III ETRX (CBGS) 23/11/17

ED

Q.P. Code :10592

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

Please check whether you have got the right question paper.

N.B:
1. **Question -1 is compulsory.**
2. **Solve any THREE from remaining questions.**
3. Assume suitable data it necessary.

1 a) Explain two terminal Mos structure. (05)

b) Calculate width of the space charge region in a PN junction when a reverse bias voltage is applied consider a P-N junction at T = 300 k, Na = $10^{16}cm^{-3}$ and Nd = $10^{15}cm^{-3}$, ni = $1.5x10^{10}cm^{-3}$ and VR = 5V; Vbi = 0.635V, Vbi is the built in potential barier voltage. (05)

c) Write note on HBT. (05)

d) Explain differences between FET and MESFET. (05)

2 a) Explain construction working and characteristics of Tunnel diode. (10)

b) Draw and explain hybrid π (pi) model of BJT (10)

3 a) Calculate Vbi in a silicon P–N junction at T = 300 K for Nd = $10^{15}cm^{-3}$ and Na = $10^{15}cm^{-3}$ and ni = $1.5 \times 10^{10}cm^{-3}$. (10)

b) Explain constructions working and characteristics of E MOSFET (10)

4 a) Explain construction, working and characteristics of FET (10)

b) Explain following effects in FET – (1) Channel length modulation (10)
(2) Velocity saturation effects.

5 a) Draw and explain energy band diagram for MOSFET for different gate bias conditions. (10)

b) Explain working and characteristics of SCR. (10)

6 Write notes on any four of the following (20)
a) Zener diode voltage regulator.
b) Triac
c) Solar Cell
d) Photo diode
e) UJT relaxation oscillator

(3 Hours) **[Total marks : 80**

Note : -
1) Question number **1** is **compulsory.**
2) Attempt any **three** questions from the remaining **five** questions.
3) **Figures** to the **right** indicate **full** marks.

Q.1 a) Find the angle between the surfaces $x \log z + 1 - y^2 = 0, \quad x^2y + z = 2$ at $(1, 1, 1)$. 05

b) Show that the functions $f_1(x) = 1$, $f_2(x) = x$ are orthogonal on $(-1, 1)$. Determine the constants a and b such that the function $f_3(x) = -1 + ax + bx^2$ is orthogonal to both f_1 and f_2 on that interval. 05

c) Find the Laplace transform of $\int_0^t u^{-1} e^{-u} \sin u \, du.$ 05

d) Prove that $f(z) = (x^3 - 3xy^2 + 2xy) + i(3x^2y - x^2 + y^2 - y^3)$ is analytic and find $f'(z)$ and $f(z)$ in terms of z. 05

Q.2 a) Obtain half- range sine series of $f(x) = x(\pi - x)$ in $(0, \pi)$ and hence, find the value of $\sum \frac{(-1)^n}{(2n-1)^3}$. 06

b) Prove that 06
$\bar{F} = (y^2 \cos x + z^3)\, i + (2y \sin x - 4)\, j + (3xz^2 + 2)\, k$
is a conservative field. Find the scalar potential for $\bar{F}$.

c) Find the inverse Laplace transform of 08

(i) $\dfrac{s + 2}{s^2 - 4s + 13}$

(ii) $\dfrac{1}{(s - a)(s - b)}$

Q. 3 a) Prove that $J_{5/2}(x) = \sqrt{\frac{2}{\pi x}} \left(\frac{3 - x^2}{x^2} \sin x - \frac{3}{x} \cos x\right)$. 06

b) Find the analytic function $f(z) = u + iv$ if 06
$3u + 2v = y^2 - x^2 + 16xy.$

TURN OVER

c) Expand $f(x) = \begin{cases} \pi x, & 0 < x < 1 \\ 0, & 1 < x < 2 \end{cases}$ period 2 into a Fourier Series. 08

Q. 4 a) Prove that 06
$\int x^3 \cdot J_0(x)\, dx = x^3 \cdot J_1(x) - 2x^2 \cdot J_2(x).$

b) Use Stoke's Theorem to evaluate $\int_C \bar{F} \cdot d\bar{r}$ 06
where $\bar{F} = yz\, i + zx\, j + xy\, k$
and C is the boundary of the circle $x^2 + y^2 + z^2 = 1,\ z = 0.$

c) Solve using Laplace transform $(D^2 - 3D + 2)\, y = 4e^{2t}$ with 08
$y(0) = -3$ and $y'(0) = 5.$

Q. 5 a) Prove that $2\, J_0''(x) = J_2(x) - J_0(x).$ 06

b) Use Laplace transform to evaluate 06
$\int_0^\infty e^{-t} \left(\int_0^t u^2 \sin hu \cos hu\ du \right) dt.$

c) Obtain complex form of Fourier Series for $f(x) = e^{ax}$ in $(-\pi,\ \pi)$ 08
where a is not an integer. Hence deduce that when α is a constant other than an integer

$$\cos \alpha x = \frac{\sin \pi\alpha}{\pi} \sum \frac{(-1)^n \alpha}{(\alpha^2 - n^2)}\, e^{inx}$$

