 4 bit R-2R type of DAC. Derive the expression for output voltage. **10**
   (b) Explain the basic telemetry system and its applications in instrumentation. **6**
   (c) In a CRT the anode to cathode voltage is 2500 V. The parallel deflection plates are 1·5 cm long and spaced 5mm. The screen is 50cm from the centre of the deflecting plates. If mass of electron is 9·109 x 10^{-31}kg and charge of electron is 1·602 x 10^{-19} C fuid— **4**
      (i) Beam speed
      (ii) Deflection Sensitivity.

5. (a) What is a True RMS meter and how does it deffer from a DMM. Explain the principle and working of a true RMS meter with a thermocouple. **10**
   (b) What is the principle of piezoelectric transducer. What are the materials used in these transducers. Give the merits, demerits and applications. **6**
   (c) Write a short note on data loggers. **4**

[TURN OVER

6. (a) What is the advantage of taking a differential output from an inductive transducer. Explain the performance characteristics and its applications. The output of LVDT is connected to 4 V voltmeter through an amplifier whose amplification factor is 500. An output of 1·8mV appears across the terminals of LVDT when the core moves through 0·6 mm. If the mV scale has 100 divisions and can be read to ¼ of division, Calculte the sensitivity and resolution of LVDT. 10

(b) What is meant by network analysis. Explain the analogy of two port linear networks with microwave networks. 6

(c) Explain the lissajous method for frequency and phase measurement. 4

7. (a) What is the basic principle of wave analyzer. Explain the heterodyne wave analyzer with applications. 10

(b) A dual slope ADC uses 16 bits counter and a 4MHz clock rate. The maximum input voltage is +10 V. The maximum integrator output voltage should be 8V when counter cycled through 2^n counts. If the capacitor of 0·1μF is used, find the value of resistor of integrator. 6

(c) Write a short note on eddy current sensor. 4

S.E. Electronics & Telecom SEM III
Electronics Devices & Circuits - I.

Con. 3150–10. AN–2536

(3 Hours) [Total Marks : 100

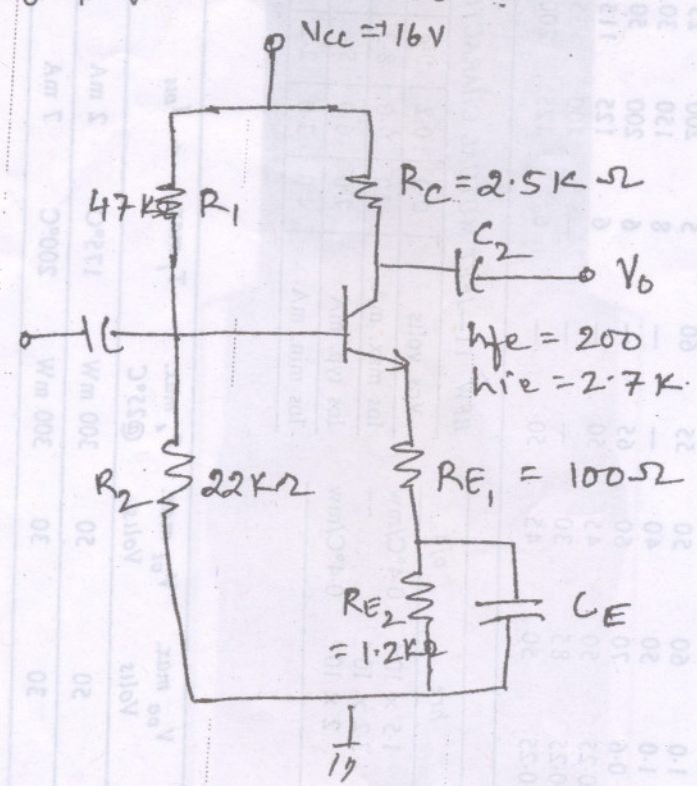
N.B. : (1) Question No. **1** and **2** is **compulsory**.
(2) Out of remaining questions attempt any **three** questions.
(3) In **all five** questions to be attempted.
(4) **Figures** to the **right** indicate **full** marks.

