SEM-III (R) ETRX – ENABS

Con. 4773-12.

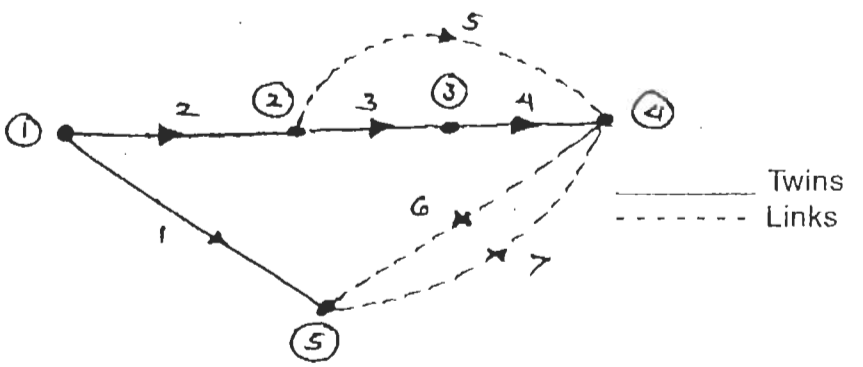
GN–9320

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

N.B.: (1) Question No. 1 is **compulsory** and solve any **four** questions out of remaining **six**.
(2) Assume suitable **data** if **necessary** and mention that **assumption** while solving that questions.
(3) **Figures** to the **right** indicate **full** marks.

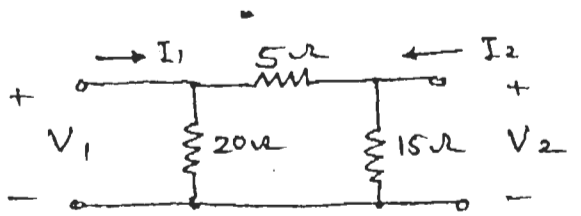
1. Any **five** :— **20**

(a) Following is a tree of graph (shown with firm lines) shown in linear graph of a network obtain fundamental cutset matrix.

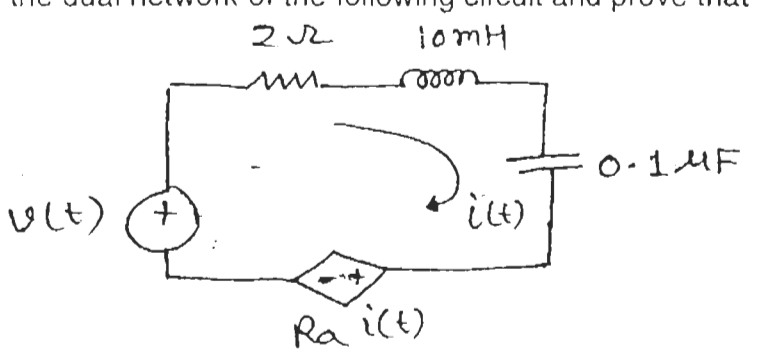


(b) What are the conditions for a rational function F(s) with real coefficients to be "positive real function ? "

(c) Find the Z-parameters for the circuit shown.



(d) Draw the dual network of the following circuit and prove that it is a dual one.



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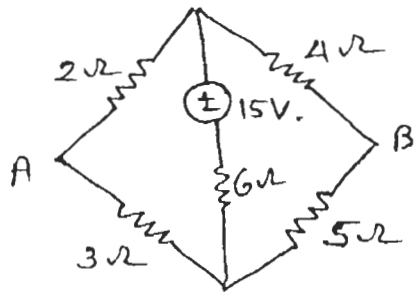
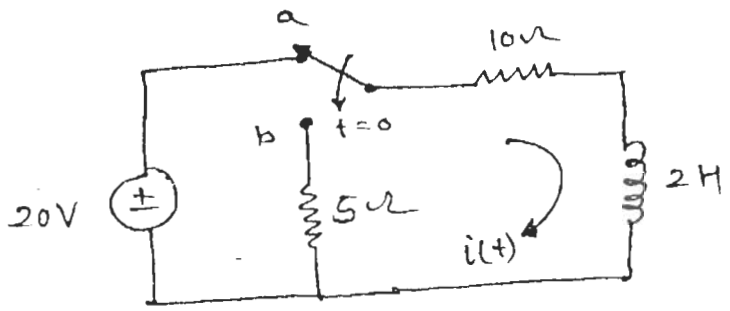
(e) For the network shown find :—