Q. 6 a) Express the function 06

$$f(x) = \begin{cases} -e^{kx} & for\ x < 0 \\ e^{-kx} & for\ x > 0 \end{cases}$$

as Fourier Integral and hence, prove that

$$\int_0^\infty \frac{\omega \sin \omega x}{\omega^2 + k^2}\, d\omega = \frac{\pi}{2}\, e^{-kx} \quad if \quad x > 0, k > 0.$$

b) Using Green's theorem evaluate 06

$$\oint_C \left(e^{x^2} - xy\right) dx - (y^2 - ax)\, dy$$

where C is the circle $x^2 + y^2 = a^2.$

c) Under the transformation $w = \frac{z-1}{z+1}$, show that the map of the straight line $y = x$ is a circle and find its center and radius. 08

_____xxx_____xxx_____

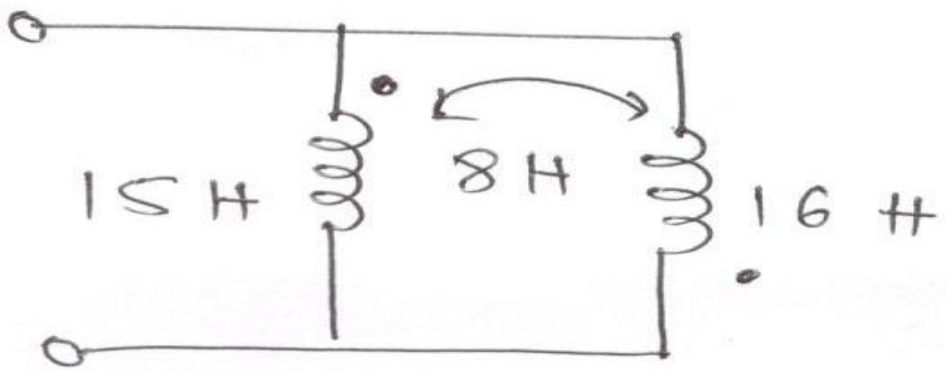
Q.P. Code :22709

[Time: Three Hours] **[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 out of remaining five questions.
3. Figures to the right indicate full marks.

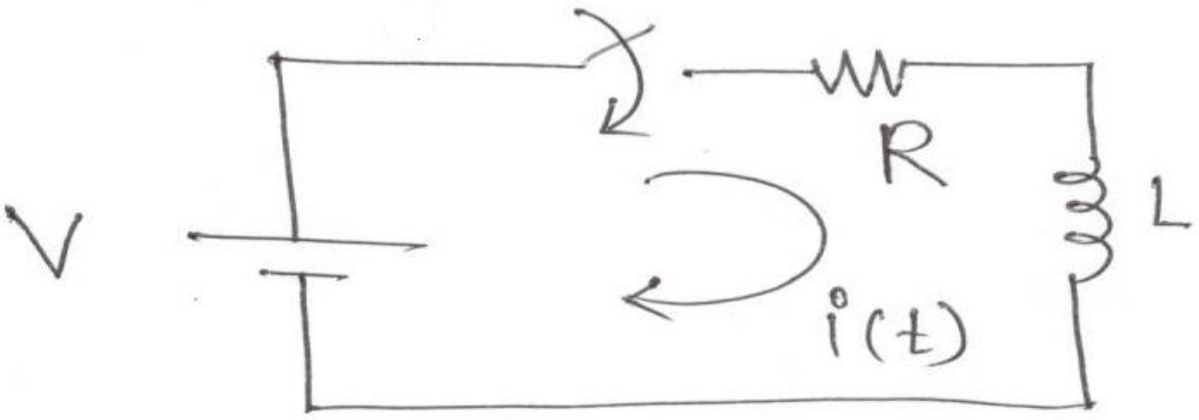
Q.1 a) Find the equivalent inductance of the network shown. 05



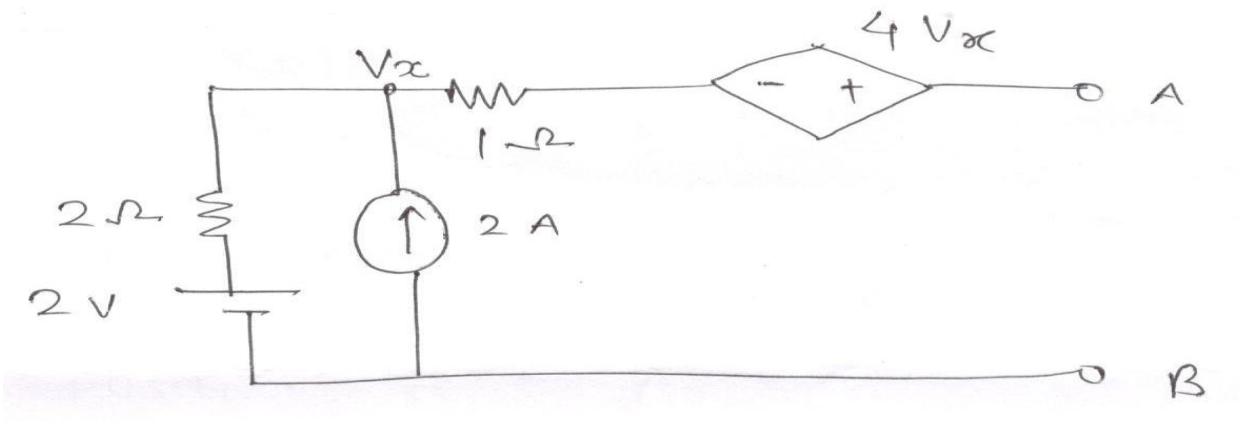
b) Test whether the polynomial P(S) = $S^4 + 7S^3 + 6S^2 + 21S + 8$ is Hurwitz. Use continued fraction method 05