1. Design a single stage R-C coupled CE amplifier for low frequency range 10 Hz to 20 KHz to give voltage gain $|Av| \geq 100$ with stability factor $S \leq 10$ and ouput voltage $V_0 = 2{\cdot}5$ V(rms). Use BC 147 B and specify V_{cc} required. Calculate A_v, R_i, R_o of designed circuit. **20**

2. (a) Design an R–C coupled CS amplifier using FETBW–II to meet the following specifications $|A_V| \geq 15$, $I_{DSQ} = 1{\cdot}2$ mA, $F_v \leq 20$ Hz, $V_o = 2{\cdot}5$ V, $R_i \geq 1$ M ohm. **15**
(b) A certain JFET has $I_{DSS} = 15$ mA and pinch off voltage $V_P = -5$V. Calculate value of transconductance for $V_{GS} = -2$V. **5**

3. (a) For full wave rectifier with center tapped transformer (15–0–15) rms, 50 Hz, $R_1 = 20\ \Omega$ **15**
(i) Find V_{dc}, I_{dc} and ripple factor.
(ii) Repeat part 1 if 100 mH inductor is present in series with load.
(iii) Repeat part 1 if 20 μF is considered and is shunted across the load.
(b) Draw UJT equivalent circuit and explain UJT characteristic curve. **5**

4. (a) Find Z_o, Z_i, A_v, Ai for the network given : **15**



(b) Explain the concept of zero Temperature drift in JFET. **5**

... output voltage is 15V and load resistance **10**

(b) Explain the concept of zero Temperature drift in ...

5. (a) For a shunt zener regulators giving output voltage is 15V and load resistance varying from 10 KΩ to 15 KΩ. V_{in} is varying between 20 to 24 V. Find : **10**

(i) R series resistance (iii) S_v

(ii) P_2(max) (iv) R_o.

Take $R_2 = 8\Omega$ $I_{2(min)} = 50\ \mu A$

(b) Explain the concept of Thermal runaway in BJT. **5**

(c) Explain Latching current and holding current in SCR. **5**

6. (a) Explain various methods of biasing JFET and MOSFET. **15**

(b) Describe four ways an SCS can be turned off. **5**

7. Write short notes on following :– **20**

(a) Compare Diac and Triac (c) Critical inductance in filter

(b) Power MOSFET (d) UJT relaxation oscillators.

[TURN OVER

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 min.	typ.	h_{fe} max.	V_{BE} max.	θ_{fc} °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
IDS 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
IDS 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
IDS 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_{ja}
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_E max. @25°C	I_P peak pulse current max.	V_{B2E} Volts max.	V_{B2B1} Volts	T_j max	η min.	η max.	R_{BB}KΩ min.	R_{BB}KΩ typ.	I_P Max.	I_P max. μA	I_V min.	I_V 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

S.E. Electronics & telecommunication
Sem III / Applied Math III

Con. 3867-10. **(REVISED COURSE)** **AN–2548**

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

N.B. (i) Question **No.1** is compulsory
(ii) Answer any **four** out of the remaining six questions
(iii) Figures to the right indicate full marks

1. (a) Find the Laplace transform of $\int_0^t u\cos^2 u\,du$. [5]

(b) Show that every skew Hermitian matrix can be expressed as $P+iQ$ where P is a real skew symmetric matrix and Q is a real symmetric matrix. [5]

(c) Find the Z transforms of (i) $\delta(n-k)$ where $\delta(k)=\begin{cases}1, & k=0\\ 0 & \text{otherwise}\end{cases}$ and

(ii) $U(k)=\begin{cases}1, & k\geq 0\\ 0 & \text{otherwise}\end{cases}$. [5]

(d) Obtain the Fourier series of

$$f(x)=\begin{cases}0, & -\pi\leq x\leq 0\\ x^2, & 0\leq x\leq \pi\end{cases}$$

where $f(x)$ is periodic with period 2π. [5]

2. (a) Find non-singular matrices P and Q such that the normal form of :–

$$A=\begin{bmatrix}1 & 3 & 6 & -1\\ 1 & 4 & 5 & 1\\ 1 & 5 & 4 & 3\end{bmatrix}$$ is PAQ. What is the rank of A? [7]

(b) Obtain the inverse Laplace transforms of the following:

(i) $\dfrac{3s+7}{s^2-2s-3}$ (ii) $\dfrac{s+2}{(s+3)(s+1)^3}$ [7]

(c) Find the Fourier integral representation of the function :

$$f(x)=\begin{cases}0, & x<0\\ \dfrac{1}{2}, & x=0\\ e^{-x}, & x>0.\end{cases}$$ [6]

