S.E. ETRX Sem-III

Con. 3135–11. **(REVISED COURSE)** Engg. Maths III **RK–1239**

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

N.B. (1) Question No. **1** is **compulsory.**
(2) Attempt any **four** out of remaining **six** questions.
(3) Make **suitable** assumptions if **required** and **justify** the **same.**
(4) A **figure to right indicates** the **full** marks.

1. **(a)** Find $L(t\sin^3 t)$ **05**

(b) Use the adjoint method to find the inverse of **05**

$$\begin{bmatrix} 1 & 0 & -1 \\ 3 & 4 & 5 \\ 0 & -6 & -7 \end{bmatrix}$$

(c) Determine the constants a,b,c,d if **05**

$f(z) = (x^2 + 2axy + by^2) + i(cx^2 + 2dxy + y^2)$ is analytic.

(d) Find complex form of Fourier Series for $f(x) = e^{-x}$ in $(-1, 1)$ **05**

2. **(a)** Show that $v = e^x \sin y$ is harmonic function. Find its harmonic conjugate and corresponding analytic function. **08**

(b) Show that the set of functions $\frac{\cos x}{\sqrt{\pi}}, \frac{\cos 2x}{\sqrt{\pi}}, \frac{\cos 3x}{\sqrt{\pi}}, \ldots\ldots$ from a orthonormal set in the interval $(-\pi, \pi)$. **06**

(c) Using Green's theorem evaluate $\int_c (x^2 y dx + x^2 dy)$ where c is the boundary described counter clockwise of the triangle with vertices (0,2), (2,0) and (4,2) **06**

3. **(a)** Find the Laplace transform of each of the following:-

(i) $\int_0^t u\cos^2 u du$ (ii) $te^{3t}\sin 3t$ **06**

(b) Find half range sine series for the function

$$f(x) = \frac{2x}{3}, \qquad 0 \le x \le \frac{\pi}{3}$$

$$= \frac{\pi - x}{3}, \qquad \frac{\pi}{3} \le x \le \pi$$

06

(c) Find non-singular matrices P & Q such that PAQ is normal form. Hence find its rank where A is given by

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & -1 & -1 \\ 3 & 1 & 1 \end{bmatrix}$$

08

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4. (a) Solve the system of equations $3x+3y-z=11$, $2x-y+2z=9$, $4x+3y+z=25$ 06

(b) Find the inverse Laplace transform of the following

(i) $\cot^{-1}(as)$ (ii) $\dfrac{8e^{-3s}}{(s+4)^3}$ 06

(c) Expand the function $f(x)$ with period 2 into a Fourier Series.

$$f(x)=\pi x, \quad 0\le x\le 1$$
$$=0, \quad 1\le x\le 2$$

08

5. (a) Using Convolution theorem, Find the inverse Laplace transform of the following

$$\frac{s^2}{(s^2+a^2)(s^2+b^2)}$$ 06

(b) Find the analytic function and its imaginary part if real part is

$$u=x^3-3xy^2+3x^2-3y^2+1$$ 06

(c) Prove that $\vec{F}=(y^2\cos x+z^3)i+(2y\sin x-4)j+(3xz^2+2)k$ is a conservative field. Find (i) scalar potential (ii) the work done in moving an object in this field from (0, 1, -1) to $(\frac{\pi}{2}, -1, 2)$. 08

6. (a) Using Laplace transformation, solve the following equation.

$$(D^2+3D+2)y=2(t^2+t+1), \text{with } y(0)=2 \& y'(0)=0$$ 06

(b) Find the orthogonal trajectories of the family of curves

$$x^3y-xy^3=c$$ 06

(c) Find the inverse Z – transform of

$$F(z)=\frac{1}{(z-3)(z-2)}$$

If ROC is (i) $|z|<2$ (ii) $2<|z|<3$ (iii) $|z|>3$ 08

7. (a) Evaluate the following integral by using Laplace transform

$$\int_0^\infty \frac{\cos 4t-\cos 3t}{t}dt$$ 06

(b) Find the bilinear transformation which maps the points $2, i, -2$ onto points $1, i, -1$ and also find the fixed points. 08