c) State and prove the condition for reciprocity in terms of Z parameters. 05

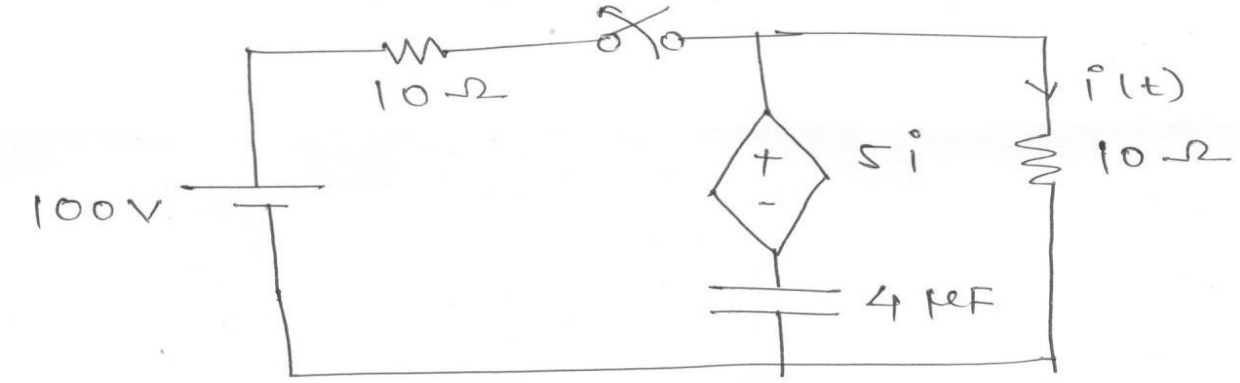
d) Obtain expression for current in the following circuit. 05



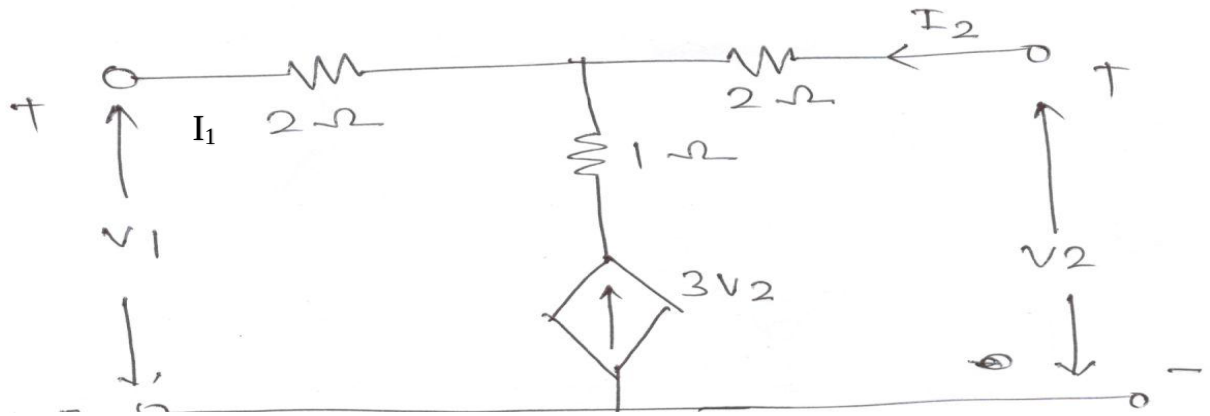
Q.2 a) Obtain Thevenin's equivalent network in the circuit given below for the terminals A and B. 10



b) For the network shown find the current i(t) when the switch is opened at t = 0 10