3. (a) Find $\int_0^\infty \cos(tx^2)\,dx$ and hence evaluate $\int_0^\infty \cos x^2\,dx$ [7]

(b) Find the inverse Z transform of (i) $(z-5)^{-3}$ when $|z|>5$

(ii) $\dfrac{z^2}{(z-1)(z-\frac{1}{2})}$, for $1/2<|z|<1$. [7]

(c) Define an orthogonal matrix. Is $A=\begin{bmatrix} \cos a\cos b & \sin b & \cos b\sin a \\ -\sin b\cos a & \cos b & -\sin b\sin a \\ -\sin a & \cos a & 0 \end{bmatrix}$ orthogonal? [6]

4. (a) (i) Solve by the Gauss-Jordan method:

$$\begin{aligned} 3x+2y-2z &= 11 \\ x-2y+3z &= -9 \\ 2x+3y+4z &= 0 \end{aligned}$$

(ii) Solve by the Gauss-Seidel method: (Go up to 3 iterations):

$$\begin{aligned} 10x+y+z &= 10 \\ 2x+10y+z &= 11 \\ 2x+2y+10z &= -6. \end{aligned}$$

[3+4]

(b) Obtain the Fourier series of $f(x)=\sqrt{1-\cos x}$ in the interval $(0,2\pi)$.

Deduce that $\frac{1}{2}=\sum_{n=1}^{\infty}\frac{1}{4n^2-1}$ [7]

(c) Find the Fourier transform of: $f(x)=e^{-|x|}$ [6]

5. (a) Find the half-range sine series for $f(x)=\frac{\pi}{4}$ in $(0,\pi)$.

Deduce that

(i) $\frac{\pi}{4}(\frac{\pi}{2}-x)=\frac{1}{1^2}\cos x+\frac{1}{3^2}\cos 3x+\frac{1}{5^2}\cos 5x+\ldots$

(ii) $\frac{\pi}{8}x(\pi-x)=\frac{1}{1^3}\sin x+\frac{1}{3^3}\sin 3x+\frac{1}{5^3}\sin 5x+\ldots$ [7]

(b) Solve using Laplace transforms:

$$\frac{d^2y}{dt^2}-\frac{dy}{dt}-2y=20\sin t,\ y(0)=1 \ \text{and}\ y'(0)=2.$$ [7]

(c) Discuss for what values of λ and μ, the following system of equations :

$$\begin{aligned} x+y+z &= 6 \\ x+2y+3z &= 10 \\ x+2y+\lambda z &= \mu \end{aligned}$$

has (i) no solution (ii) a unique solution and (iii) infinite number of solutions. [6]

6. (a) State the convolution theorem for Z-transforms. Use the theorem to find $Z(h(k))$ where $h(k)$ is the convolution of $f_1(k)=\frac{1}{2^k}$, $k\geq 0$ and $f_2(k) = \cos k\pi$, $k\geq 0$ [7]

(b) (i) Express $f(t)=\begin{cases}2t, & 0<t<1\\ 3t^2 & t>1\end{cases}$ in terms of Heaviside's unit step function and find its Laplace Transform.

(ii) Evaluate using Laplace Transform: $\int_0^\infty e^{-t}(1+2t-t^2+t^3)H(t-1)\,dt$ where $H(t)$ is the Heaviside's unit step function. [7]

(c) Find the Fourier series of $f(x)=x|x|$ in (-1,1). [6]

7. (a) Find the Fourier sine transform of $f(x)=\frac{e^{-ax}}{x}$. Hence evaluate :-

$$\int_0^\infty \tan^{-1}(\frac{x}{a})\sin x\,dx.$$ [7]

(b) Obtain the Laplace transform of (i) $t^2e^t\sin 4t$ (ii) $\frac{\cosh 2t\sin 2t}{t}$ [7]

(c) When do you say that vectors $X_1, X_2, ..., X_n$ are linearly dependent? Are the vectors $X_1=[1\ 3\ 4\ 2]$, $X_2=[2\ -1\ 3\ 2]$, $X_3=[3\ -5\ 2\ 2]$ linearly dependent? [6]

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Con. 3007-10. AN-2539

Digital Logic Design.

(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume **suitable** data if **necessary**.