(i) Power from voltage source

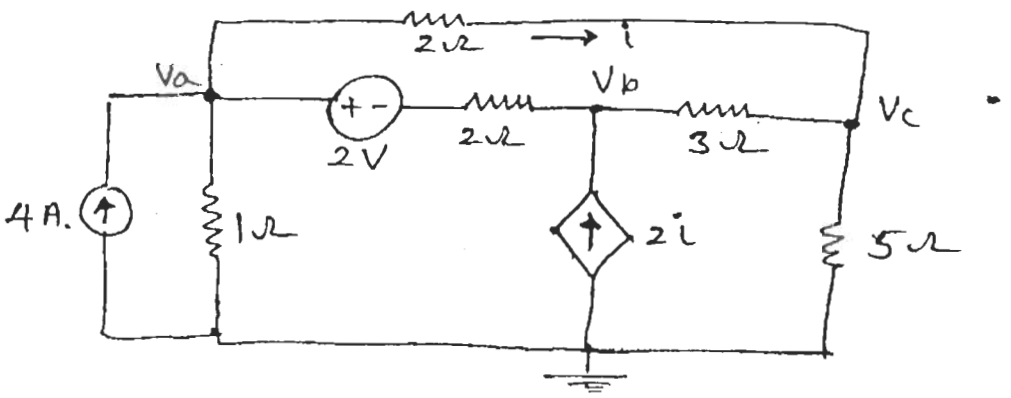
(ii) Voltage across A–B.



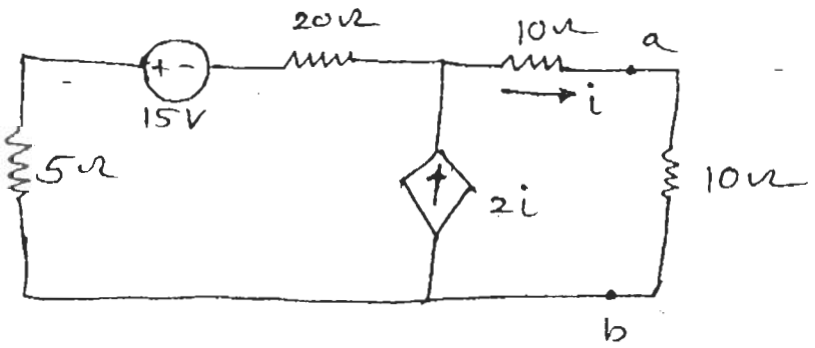
(f) The circuit is operating under steady state condition when switch is at position 'a' of at t = 0, the switch is moved to position 'b'. Determine current I(s) and i(t).



2. (a) Find V_a, V_b and V_c using Nodal Analysis. 10



(b) Find the Norton's equivalent circuit across terminals a–b of given circuit and hence the power discipated in 10Ω resistor. 10



3. (a) State giving appropriate reasons whether the following functions are "positive real functions." **10**

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

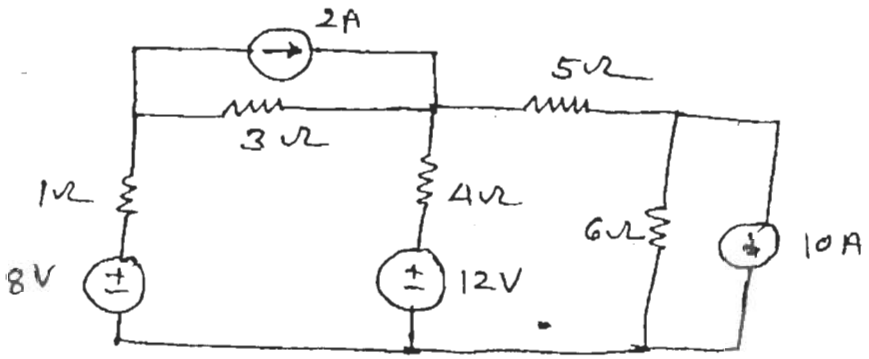
(ii) $Y_2(s) = \dfrac{s^3 + 5s}{s^4 + 2s^2 + 1}$

(b) Realise :— **10**

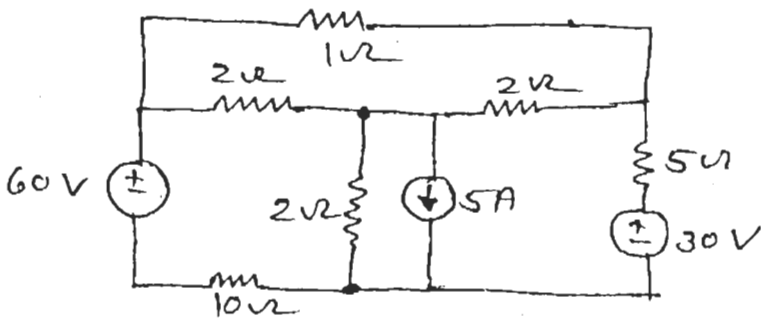
(i) $Y(s) = \dfrac{s^4 + 6s^2 + 4}{2s^3 + 4s}$ in Cauer II form.

(ii) $Z(s) = \dfrac{4(s^2 + 1)(s^2 + 16)}{s(s^2 + 4)}$ in Foster I form.