Q.3 a) Find Y parameter of the network shown in below figure. 10

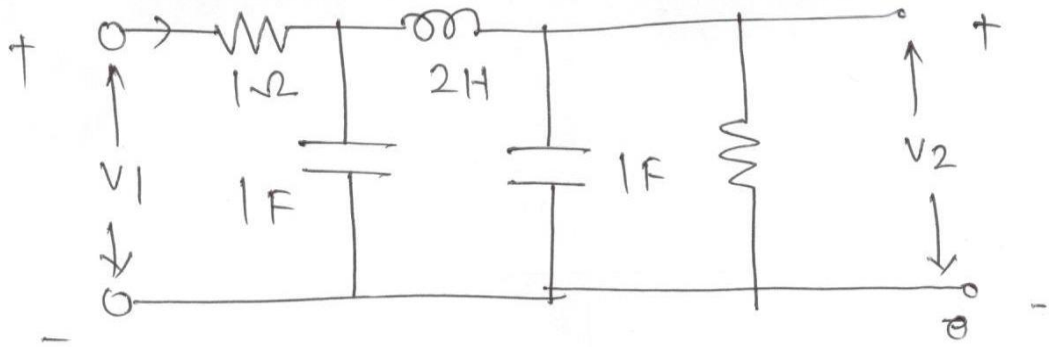


b) Realise foster-I and caur- II of the following impedance function 10

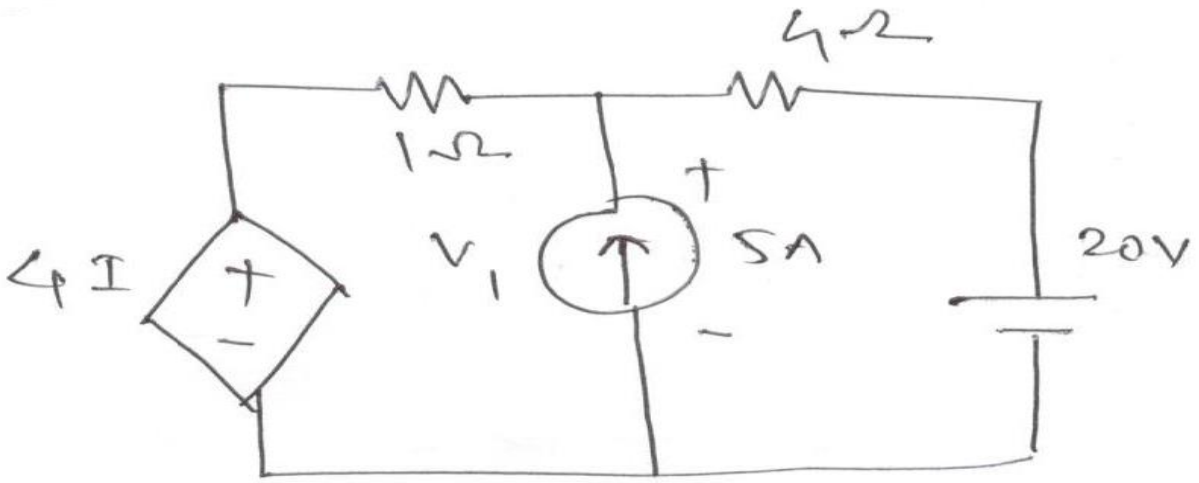
$$z(s) = \frac{(S+1)(S+3)}{S(S+2)}$$

Q.4 a) Test whether $F(S) = \frac{S(S+3)(S+5)}{(S+1)(S+4)}$ is positive real function. 05

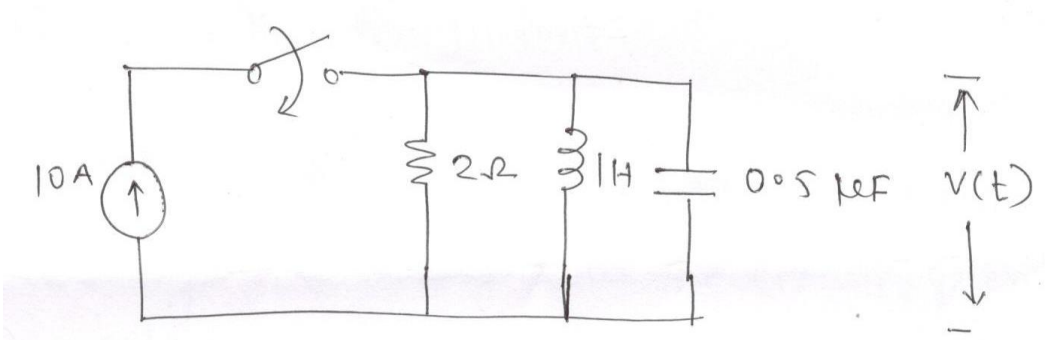
b) Determine the voltage transfer function $\frac{V2}{V_1}$ for the network given 10



c) Find The voltage V_1 in given figure below 05



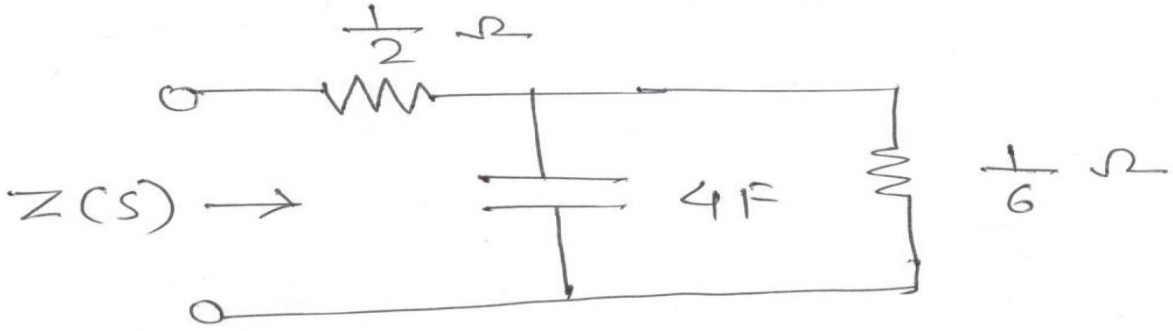
Q.5 a) For the network shown the switch is closed at t = 0 Determine V, $\frac{dv}{dt}$ and $\frac{d^2v}{dt^2}$ at t = 0^+ 10