(c) Find Fourier integral representation of

$$f(x)=e^{ax}, \quad x\le 0, a>0$$
$$=e^{-ax} \quad x\ge 0, a>0$$ 06

SE (ETRX) SEM-III (R)
Electrical Network Analysis and Synthesis

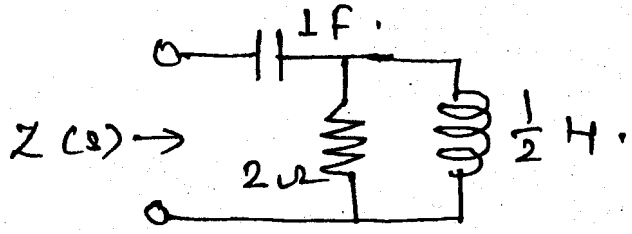
Karu-upq kl-11 94

Con. 3379–11. **RK–1245**

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

N.B. : (1) Question No. **1** is **compulsory**
(2) Attempt any **four** out of remaining **six** questions.
(3) Assume **suitable** data wherever **required** but justify the **same**.
(4) **Figures** to the **right** indicate **full** marks.

1. Solve the following — **20**
   (a) State the properties of positive real function.
   (b) Find poles and zeros of the impedance of the following network and plot it on s-plane.



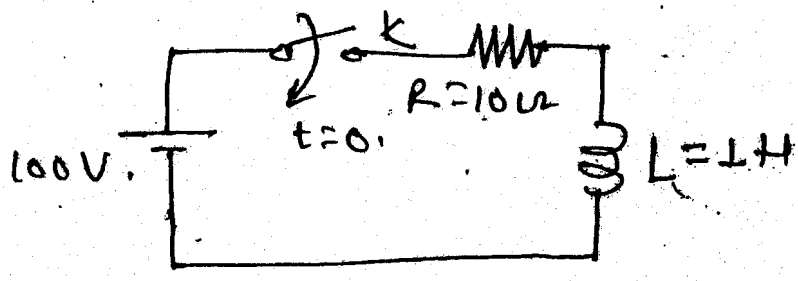
   (c) Explain Y-parameters interms of Z-parameters.
   (d) State the properties of Hurwitz polynomial.

2. (a) The reduced incidence matrix of an oriented graph is. **10**

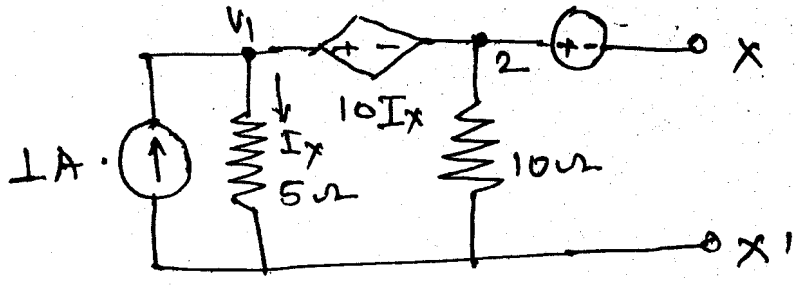
$$A=\begin{bmatrix} 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & -1 & -1 \\ -1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

   (i) Draw the graph.
   (ii) How many trees are possible for this graph ?
   (iii) Write TIE set and Cut set.

   (b) The switch is closed at t = 0. Find value of I, di/dt, d^2i/dt^2 at $t = 0^+$. Assume initial current of inductor to be zero for circuit given below. **10**



3. (a) Find Thevenin's equivalent of circuit shown below to the left of X–X'. **10**