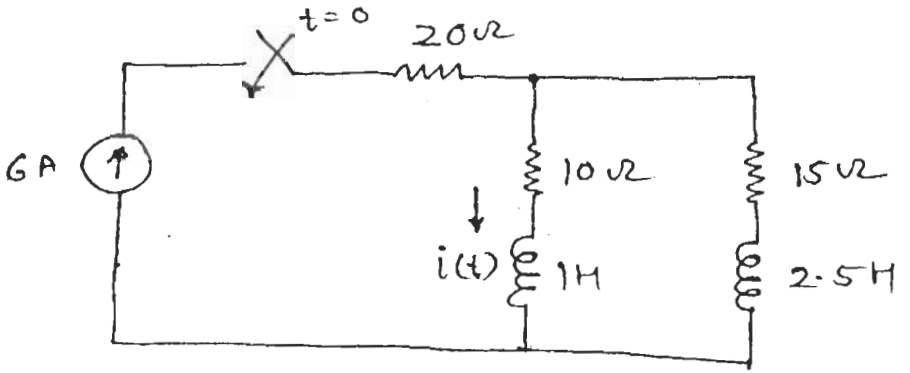
4. (a) For the network shown find branch currents and branch voltages using loop current analysis. This is to be solved by graph theory. **10**



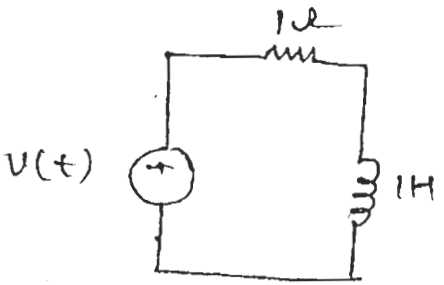
(b) Graph of a given network is to be drawn. Also find Aa, A, B and Q matrices for the same. How many trees are possible in the above graph ? **10**

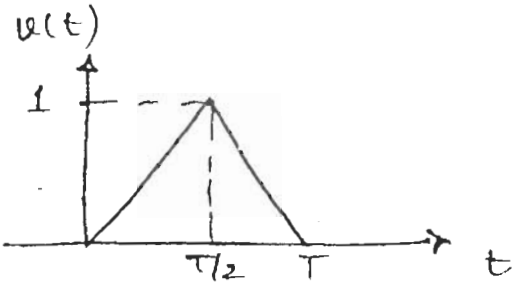


5. (a) Using Laplace transform find i(t) if the switch is closed at t = 0. Assume initial conditions to be zero. 10

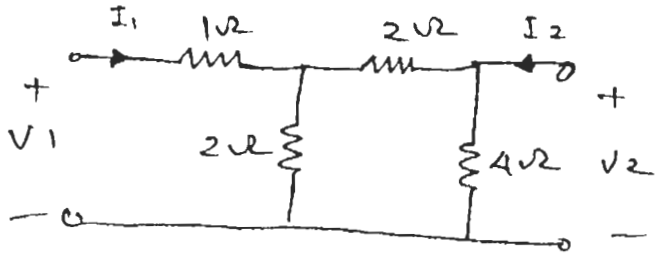


(b) A triangular voltage pulse of duration T and peak value unity is switched in to a series RL circuit which is initially relaxed. Determine i(t). 10





6. (a) Two identical sections of this network are in parallel. Obtain Y-parameters for connected network. 10



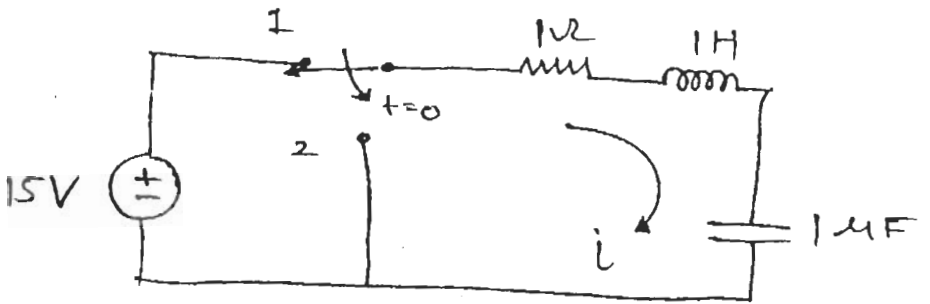
(b) Define ABCD parameters and relate them to other parameters as indicated. 10

(i) A and C in terms of Z
(ii) B in terms of Y
(iii) D in terms of H.