1. (a) Explain the difference between error detecting codes and error correcting codes. 5
   (b) Determine the value of x, 5
   $(211)_x = (152)_8$.
   (c) Explain D Flip-Flop. 5
   (d) 4-bits magnitude comparator. 5

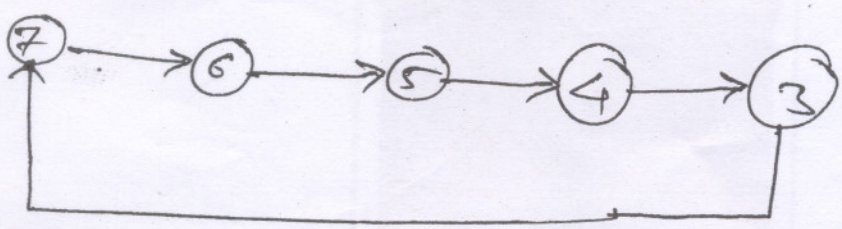
2. (a) Explain interfacing of T.T.L. and CMOS logic families. 8
   (b) Explain parameter's of logic families. 8
   (c) Explain RTL logic family. 4

3. (a) Prove the following using Boolean Theorems :— 6
   (i) $\left[\left(C+\overline{C}D\right)\left(C+\overline{C}\,\overline{D}\right)\right]\left[\left(AB+\overline{A}\,\overline{B}+A\oplus B\right)\right]=C$
   (ii) $\overline{A}BC+A\overline{B}C+AB\overline{C}+ABC = AB+AC+BC$
   (b) Minimise the expression using Quine McCluskey method. 10
   $f(A\ B\ C\ D) = \sum m\ (1, 3, 7, 9, 10, 11, 13, 15)$
   (c) Realise expression using minimum NAND gates only. 4
   $y = A\overline{B}+A\overline{C}+C+AD+A\overline{B}C+ABC$

4. (a) The circuit has four I/ps and two O/ps one of the outputs is to be true when the majority of inputs are false. The other o/p's is true only when there are equal number of true and false in the inputs. Design and implement combinational circuit using NAND gates only. 10
   (b) Implement an even parity checker for a 4 bit data, using 8 : 1 mux and inverters. 10

5. (a) Explain Master slave JK-FF. 10
   (b) Convert T FF to D FF. 10

6. (a) Design ripple counter for state diagram shown. 10



   (b) Explain Johnson counter. 10

7. (a) What are decoding glitehes and how these can be eliminated ? 10
   Explain universal shift register.
   (b) Implement 8-bit adder using 4-bit full adder. 10

S.E / ELTC / Telecommunication

Sem III

Con. 3245-10. Electrical Networks **AN-2545**

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

N.B. (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from remaining **six** questions.
(3) Assume any **suitable** data if **necessary** and state it **clearly**.
(4) **All** questions carry **equal** marks (**20 each**).

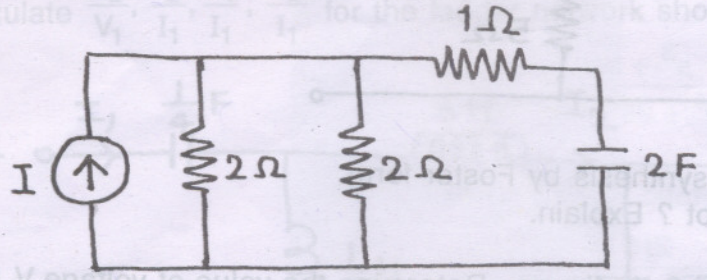
1. (a) The Z parameters of a two-port network are $Z_{11} = 20\ \Omega$, $Z_{22} = 30\ \Omega$, $Z_{12} = Z_{21} = 10\ \Omega$. Find ABCD parameters. **20**

(b) Reduced incidence matrix is given below :

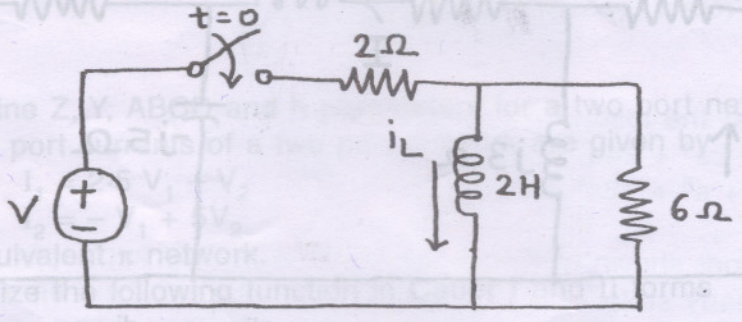
$$A = \begin{bmatrix} -1 & -1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & -1 & 1 & 0 \\ 0 & 0 & -1 & 0 & -1 & -1 \end{bmatrix}$$

Draw the oriented graph.