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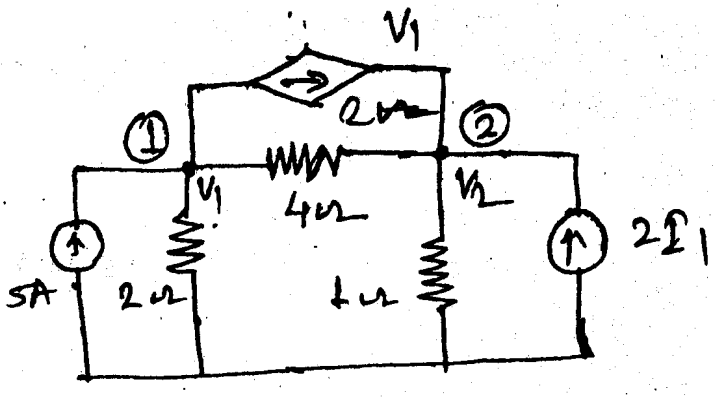
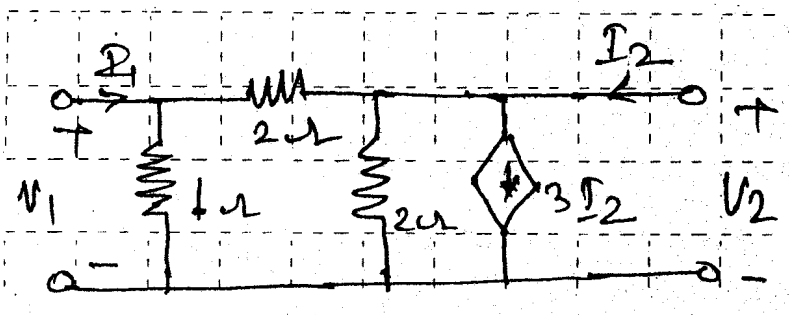
(b) Determine the node voltage at node (1) and (2) of network shown in **figure** below by using nodal analysis. 10



4. (a) Find Z and Y parameters. 10



(b) Realise the function in FI and FII forms. 10

$$Y(s) = \frac{s(s+2)(s+6)}{(s+1)(s+4)(s+8)}$$

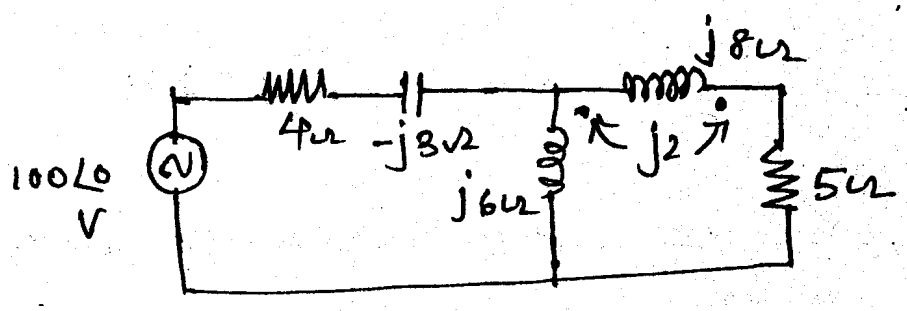
5. (a) Check the following polynomials for Hurwitz. 10

(i) $P(s) = s^4 + s^3 + 4s^2 + 2s + 3$

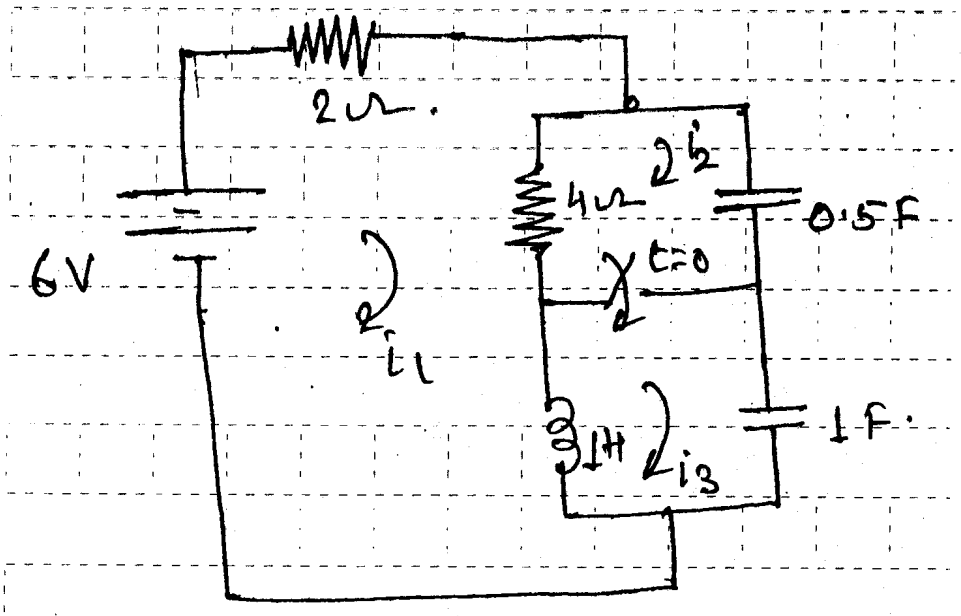
(ii) $P(s) = s^3 + 4s^2 + 5s + 20$.