05

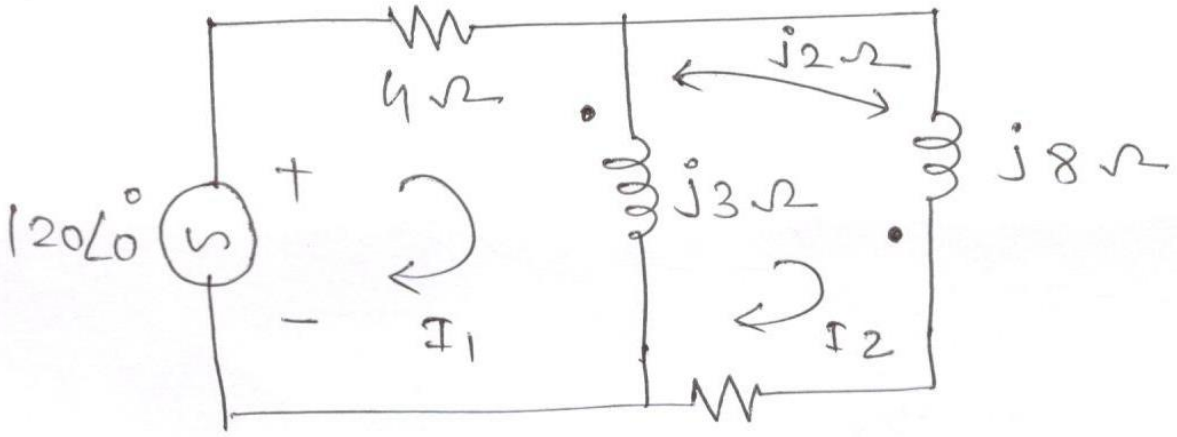
b) The constants of a transmission line are
R = 6 Ω /km L = 2.2 MH/km
G = 0.25 ×10^{-6} ℧ /km C = 0.005 ×10^{-6} F/km
Determine the characteristics impedance and propagation constant, attenuation constant and phase shift constant at 1 kHz

c) Determine the poles and zeros 0+ the impedance function Z(S) in the network shown. 05



Q.6 a) A lossless 75 Ω transmission line is terminated by an impedance of 150 + j150 Ω. Using Smith chart find 05
a) VSWR
b) Reflection Coefficient

b) Find the Current through 6 Ω resistor using mesh analysis in the circuit given below. 10



c) Write short note on initial conditions and final conditions of R, L, C, Components 05

QP CODE : 22982

(3 Hours) Marks : **80**

NB : (1) Question **No.1** is **compulsory.**
(2) Out of remaining questions, attempt **any three** questions.
(3) Assume suitable data, wherever necessary.

1. (a) Draw Master slave JK flip flop **5**
(b) Describe ring counter operation with the help of logical diagram **5**
(e) Use half subtractors and gates to realize the Full Subtractor **5**
(d) Compare Moore and Melay machines **5**

2. (a) Design 2 bit comparator and draw its logical diagram **10**
(b) Design 1 digit BCD adder using IC 7483 and perform $(0011)_{BCD} + (1100)_{BCD}$ **10**

3. (a) Use 4:1 MUX and gates to implement the following function **10**
$Y(P,Q,R,S) = \sum m(0,3,4,6,9,11,12,14, 15)$
(b) Explain the working of shift register IC 74194 in detail with applications. **10**

4. (a) Design a mealy sequence detector to detect ---1001--- using D flip-flops and logic gates **10**
(b) Design a circuit with optimum utilization of PLA to implement the following functions . **10**
$A = \sum m(1 , 2, 6, 8, 11 , 13, 15)$
$B = \sum m(0, 3, 5, 8, 9,12, 14)$
$C = \sum m(0, 2, 4, 7, 10, 11)$

5. (a) Use K-map to reduce following function and then implement it by NOR gates. **10**
$F = \pi M(I , 2, 4, 7, 8, 11, 13, 15) + d(0, 5, 9)$
(b) Eliminate redundant states and draw the reduced state diagram. **10**

Present State	Next State		Output
	X = 0	X = 1	Y
A	B	D	1
B	C	E	0
C	E	F	1
D	E	B	0
E	D	C	0
F	B	D	1

6. Write short notes : **20**
(a) Universal shift register
(b) Johnson 4-bit counter
(c) Stuck at '0' and '1' faults
(d) Explain the characteristics parameters of logic families.

Q.P. Code: 23747

Max Marks: 80 **Duration : 3Hrs**

N.B.-1] Question no.1 is compulsory
2] Attempt any three from remaining

Q 1.Attempt any four questions **[20]**

a) Define Accuracy, Precision, Linearity, Sensitivity, Resolution
b) Write applications of Q-Meter
c) Explain Role of Delay Line in CRO
d) Write Selection Criteria of Transducers.
e) Write brief information of Programmable Logic Controller
f) List pressure, level and flow transducers

Q 2.Attempt the following questions **[20]**

a) Draw and Explain Measurement of Inductance using Maxwell Bridge
b) Draw and Explain Measurement of Low and High Resistance using, Kelvin's Double Bridge and Mega ohm Bridge

Q 3.Attempt the following questions **[20]**

a) Draw and Explain Digital Storage Oscilloscope (DSO) also write applications of DSO.
b) Draw and Explain Lissajous Figures in Detection of Frequency and Phase

Q 4.Attempt the following questions **[20]**

a) Compare RTD, Thermisters, Thermocouples- with their construction , Ranges, and Applications
b) Draw and Explain any one application of Linear Variable Differential Transformer

Q 5.Attempt the following questions **[20]**

a) Draw and Explain Capacitance type method for level measurement .write advantages and disadvantages it.
b) Draw and Explain Rotameter for flow measurement. write advantages and disadvantages of it

Q 6.Write a short note on **[20]**

a) Elastic Pressure Transducers
b) Data acquisition system (DAS)- Single channel
c) Errors in Measurement
d) Auto Ranging and Auto Zero Adjustments in Digital Instruments.