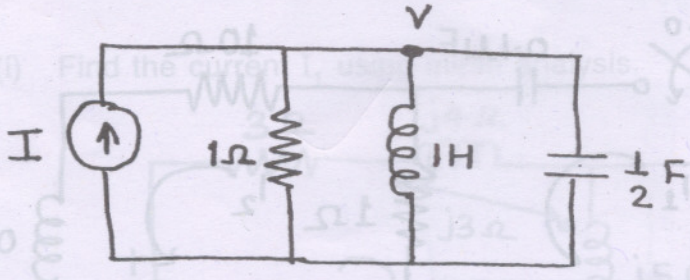
(c) Find the time constant of the following circuit.



(d) Write a differential equation valid for t > 0 for the circuit shown in **figure**.

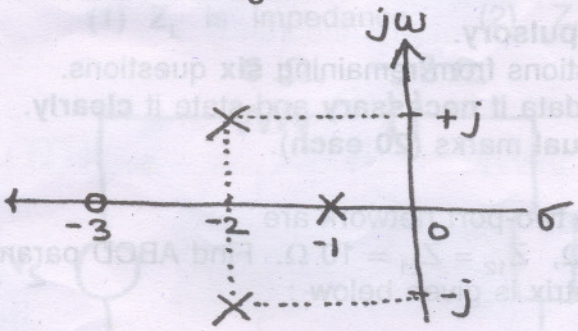


(e) Find the second order differential equation for the circuit shown in **figure**.

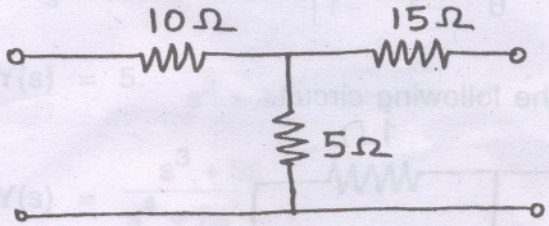


(f) Write the V-I relationships and their S-domain equivalents for Resistor, Inductor and Capacitor.

(g) Determine the system function if the d.c. gain of the system is 10 and Pole zero plot is as shown in **figure**.



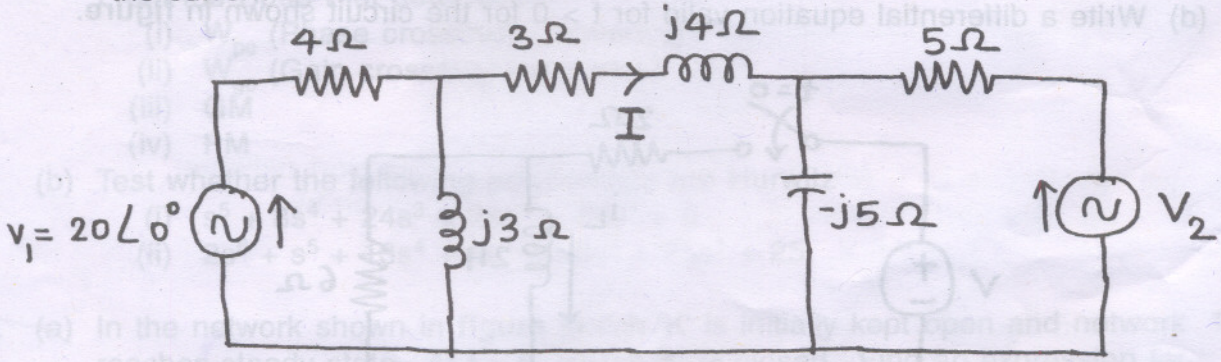
(h) Find the Z-parameters of the network shown in **figure**.