Con. 4773-GN-9320-12. 5

7. (a) A series R–L circuit with R = 10Ω and L = 1H is applied with constant 20V voltage at t = 0. Find the time at which $V_R = V_L$. **10**

   (b) Find i, $\frac{di}{dt}$, $\frac{d^2i}{dt}$ at $t = 0^+$ in the following network when the switch is changed from position 1 to 2 at t = 0. Steady state condition reached before switching. **10**



SEM-III (R) – ~~Comp~~ ETRX — May/June-2012
– Control Sys

P4-Exam.-May-12-11

Con. 4583–12. **GN–8696**

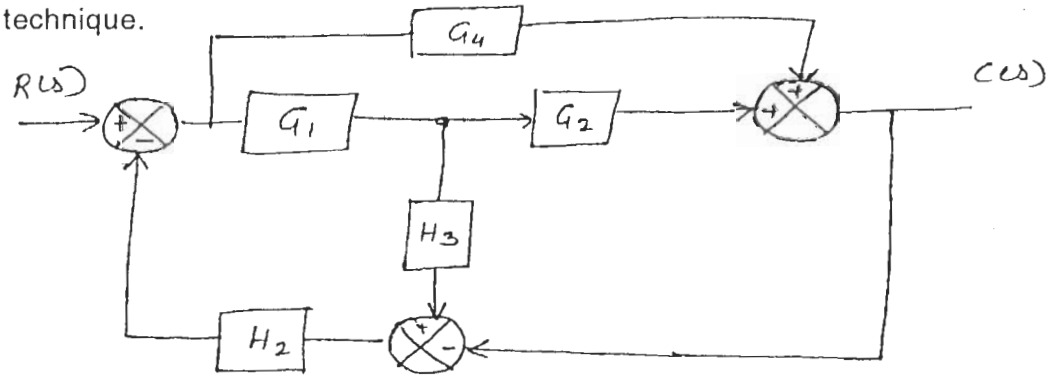
(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from the remaining **six** questions.
(3) Assume **suitable** data wherever **necessary**.

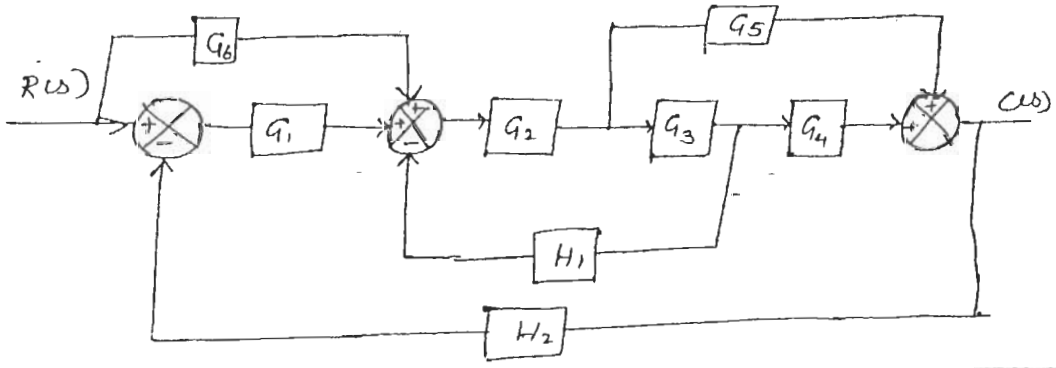
1. (a) Define static error coefficients. Explain their significance. **20**
(b) Explain how roots of characteristic equation is related to stability of a system.
(c) Define gain and phase margin. Draw approximate Bode Plot for a stable system showing gain and phase margin.
(d) Explain the effect of addition of open loop poles and zeros to the root locus of the system.

2. (a) A system when subjectd to unit step input gave the following response. **10**
$C(+) = 1 + 0{\cdot}2\ e^{-60t} - 1{\cdot}2\ e^{-10t}$
(i) Find the closed loop transfer function.
(ii) Find unclamped natural frequency and damping ratio.
(iii) Find settling time and peak overshoot.

(b) Find the transfer function $\frac{C(s)}{R(s)}$ for the following system using block reduction technique. **10**



3. (a) Find the overall transfer function of the system using signal flow graph. Using Mason's gain formula. **10**



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(b) Find the range of values of K for which the following systems are stable. **10**

(i) $G(s)\,H(s) = \dfrac{K e^{-5}}{s\left(s^2+5s+9\right)}$ (ii) $G(s)\,H(s) = \dfrac{K}{(s+2)\,(s+4)\left(s^2+6s+25\right)}$

4. (a) Derive the output response for second order underdamped control system subjected to unit step input. **10**

(b) For a unity feedback system the open loop transfer function is given by **10**

$$G(s) = \frac{K}{s(s+2)\left(s^2+6s+25\right)}$$

Sketch the root locus and find the value of K at which the system becomes unstable.