use continued fraction Expansion.

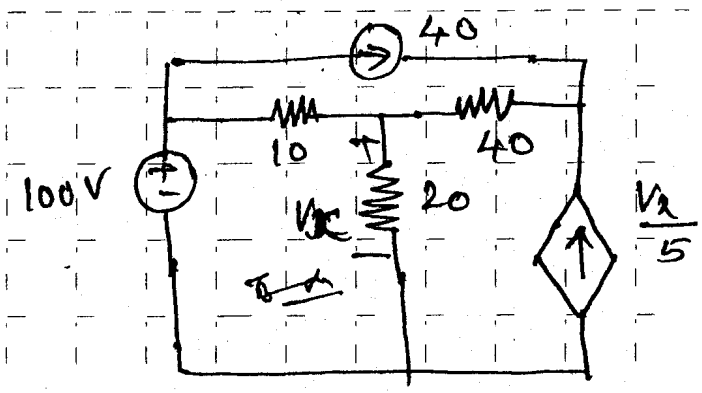
(b) Calculate the mesh currents for the circuit shown. 10



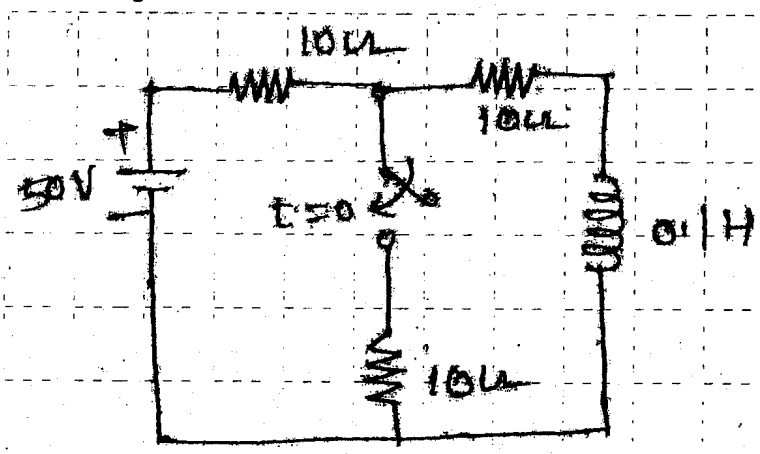
6. (a) Find three loop currents at $t = 0^+$. 10



(b) Find magnitude of VCCS by mesh analysis. 10



7. (a) Find i through circuit as shown in **figure** below if the switch is closed at t = 0. 10



(b) Test which of the following are positive functions. 10

(i) $\dfrac{s+2}{s^2+3s+2}$ (ii) $\dfrac{s^2+6s+2}{s^2+3s+5}$

SE ETRX III (REV)
Control system

82 : 1st half.11-PH(I)

Con. 3081-11.