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.	max.	h_{fe}	V_{BE} max.	θ_{fc} °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 × 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
ECN 100	500 Ω	—	——	——
ECN 149	250 Ω	—	——	——
ECN 055	100 Ω	—	——	——
2N 3055	25 Ω	—	——	——

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} (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	5000 μ ℧	2·5	50 KΩ	——	0·59° C/mW

III ETRX (CBCS) choice 23/11/17
AM III

Q.P. Code: 25014

(3 Hours) *Total Marks :80*

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

Q1

A) Find Laplace transform of $e^{-4t}\int_0^t usin3udu$ 5

B) Find the orthogonal trajectories of the curves $e^{-x}cosy + xy = \alpha$, where α is a real constant in XY plane. 5

C) Find a Fourier series to represent $f(x) = x^2$ in $(0, 2\pi)$ hence deduce that 5

$$\frac{\pi^2}{12} = \frac{1}{1} - \frac{1}{4} + \frac{1}{9} - \frac{1}{16} + \ldots\ldots$$

D) Prove that $\vec{F} = (x^2 + xy^2)\,\hat{\imath} + (y^2 + x^2y)\hat{\jmath}$ is irrotational and find its scalar potential 5

Q2

A) If $u = -r^3\sin 3\theta$, find analytic function whose real part is u. 6

B) Find the Bilinear transformation which maps the points z = 1, i, -1 onto the points w = i, 0, -i 6

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

Hence deduce that $\frac{\pi^2}{8} = \frac{1}{1} + \frac{1}{9} + \frac{1}{25} + \ldots\ldots$

Q3

A) Find inverse Laplace transform of (i) $\tan^{-1}\left(\frac{2}{s}\right)$ (ii) $e^{-4s}\cdot\frac{s}{(s+4)^3}$ 6

B) Find Complex form of Fourier Series of coshax + sinhax in (-a, a) 6

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

Q4

A) Prove that $\int x^4 J_1(x)dx = x^4J_2(x) - 2x^3J_3(x)$ 6

B) Use Gauss's Divergence theorem to evaluate $\iint_S \bar{N}.\bar{F}ds$ where $\bar{F}$=4xi +3yj -2zk and S is the surface bounded by x=0, y=0, z= 0 and 2x +2y +z=4 6

C) Solve using Laplace transform($D^2 + 2D + 1)y = 3te^{-t}$, given y(0)=4 and y'(0)=2 8

Q5

A Find half range cosine series for $f(x) = \begin{cases} x, & 0 < x < \left(\frac{\pi}{2}\right) \\ \pi - x, & \left(\frac{\pi}{2}\right) < x < \pi \end{cases}$ 6

B) Find the image of real axis in z –plane onto w-plane under the bilinear transformation $w = \frac{1}{z+i}$ 6

c) Prove that $y = \sqrt{x}\,J_n(x)$ is a solution of the equation, 8

$$x^2\frac{d^2y}{dx^2} + (x^2 - n^2 + \frac{1}{4})y = 0$$

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

(i) Question No. 1 is compulsory & attempt any four 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 has equal weightage.
(iv) This paper tests your basic level of understanding the fundamentals; so read each question carefully.

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

(a) Define the following dynamic characteristics of instruments & mention for which types of measurements they have to be considered ?

(i) Speed of Response
(ii) Lag
(iii) Fidelity
(iv) Dynamic Error

(b) Draw a neat circuit diagram of LCR – Q meter & explain its operating principle.

(c) Explain the function of delay line in cathode ray oscilloscope (CRO) with neat diagram.

(d) Describe operating principle of heterodyne wave analyzer with a neat block diagram.

(e) With a neat diagram, explain the principle of digital time measurement.

(f) Describe in brief, the classification / types of transducers.

Q.2 (a) The true value of the voltage across a resistor in a circuit is 10 V when it is calculated by mathematical analysis. Measuring the same voltage by six different random individuals (but all with the same digital multimeter) gives the following results as shown :- **20**

Observation No.	Measured Values
1	10.25 V
2	10.05 V
3	9.9 V
4	9.95 V
5	10.15 V
6	9.85 V

(i) Calculate the arithmetic mean (average) for the above observations.
(ii) Calculate the percentage error for the fourth observation.
(iii) Calculate the accuracy for the second observation.
(iv) Determine the precision of the fifth observation.
(v) Calculate the standard deviation (σ) for the above observations.
(vi) Calculate the average deviation (d_{avg}) for the above observations.

For Q.2 (a) students can attempt any five sub-questions between (i) to (vi)

(b) Wien Bridge is one of the AC bridges as shown in the Fig. 1 below. Derive conditions under which the bridge becomes balanced. Which quantity / parameter is it used to measure?

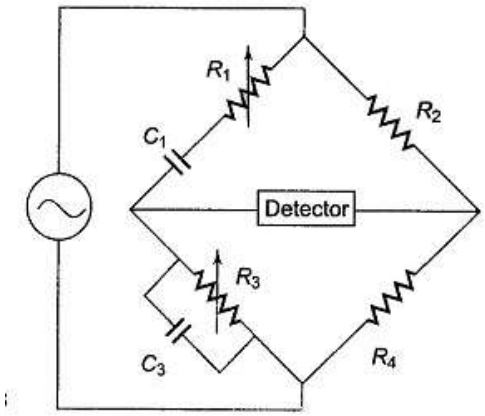


Fig. 1 – The Wien Bridge for Q.2 (b)

Q.3 (a) The block diagram of a general purpose cathode ray oscilloscope (CRO) is as shown in Fig. 2 below. Identify the blocks / elements numbered from 1 to 5 & describe their functionality. What is the use of trigger circuit / trigger generator in CRO ? Explain with neat diagram. **20**