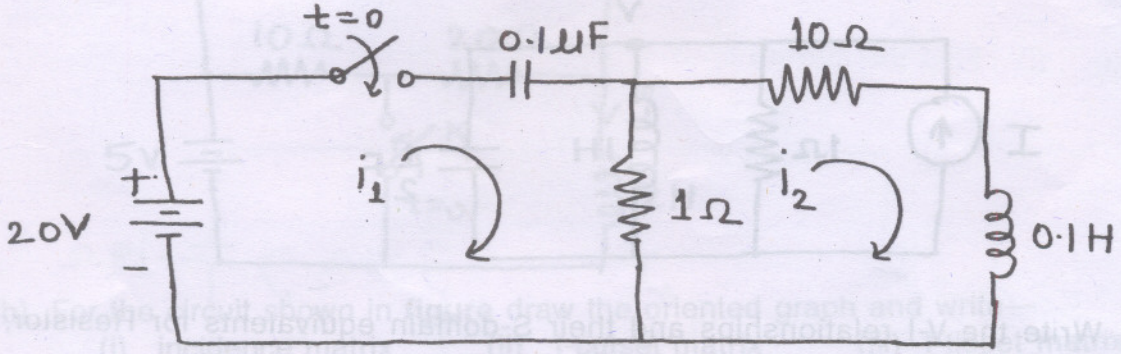
(i) Explain network synthesis by Foster form.

(j) What is Bode Plot ? Explain.

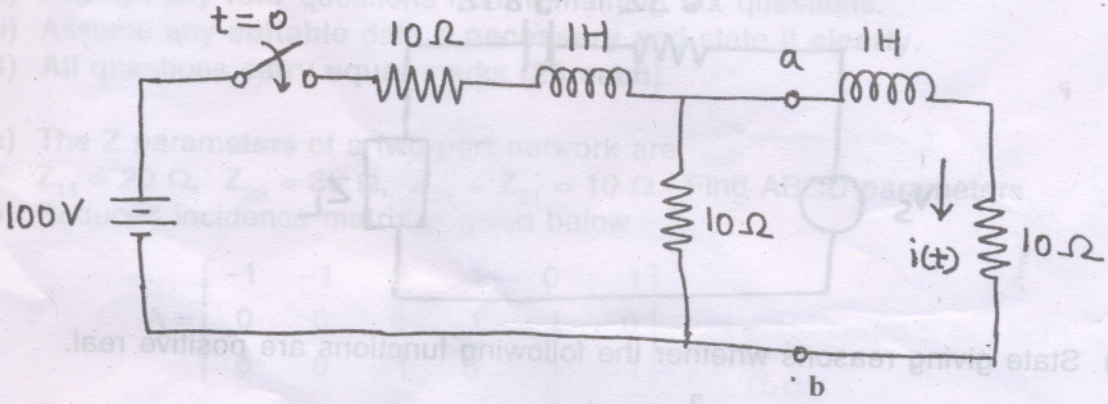
2. (a) For the circuit shown in **figure**. Determine the value of voltage V_2 such that the current I is zero. **10**



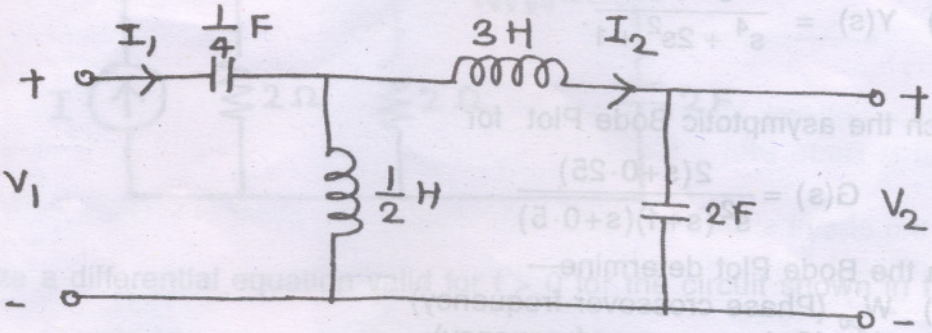
(b) For the circuit shown in **figure** find i_1, i_2, $\frac{di_1}{dt}$ and $\frac{di_2}{dt}$ at t = 0+ **10**



3. (a) Find i(t) using Thevenin's theorem in 'S' domain. Find initial value and final value of i(t) using Laplace transform theorem. 10



(b) Calculate $\frac{V_2}{V_1}, \frac{I_2}{I_1}, \frac{V_1}{I_1}, \frac{V_2}{I_1}$ for the ladder network shown in **figure**. 10