5. (a) Consider the given open loop transfer function $G(s)H(s) = \dfrac{16(1+0\cdot25s)}{s(s+2)\,(s+100)}$. Obtain the Bode Plot and find gain margin and phase margin. **10**

(b) Find Polar Plots for the transfer functions given below – **10**

(i) $G(s) = \dfrac{1}{(1+s)(1+4s)}$ (ii) $G(s)H(s) = \dfrac{1}{s(Ts+1)}$.

6. (a) Sketch the Nyquist plot and comment on the stability of the following system. **10**

$$G(s)H(s) = \frac{k(s+3)}{s(s-1)}.$$

(b) For the control systems with open loop transfer functions given below; explain the type of input signal which produce a finite steady state error. Also find the steady state error. **10**

(i) $G(s) = \dfrac{20}{(s+2)(s+3)}$

(ii) $G(s)\,H(s) = \dfrac{20(s+1)}{s^2(s+2)(s+4)}$

(iii) $G(s)\,H(s) = \dfrac{2\cdot5\left(s^2+2s+1\right)}{s(s+1)\left(s^2+5s+2s\right)}$.

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

(a) Co-relation between time domain and frequency domain.

(b) Synchro error ditector

(c) PI, PID Controllers

(d) Root locus techniques.

Con. 3614-12.

SE / ETRX / III 15/5/2012

Engineering Mathematics - III

GN–5288

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

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of the remaining **six** questions.
(3) **Figures** to the **right** indicate **full** marks.

1 (a) If $f(z)=(ax^4+bx^2y^2+cy^4+dx^2-2y^2)+i(4x^3y-exy^3+4xy)$ is analytic, find the constants a, b, c, d, e. 5

(b) Find the Fourier series expansion for $f(x)=|\sin x|$, in $(-\pi,\pi)$ 5

(c) Find the Laplace transform of $\sin t\cdot H\left(t-\frac{\pi}{2}\right)-H\left(t-\frac{3\pi}{2}\right)$ 5

(d) If $\{f(k)\}=\begin{cases}4^k, & for\ k<0\\ 3^k, & for\ k\geq 0\end{cases}$ find $Z\{f(k)\}$ 5

2 (a) If $\int_0^\infty e^{-2t}\sin(t+\alpha)\cos(t-\alpha)\,dt=3/8$ *then find* α. 6

(b) Find the Fourier series expansion for $f(x)=\sqrt{1-\cos x}$ in $(0,2\pi)$

Hence deduce that $\sum_{n=1}^{\infty}\frac{1}{4n^2-1}=\frac{1}{2}$ 7

(c) Find the inverse of A if $\begin{bmatrix}1&0&0\\2&-1&0\\-2&1&1\end{bmatrix}A\begin{bmatrix}1&-2&9\\0&1&-6\\0&0&1\end{bmatrix}=\begin{bmatrix}1&0&0\\0&1&0\\0&0&1\end{bmatrix}$ 7

3. (a) Find Laplace Transform of following

i) $e^{-4t}\int_0^t u\sin 3u\,du$ ii) $\frac{1}{t}(1-\cos t)$. 6

(b) Find non-singular matrices P & Q s.t. PAQ is in Normal form . Also find rank of A & A^{-1}.

$$A=\begin{bmatrix}1&2&3\\2&3&0\\0&1&2\end{bmatrix}$$ 7

(c) Evaluate by Green's theorem $\int_C \bar{F}\cdot d\bar{r}$ where $\bar{F}=-xy(xi-yj)$ and C is

$r=a(1+\cos\theta)$ 7

4. (a) Obtain complex form of Fourier series for the functions $f(x)=\sin ax$ in $(-\pi,\pi)$ 6

(b) For what value of λ, the following system of equations possesses a non-trivial solution? Obtain the solution for real values of λ.

$3x_1+x_2-\lambda x_3=0,\ 4x_1-2x_2-3x_3=0,\ 2\lambda x_1+4x_2+\lambda x_4=0$ 7

(c) Find inverse Laplace Transform of following

i) $2\tanh^{-1}s$ ii) $\frac{s^2}{(s^2+1)(s^2+4)}$ 7

5. (a) Find the orthogonal trajectory of the family of curves $3x^2y + 2x^2 - y^3 - 2y^2 = c$ 6

(b) Find the relation of linear dependence amongst the rows of the matrix

$$A = \begin{bmatrix} 1 & 1 & -1 & 1 \\ 1 & -1 & 2 & -1 \\ 3 & 1 & 0 & 1 \end{bmatrix}.$$ 7

(c) Express the function $f(x) = \begin{cases} -e^{kx}, & for\ x < 0 \\ e^{-kx}, & for\ x > 0 \end{cases}$ as Fourier Integral.