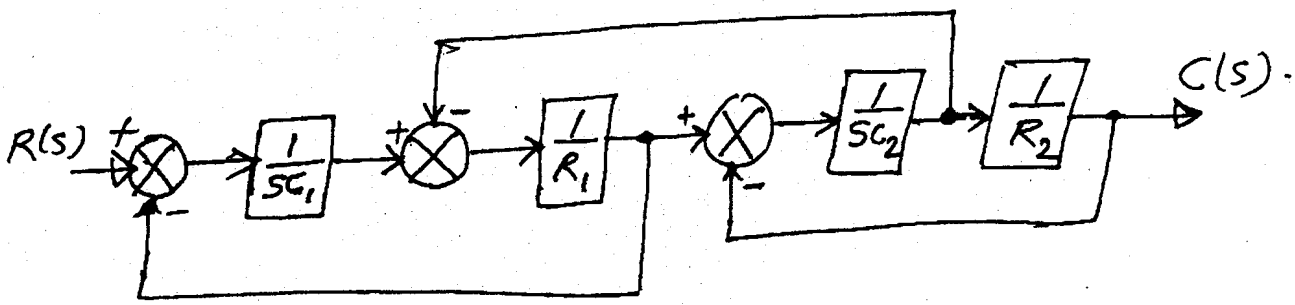
RK-1236

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

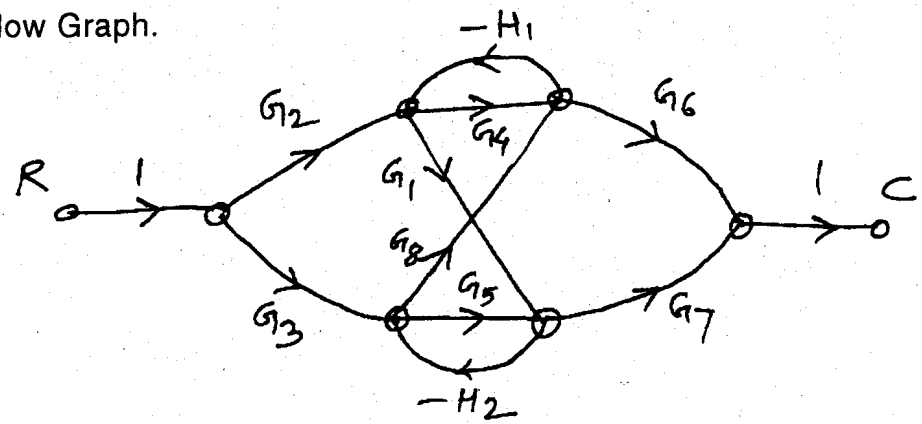
N.B. : (1) Question No. **1** is **compulsory**.
(2) Solve **five** questions in total.
(3) Assume suitable data wherever **required**.

1. Attempt following :– **20**
   (a) Explain, with appropriate examples, open loop and closed loop control system.
   (b) Derive the expression for peak time of second order underdamped control system for unit step input.
   (c) What are the effects of feedback on control system ?
   (d) Explain the comparisons between the Time response analysis and Frequency response analysis of control system.
   (e) What are the standard test inputs ? Explain each in brief.

2. (a) Explain various rules for block diagram reduction process. **5**
   (b) Explain the Mason's Gain formula with reference to Signal Flow Graph Technique. **5**
   (c) Determine the transfer function of a control system shown by following block diagram. **10**



3. (a) Obtain the overall transfer function of a control system shown by following Signal Flow Graph. **10**



   (b) Derive the output response of a second order underdamped control system for unit step input. **10**

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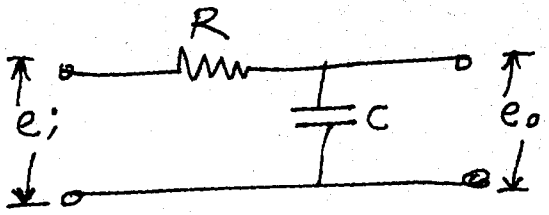
4. (a) Derive the transfer function of a DC servometor. 10
   (b) Explain synchro as an error detector. 10

5. (a) Show the pole locations of a second order control system for various values of damping ratio. 5
   (b) Derive the time response of first order control system for unit step input. Show the graph of error and output with respect to time. 5
   (c) Draw the Bode plot of a control system shown by following transfer function– 10

$$G(s)=\frac{64(s+2)}{s(s+0.5)\left(s^2+3.2s+64\right)}$$

6. (a) Derive the value of k_p, k_v and k_a for type 0, type 1 and type 2 control system. 5
   (b) What is the effect of adding zero to a control system ? 5
   (c) Draw the polar plot of a RC filter circuit shown below– 10



7. (a) Sketch the Root locus for a open loop transfer function of a control system– 10

$$G(s)H(s)=\frac{K}{s\left(s+4\right)\left(s^2+4s+10\right)}.$$

   (b) Determine the stability of a system shown by following open loop transfer function using Nyquist criterion – 10

$$G(s)H(s)=\frac{(4s+1)}{s^2(s+1)(2s+1)}.$$

S.E. ETRX III (Rev)
Digital System Design I

ws-Scan Paper -3 2

Con. 3837–11. **RK–1242**

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

N.B. : Question No. 1 is compulsory. Solve any four from rest six.