4. (a) (i) Define Z, Y, ABCD and h parameters for a two port network. 5

(ii) The port currents of a two port network are given by 5

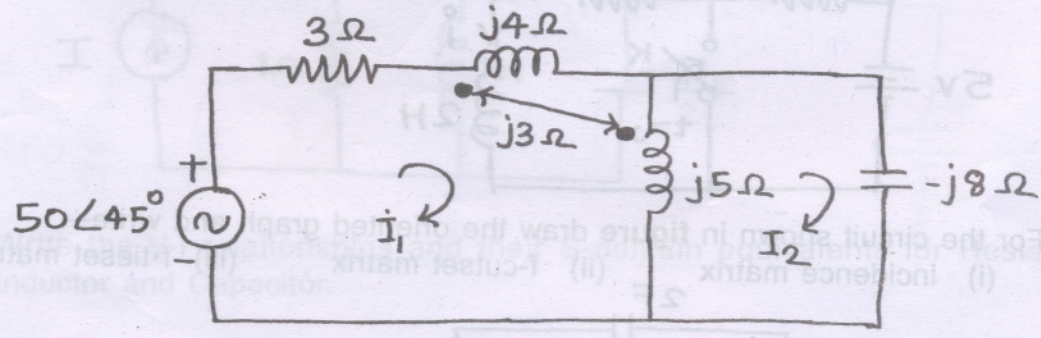
$$I_1 = 2{\cdot}5\, V_1 - V_2$$
$$I_2 = -V_1 + 5V_2$$

Find equivalent π network.

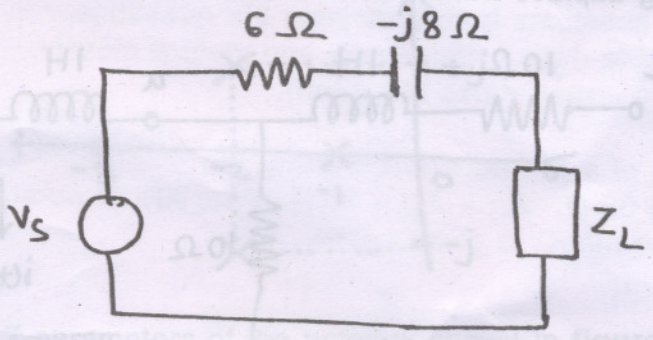
(b) Synthesize the following function in Cauer I and II forms 10

$$Z(s) = \frac{s^5 + 7s^3 + 10s}{s^4 + 4s^2 + 3}$$

5. (a) (i) Find the current I_1 using mesh analysis. 5



(ii) For the maximum power transfer find the value of Z_L if 5
(1) Z_L is impedance (2) Z_L is pure resistance.



(b) State giving reasons whether the following functions are positive real. 10

(i) $Y(s) = 5. \dfrac{s^2+2s+1}{s^3+2s^2+2s+40}$

(ii) $Y(s) = \dfrac{s^3+5s}{s^4+2s^2+1}$.

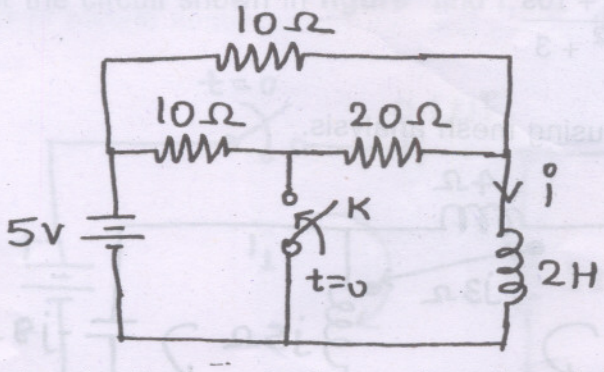
6. (a) Sketch the asymptotic Bode Plot for 12

$$G(s) = \frac{2(s+0\cdot25)}{s^2(s+1)(s+0\cdot5)}$$

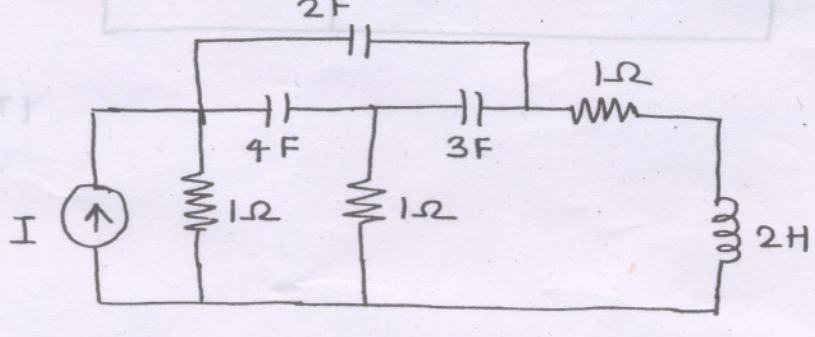
From the Bode Plot determine—
(i) W_{pc} (Phase crossover frequency)
(ii) W_{gc} (Gain crossover frequency)
(iii) GM
(iv) PM

(b) Test whether the following polynomials are Hurwitz 8
(i) $s^5 + 8s^4 + 24s^3 + 28s^2 + 23s^1 + 6$
(ii) $2s^6 + s^5 + 13s^4 + 6s^3 + 56s^2 + 25s^1 + 25$.