And prove that $\int_0^\infty \frac{\omega \sin \omega x}{\omega^2 + k^2}\, d\omega = \frac{\pi}{2} e^{-kx}$ *if* $x > 0, k > 0$ 7

6. (a) Obtain half-range cosine series for $f(x) = x$ *in* $0 < x < l$. 6

(b) Show that under the transformation $w = \frac{5 - 4z}{4z - 2}$ the circle $|z| = 1$ in the z-plane is transformed into a circle of unity in the w-plane. Also find the center of the circle. 7

(c) A vector field is given by $\overline{F} = 3x^2y\ i + (x^3 - 2yz^2)\ j + (3z^2 - 2y^2z)k$ is irrational. Also find ϕ such that $\overline{F} = \nabla\phi$. Also evaluate the line integral from $(2,1,1), (2,0,1)$. 7

7 (a) Find inverse Z-transform of $F(z) = \frac{z}{[z - (1/4)][z - (1/5)]}$, $\frac{1}{5} < |z| < \frac{1}{4}$ 6

(b) Find the analytic function $f(z) = u + iv$ in terms of z if $u - v = (x - y)(x^2 + 4xy + y^2)$ 7

(c) Using laplace transform solve the following differential equation with given condition. $(D^2 - 3D + 2)y = 4e^{2t}, \quad y(0) = -3, y'(0) = 5$ 7

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SE / ETRX / III (REV) 24/5/2012

Digital System Design

Con. 3892-12. **GN-5294**

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

N.B. : (1) Question No. **1** is **compulsory** and solve any **four** from remaining **six** questions.
(2) In **all** attempt **five** questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) Assume **data** if **necessary** and **justify** the **same**.

1. Answer the following :—
   (a) Construct Hamming code for BCD 0110. Use even parity. **5**
   (b) Explain the term 'metastability', its causes and effects. **5**
   (c) Define the following terms :— **5**
      (i) Fan out
      (ii) Noise margin
      iii) Fan in active pull up
      (iv) Propagation delay
      (v) Figure of merit.
   (d) Implement X-NOR operation using only minimum number of NAND gates. **5**

2. (a) Implement the following expression using IC 74138, 3:8 active low decoder and additional gates. **10**
   $F(A,B,C,D) = \prod M \{ 0, 6, 7, 8, 12, 13, 14, 15 \}$
   (b) Find reduced SOP form using K-maps, and implement using universal gates :— **10**
      (i) $f(A, B, C, D) = \Sigma m \{ 2, 3, 6, 7, 8, 9, 12, 13 \} + d(4, 10, 14)$
      (ii) $f(A, B, C, D) = \prod M \{ 0, 6, 7, 8, 12, 13, 14, 15 \}$

3. (a) Simplify the following using Quine Mc-Clusky method. **10**
   $f(A, B, C, D, E) = \Sigma m \{ 0, 1, 9, 15, 24, 29, 30 \} + d(3, 11, 31)$
   (b) Implement the following using single IC 74151 and some gates. **10**
      (i) $f1 = \Sigma m \{ 1, 2, 4, 7, 10, 13, 14 \}$
      (ii) $f2 = \Sigma m \{ 1, 4, 5, 7, 8, 12, 13, 15 \}$

4. (a) Determine whether any static 0 or static 1 hazards exist in the following Boolean expression. Identify where the hazards are and what must be done to avoid them. **10**
   $f(A,B,C,D) = \Sigma m \{ 5, 7, 8, 9, 10, 11, 13, 15 \}$
   (b) Explain and draw asynchronous counter for the following :— **10**
   -4- 5-6-7-8-9-10-11-12-13-14-15-

5. (a) Design and explain one digit BCD adder using IC 7483 and NAND gates. **10**
   (b) Write short notes on : **10**
      (i) ALU (ii) programmable logic unit

6. (a) Construct twisted ring counter using IC 74194 and draw the output wave-form. **10**
   (b) Draw and explain a 9 bit even parity checker using IC 74180. **10**

7. (a) Implement binary to BCD converter using universal gates. **10**
   (b) Explain the following :— **10**
      (i) Self complementing codes, with example.
      (ii) The term 'noise margin' and its value for TTL and CMOS families.

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SE | ETRX | III (REV) 19/5/2012

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Basic Electronic Circuits

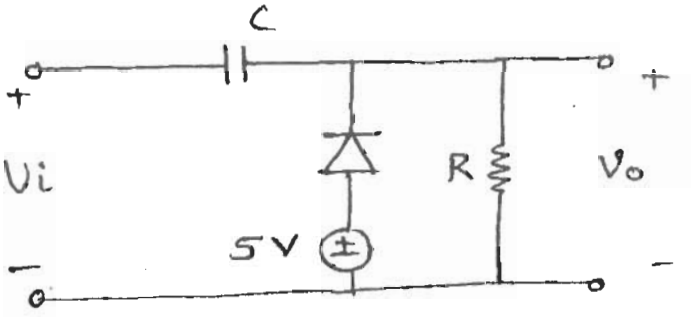
Con. 3760-12. **GN-5282**

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

N.B. (1) Question No. **1** is **compulsory** and **solve** any **four** questions out of remaining **six** questions.
(2) Assume **suitable** data **if necessary** and mention that assumption while solving that question.
(3) **Figures** to the **right** indicate **full** marks.