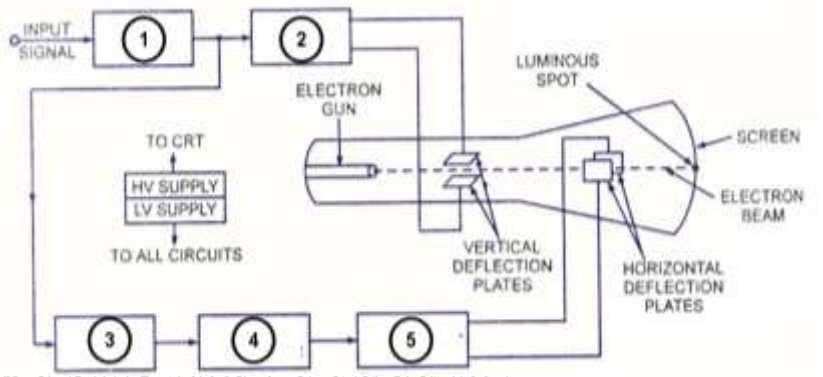


Fig. 2 – Block diagram of general purpose CRO for Q.3 (a)

(b) Explain how Lissajous patterns / figures are used for measurement of an unknown frequency & phase shift using a cathode ray oscilloscope (CRO). Determine the approximate phase shift of the Lissajous figure / pattern as shown in Fig. 3 below observed on CRO screen :-

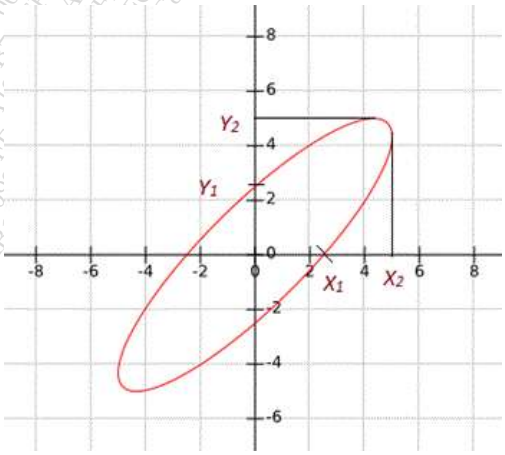


Fig. 3 – Lissajous pattern on CRO for phase measurement for Q.3 (b)

Q.4 (a) From the diagram shown in Fig. 4 below, identify which type of instrument is being used & to measure which kind of electrical signal / input quantity. Describe the operation of that instrument with a neat block diagram. **20**

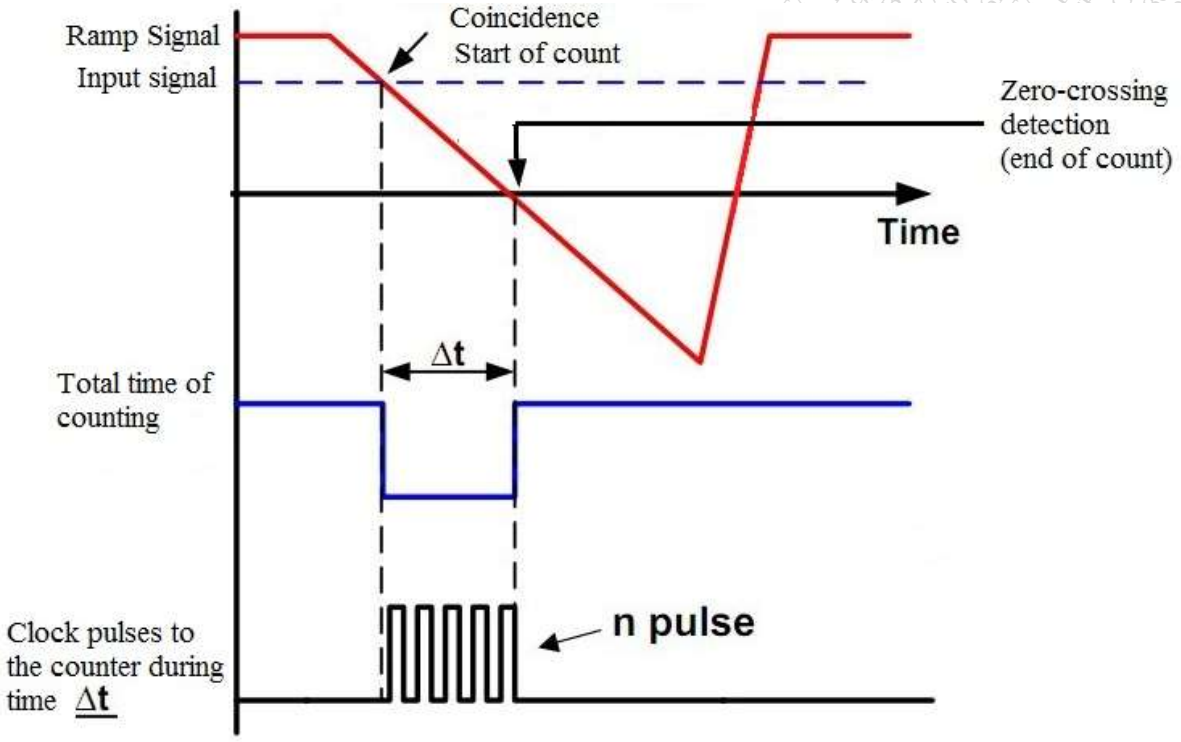


Fig. 4 – Waveform analysis for Q.4 (a)

(b) The diagram below in Fig. 5 shows a graph (spectrum) where a complex waveform having multiple signal components is displayed on a screen, with each individual signals having its own frequency (Hz) & its own amplitude (magnitude is as shown in mV). Which instrument is used to display it ? Describe its operation with a neat block diagram.