1. Answer the following questions: Each question carries 5 marks. 20

   (a) Construct Hamming code for BCD 0111. Use even parity.

   (b) Construct an EX-OR gate using universal gates.

   (c) Draw the circuit of 2-input TTL NAND gate.

   (d) Explain with example self-complementing codes

2. (a) Simplify the following 4 variable Boolean expression using Quine-McCluskey method 10
   $F = \Sigma m\ (0,1,3,7,9,15) + d(8,11)$

   (b) For the expression $Y = (P + Q)(Q'+R')$

   i) Convert to standard POS 4

   ii) Reduce using K-map 4

   iii) Construct circuit using NOR gates only 2

3. (a) Implement the following expression using IC 74138, 3:8 active low decoder and additional gates
   $F(A,B,C,D) = \pi M\ (0,6,7,8,12,13,14,15)$ 10

   (b)Find the reduced SOP form using K-map 5

   $F(A,B,C,D) = \Sigma M\ (0,6,7,8,12,13,14,15)$
   Implement using only NAND gates

   (c) Explain the term " noise margin" and its values for TTL and CMOS families. 5

4. (a)Design and explain 8 bit binary adder using IC 7483 10

(b) Design an clocked MN flip-flop using JK flip-flop. The function table of MN flip-flop is as follows: 10

M	N	Q_{n+1}
0	0	Q_n'
0	1	0
1	0	1
1	1	Q_n

5. (a) Explain and draw MOD – 10 asynchronous counter using T- FF. Draw output waveforms and show where glitches occur. 10

(b) A parking lot has 4 parking slots. A car requires 1 empty slot, a tempo requires 2 empty adjacent parking slots and a truck requires 3 empty adjacent parking slots. Each slot has a sensor which indicates a'1' when slot is full and indicates a'0' when slot is empty. Generate 3 outputs: car, tempo and truck which indicate which vehicle should be allowed to park. 10

6. (a)Construct a ring counter using IC 74194 and draw the output waveforms. 10

(b) Consider the expression $Y = AD' + BD$. Find out whether any hazard exits in the hardware implementation. If yes, eliminate the hazard. 10

7. (b) Draw and explain a 9 - bit even parity checker using IC 74180 10

(a) Implement the function using single IC 74151 and some gates 10
$F = \Sigma m\ (1,2,4,7,10,13,14)$

Basic Electronics circuits
SE (ETRX) Sem - III

93 : 1st half.11-PH(I)

Con. 3265-11.

RK-1233

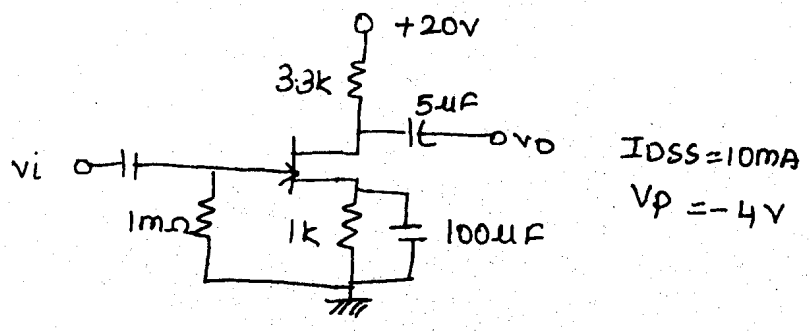
(3 Hours)