1. Any **four** :—

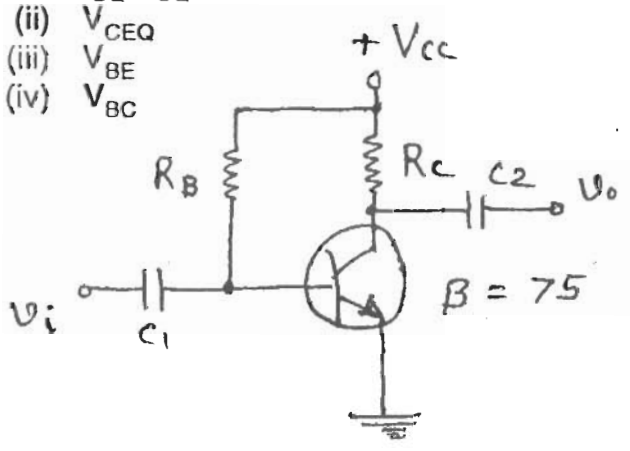
(a) **If** input V_i **is** 1 kHz square wave **with** 30 V p-p voltage applied to a given circuit with practical diode of silicon. Determine V_0 and draw waveform. 5



C = 1mF
R = 100 KW

(b) For the fixed-biased configuration given, determine the following :— 5

(i) I_{BQ}, I_{CQ}
(ii) V_{CEQ}
(iii) V_{BE}
(iv) V_{BC}



R_B = 240 kΩ
R_C = 2·2 kΩ
V_{CC} = +12 V
$C_1 = C_2$ = 10 μF

(c) Explain basic construction of a **n-channel** JFET and explain working of n-channel JFET for $V_{GS} = 0$ and $V_{GS} < 0$ and draw I_D v/s V_{DS} characteristic of the same. 5

(d) **If** I_E = 3·2 mA, h_{fe} = 150, h_{oe} = 25 μmho and h_{ob} = 0·5 μs for transistor then determine and draw : 5
(i) The common-emitter hybrid equivalent circuit
(ii) The common-base r_e model circuit.

(e) Compare 'L' and 'C' filter circuit. 5

2. (a) For a standard voltage-divider bias configuration of C-E amplifier with R_E bypassed by a capacitor CE the following data is given — 12

$V_{CC} = 22$ V, $R_1 = 56$ kΩ, $R_2 = 8{\cdot}2$ kΩ, $R_C = 6{\cdot}8$ kΩ, $R_E = 1{\cdot}5$ kΩ,

$C_{ci} = C_{co} = 10$ μF, $C_E = 20$ μF, $\beta = 90$.

Determine :

(a) r_e

(b) Z_i

(c) Z_0 for $r_0 = \infty\Omega$

(d) A_V for $r_0 = \infty\Omega$.

(e) Re-calculate parameters of part (b) through (d) if $r_0 = \frac{1}{h_{oe}} = 50\,k\Omega$ and compare the results.

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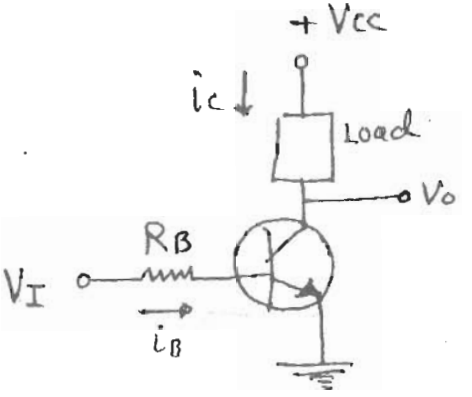
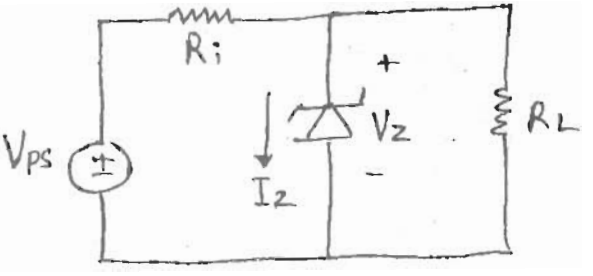
(b) A power transistor is used as a switch. Calculate the currents, output voltage and power dissipated in the transistor for the given circuit when $V_I = 0$ V and 12 V. Circuit and transistor parameters are : $R_B = 240\ \Omega$, $V_{CC} = 12$ V, $V_{BE\ (ON)} = 0{\cdot}7$ V, $V_{CE(Sat)} = 0{\cdot}1$ V, $\beta = 75$. Assume the load is a motor with an effective resistance of $R_C = 5\ \Omega$. 8