7. (a) In the network shown in **figure** switch 'K' is initially kept open and network reaches steady state. At t = 0, switch 'K' is closed. Find an expression for the current through the inductor for t > 0. Also sketch the waveform. 10



(b) For the circuit shown in **figure** draw the oriented graph and write— 10
(i) incidence matrix (ii) f-cutset matrix (iii) f-tieset matrix



Con. 3015-10. AN–2542

(3 Hours) [Total Marks : 100

N. B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from remaining **six** questions.
(3) Assume data if **required** but justify the **same**.

1. Answer any **four** questions:— **20**
   (a) Explain the functions of delay line in CRO.
   (b) What are the criteria for selection of a transducer ?
   (c) What are the various sources of error in a Q-meter ?
   (d) Which is the fastest ADC and why ?
   (e) A voltmeter reading 70 V on its 100 V range and an ammeter reading 80mA on its 150mA range are used to determine power dissipated in a resistor. Both these instruments are guaranteed to be a accurate within ± 1·5% at full scale deflection. Determine the limiting error of power.

2. (a) How does a Digital Storage oscilloscope differ from a conventional CRO using storage CRT. Explain the principle and block diagram of DSO. **10**
   (b) A 4½ digit voltmeter is used for voltage measurement. Find the resolution. How would values 12·98 V and 0·6973 displayed on 10 V ranges. **6**
   (c) Write a short note on Automatic Test Equipment. **4**

3. (a) What is the need of modulation in data transmission?Explain with waveforms the various digital modulation techniques. **10**
   (b) Explain the function of timebase generator in a CRO. **6**
   (c) A stream gauge with a gauge factor of 2 is fastened to a metallic member subjected to a stress of 1000 kg/cm^2. The modulus of elasticity of metal is 2 x 10^6 kg/cm^2. Calculate the percentage change in resistance of strain gauge. What is the value of Poisson's ratio. **4**

4. (a) Explain the operation of 4 bit R-2R type of DAC. Derive the expression for output voltage. **10**
   (b) Explain the basic telemetry system and its applications in instrumentation. **6**
   (c) In a CRT the anode to cathode voltage is 2500 V. The parallel deflection plates are 1·5 cm long and spaced 5mm. The screen is 50cm from the centre of the deflecting plates. If mass of electron is 9·109 x 10^{-31}kg and charge of electron is 1·602 x 10^{-19} C fuid— **4**
      (i) Beam speed
      (ii) Deflection Sensitivity.

5. (a) What is a True RMS meter and how does it deffer from a DMM. Explain the principle and working of a true RMS meter with a thermocouple. **10**
   (b) What is the principle of piezoelectric transducer. What are the materials used in these transducers. Give the merits, demerits and applications. **6**
   (c) Write a short note on data loggers. **4**

[TURN OVER

6. (a) What is the advantage of taking a differential output from an inductive transducer. Explain the performance characteristics and its applications. The output of LVDT is connected to 4 V voltmeter through an amplifier whose amplification factor is 500. An output of 1·8mV appears across the terminals of LVDT when the core moves through 0·6 mm. If the mV scale has 100 divisions and can be read to ¼ of division, Calculte the sensitivity and resolution of LVDT. **10**

   (b) What is meant by network analysis. Explain the analogy of two port linear networks with microwave networks. **6**

   (c) Explain the lissajous method for frequency and phase measurement. **4**

7. (a) What is the basic principle of wave analyzer. Explain the heterodyne wave analyzer with applications. **10**

   (b) A dual slope ADC uses 16 bits counter and a 4MHz clock rate. The maximum input voltage is +10 V. The maximum integrator output voltage should be 8V when counter cycled through 2^n counts. If the capacitor of 0·1μF is used, find the value of resistor of integrator. **6**

   (c) Write a short note on eddy current sensor. **4**