[Total Marks : 100

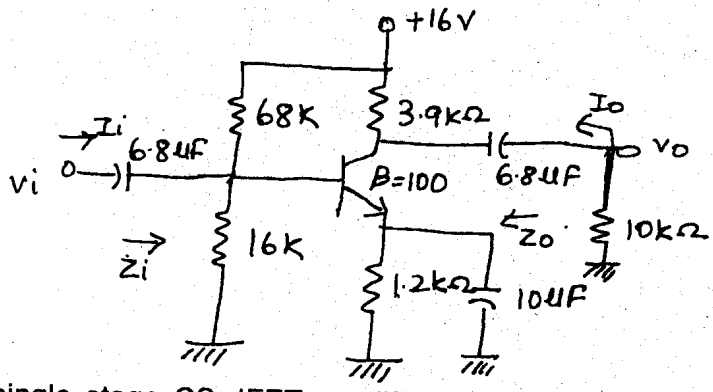
N.B. : (1) Question No. 1 is **compulsory.**
(2) Answer any **four** out of remaining **six** questions.
(3) Assume any **suitable** data wherever **required.**

1. Answer the following questions :–
   (a) Compare common base, common collector and common emitter BJT amplifier. 5
   (b) Derive the condition for zero temperature drift biasing of FET. 5
   (c) Draw the circuit diagram of voltage multiplier and explain its operation. 5
   (d) Explain Zener as Voltage Regulator. 5

2. (a) Draw the common emitter $r\pi$ equivalent circuit of the BJT transistor with RE unbypassed and drive the expression for the following :– 10
      (i) Input resistance
      (ii) Output resistance
      (iii) Voltage gain.
   (b) Derive the equations for A_v, Z_i, Z_0 and determine A_v, Z_i and Z_0 for a given network. 10



3. (a) Draw a circuit diagram of a fullwave rectifier with C filter. Derive expression for ripple factor and also explain the basic rectifier operation. 10
   (b) For the given circuit find :– 10
      (i) Determine Z_i, Z_0 and A_v no load
      (ii) A_v with load
      (iii) A_i



4. Design a single stage CS JFET amplifier using potential divider biasing for the following specification :– 20

   $V_0 = 2V$, $f_L = 20$ Hz, ID = 3·3 ± 0·6 mA
   $|A_v| = 11$. Use BFW 11
   Calculate R_i, R_0 and V_0 (max) for the designed amplifier.

5. Design a single stage CE amplifier for voltage gain AV ≥ 170, V_0 = 6V rms, F_L = 20 Hz, $S_{ICO} \geq 10$. 20
   Calculate Z_i, Z_0 and A_v for the designed circuit.
   Use a suitable transistor from the data sheet.

6. (a) Explain construction, working principle and characteristic of E MOSFET. 10
   (b) Compare L and C Filter. 5
   (c) Comapre MOSFET and FET. 5

7. Write a short note on the following :– 20

(a) Schottky diode

(b) Diode clamping circuits : Working and waveforms.

(c) Temperature effects in MOSFET

(d) Transistor as a switch.

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DBEC DATA SHEET

istor 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_{EBO} 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_{j-a} °C/W	Derate above 25°C W/°C
055	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
7A	0·25	0·1	0·25	50	45	50	—	6	125	115	180	220	125	220	260	0·9	—	—
5(PNP)	0·225	0,5	0·25	85	30	—	—	—	100	35	—	65	—	45	—	—	—	—
7B	0·25	0·1	0·25	50	45	50	—	6	125	200	290	450	240	330	500	0·9	—	—

istor type	hie	hoe	hre	θja
47A	2·7 K Ω	18μ ℧	1·5 × 10^{-4}	0·4°C/mw
25 (PNP)	1·4 K Ω	25μ ℧	3·2 × 10^{-4}	—
47B	4·5 K Ω	30μ ℧	2 × 10^{-4}	0·4°C/mw
100	50 Ω	—	—	—
149	15 Ω	—	—	—
055	12 Ω	—	—	—
055	6 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

annel *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_{fs} (typical)	$-V_p$ Volts	r_d	Derate above 25°C	θ_{j-a}
22	50	50	50	300 mW	175°C	2 mA	3000 μ ℧	6	50 KΩ	2 mW/°C	0·59°C/mW
11 (typical)	30	30	30	300 mW	200°C	7 mA	5600 μ ℧	2·5	50 KΩ	—	0·59° C/mW