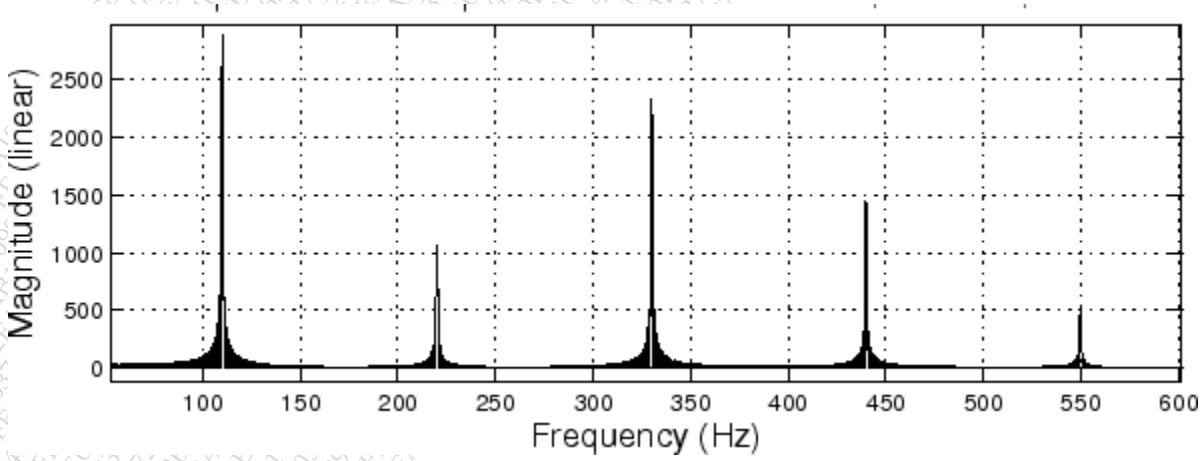


Fig. 5 – Amplitude spectrum of a complex signal waveform for Q.4 (b)

Q.5 (a) You have been asked to measure the displacement of a shaft, which is linearly attached to a piston in a machine wherein the shaft has a rectilinear motion (straight line) going back & forth. Which transducer will you use for above application ? Describe its operation with a neat diagram. **20**

(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.

Q.6 (a) You are asked to measure the flow rate in a network of pipes that carry brine (a salt water solution). At first, it seems an easy task to use electromagnetic flow meters since brine solution being highly conductive, the output signal obtained is proportional to the flow rate. However on close inspection, you find that due to several issues; including the shortage of space & the myriad arrangement of piping the flow transducer can be only installed in a vertical position. The plant supervisor also tells you 'it should be such that' simply by looking at flow rate directly on its scale, he can adjust the valve manually & quickly so as to control it. Which flow transducer will you select for such an application ? Explain with a neat diagram. **20**

(b) A thermostat in a home heating system needs a temperature transducer to work between the temperature ranges of + 15 °C to + 45 °C. Being fully electronic in nature, the thermostat requirements are that the sensor should be as small as possible, be extremely light in weight & portable. Apart from being easily interfaced with electronic devices / circuits in the thermostat, it should have a quick response to the variations in the ambient temperature & should be of cheaper cost. Out of the various temperature transducers, describe which is the best suited for above requirements. Explain its construction, operation & characteristics with a neat diagram.

Time: 3 Hours **Marks: 80**

N.B.: 1. Question No. 1 is compulsory.
2. Attempt any three questions out of remaining five questions.
3. Figures to the right indicate full marks.
4. Assume suitable data if required and mention it in answer sheet.

Q1. Solve following **(20 Marks)**

a) Explain the following decimals in gray code form
1. $(42)_{10}$ 2. $(17)_{10}$

b) Explain characteristics of logic families

c) State and Prove Demorgan Theorem

d) Convert JK flip flop to T flip flop.

Q2. a) What is shift register? Explain any one type of shift register. Give its applications. **(10 Marks)**

b) Implement the following Boolean function using 8:1 multiplexer.
F(A,B,C,D)=∑M(0,1,4,5,6,8,10,12,13) **(10 Marks)**

Q3. a) Explain the Johnson's Counter. Design for initial state 0110. From initial state explain and draw all possible states. **(10 Marks)**

b) Minimize the following expression using Quine McClusky technique.
F(A,B,C,D)=∑M(0,1,2,3,5,7,9,11) **(10 Marks)**

Q4. a) Design a 2 bit comparator and implement using logic gates **(10 Marks)**

b) Using Boolean Algebra and De-Morgan's theorem prove that
$\overline{Y}\,\overline{Z} + \overline{W}\,\overline{X}\,\overline{Z} + \overline{W}\,XY\overline{Z} + WY\overline{Z} = Z$
Simplify the expression $[A\overline{B}\,(C+BD) + \overline{A}\,\overline{B}\,]C$ as much as possible **(10 Marks)**

Q5. a) Explain the working of 3 bit asynchronous counter with proper timing diagram **(10 Marks)**

b) Design BCD Adder using the integrated circuit 4 bit binary adders. **(10 Marks)**

Q6. Write short notes on following **(20 Marks)**
a) Hazards
b) Hamming Code
c) Encoder and Decoder
d) Compare TTL and CMOS logic families

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