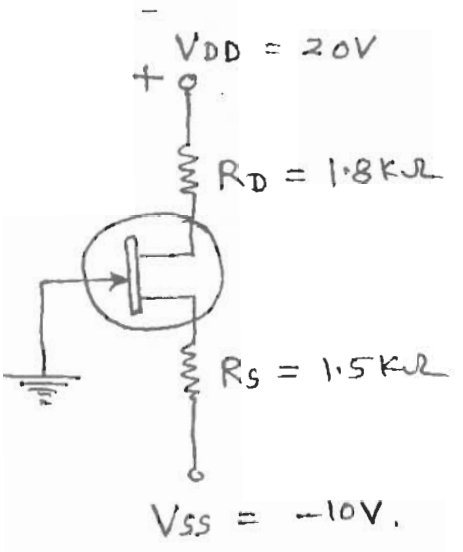
3. (a) Design a full wave bridge rectifier to meet particular specifications. It should produce a peak output voltage of 12 V and deliver 120 mA to the load R_L. Output must be with a ripple of not more than 5%. An input line voltage of 120 V (rms), 60 Hz is available. 8

(b) Draw and explain working of a voltage doubler circuit. 6

(c) The zener diode regulator circuit shown has an input voltage (V_{PS}) that varies between 10 and 14 V and load resistance varies between 20 Ω and 100 Ω. Assume 5·6 V. Zener diode is used and assume $I_{Z\ (min.)} = 0{\cdot}1\ I_{Z\ (max)}$. Find the value of R_i required and the minimum power rating of the diode. 6



4. (a) Determine the following for the given network I_{DSS} = 9 mA and V_P = –3 V. 10



(1) I_{DQ} and V_{GSQ}
(2) V_{DS}
(3) V_D
(4) V_S

You can use Graphical method.

(b) Draw npn BJT common collector (emitter follower) amplifier circuit and derive equation for small-signal voltage gain Av using rπ model. 10

5. Design a single stage CS JFET amplifier using potential divider biasing for the following specifications :— 20

   $V_0 = 2$ V
   $f_L = 20$ Hz
   $I_D = 3{\cdot}3 \pm 0{\cdot}6$ mA
   $|A_V| = 11$
   Use BFW 11.

   Calculate R_i, R_o and $V_{o\,(max)}$ for the designed amplifier.

6. Design a single stage CE BJT amplifier using BC 147A to satisfy the following specifications :— 20

   $|A_V| \geq 120$
   $SI_{CO} \leq 8$
   $V_{CC} = 24$ V
   $R_L = 10$ kW
   f_L is better than 10 Hz
   $I_{ca} = 3$ mA

   Estimate R_i and R_0 of designed amplifier. If $R_i \geq 3$ KΩ is a new specification added then without changing the selected transistor suggest suitable modifications in the above design. What sacrifices you have made ?

7. Write short notes (any **three**) :— 20

   (a) Construction, working and transfer characteristic of n-channel enhancement type MOSFET
   (b) Comparison of performance of CE, CB and CC BJT amplifiers
   (c) Construction, process of electroluminescence of Light-Emitting Diode (LED)
   (d) Multistage Amplifiers
   (e) Photodiodes and Schottky Barrier Diode.

BEC DATA SHEET

nsistor 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_{fe} °C/W	Dera above 25°C W/°C
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
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
149	30·0	4·0	1·0	50	40	—	—	8	150	30	50	110	33	60	115	1·2	4·0	0·3
100	5·0	0·7	0·6	70	60	65	—	6	200	50	90	280	50	90	280	0·9	35	0·05
47A	0·25	0·1	0·25	50	45	50	—	6	125	115	180	220	125	220	260	0·9	—	—
525(PNP)	0·225	0·5	0·25	85	30	—	—	—	100	35	—	65	—	45	—	—	—	—
47B	0·25	0·1	0·25	50	45	50	—	6	125	200	290	450	240	330	500	0·9	—	—

nsistor type	hie	hoe	hre	θja
147A	2·7 K Ω	18μ ℧	1·5 × 10^{-4}	0·4°C/mw
525 (PNP)	1·4 K Ω	25μ ℧	3·2 × 10^{-4}	—
147B	4·5 K Ω	30μ ℧	2 × 10^{-4}	0·4°C/mw
100	500 Ω	—	——	——
149	250 Ω	—	——	——
055	100 Ω	—	——	——
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

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}
822	50	50	50	300 mW	175°C	2 mA	3000 μ ℧	6	50 KΩ	2 mW/°C	0·59°C/mW
V 11 (typical)	30	30	30	300 mW	200°C	7 mA	5600 μ ℧	2·5	50 KΩ	——	0·59° C/mW