Time: 3 hrs. **Max. Marks: 80**

N.B. : 1. Q1 is compulsory
2. Attempt any three questions from Q2 to Q6.
3. Figures to the right indicate full marks.

Q1. (a) Evaluate the integral $\int_C \frac{z^2}{(z-i)(z+2)^2}\,dz$, C: $|z-i|=1$. **5**

(b) A r.v. X has the distribution **5**

x:	0	1	2	3	4	5	6	7
p(x):	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

Find i) k ii) evaluate $P(X<6)$

(c) Find the usual inner product between the two vectors $(2,1,-3)$ **5**
and $(-1,1,2)$. Find the norm of each vectors and verify the Cauchy Schwarz inequality.

(d) The given data indicates weight x and heights y of 1000 men. $\bar{x}=150$ lbs, **5**
$\bar{y}=68$ inches, $\sigma_x=20$ lbs, $\sigma_y=2.5$ inches, $r=0.6$. John weighs 200 lbs.
Find the line of regression of y on x and estimate the height of John.

Q2. (a) Find the Extremal of $\int_{x_1}^{x_2}\sqrt{1+(y')^2}\,dx$. **6**

(b) Find the Laurent series expansion of $\frac{z+2}{z^2-1}$ convergent in the **6**
domain $|z|>1$.

(c) Reduce the quadratic form $x_1^2+2x_2^2+2x_3^2-2x_1x_2+x_1x_3-2x_2x_3$ **8**
to diagonal form by congruent transformation. Obtain the transformation applied in the reduction and Find the rank, index and class value.

Q3. (a) Find the Extremal of $\int_0^1 y\,y' + (y'')^2\ dx$, **6**

$y(0) = 0,\ y'(0) = 1,\ y(1) = 2,\ y'(1) = 4$

(b) From a vessel containing 3 white and 5 black balls, 4 balls are transferred into an empty vessel. From this vessel a ball is drawn and found to be white. Find the probability that out of four balls transferred 3 are white and 1 is black. **6**

(c) Find a singular value decomposition of the matrix $\begin{bmatrix} 1 & 1 \\ 1 & -1 \\ 1 & -1 \end{bmatrix}$. **8**

Q4. (a) Evaluate the integral $\int_C \frac{\sin^2 z}{z^3}\ dz,\ C: |z| = 1,$ using Cauchy integral formula. **6**

(b) Using Gram Schmidt method, find an orthogonal set of vectors corresponding to $(1,1,0,1), (-1,0,1,0), (0,0,1,-1)$. **6**

(c) After correcting 50 pages of the proof of a book, the proof reader finds that there are on the average 2 errors per 5 pages. How many pages would one expect to find with 0, 1, 2, 3 errors in 1000 pages of the first print of the book. **8**

Q5. (a) Evaluate the Integral $\int_C \bar{z}\ dz$ along astraight line from $z = 0$ to $z = 4 + 2i$. **6**

(b) Find the rank correlation coefficient for the following data. **6**

x	:	10	12	18	16	15	40
y	:	12	18	20	15	50	25

(c) Using Rayleigh-Ritz method, find an approximate solution for the Extremal of $\int_0^1 (y')^2 - 4y^2 + 2x^2 y\ dx,\ y(0) = 0,\ y(1) = 0$ **8**

Q6. (a) If $f(x)=\begin{cases}\frac{x}{2} & 0<x<2\\ 0 & \text{otherwise}\end{cases}$ is a pdf of a random variable X, then **6**

find $E(X)$, $\text{var}(X)$, $\text{var}(3X)$.

(b) Let $W_1=\{(x,y)\mid x,y \text{ are real numbers, } y=mx\}$ and **6**

$W_2=\{(x,y)\mid x,y \text{ are real numbers, } xy\geq 0\}$. Show that

W_1 is a subspace and W_2 is not a subspaces of two dimensional space.

(c) A Chemical Engineer is investigating the effect of process operating **8**

temperature x on product yield y. The study results in the following data

x :	100	110	120	130	140	150	160	170	180	190
y :	45	51	54	61	66	70	74	78	85	89

Find the equation of the least square lines which will enable us to predict

(i) yield on the basis of temperature (ii) temperature on the basis of yield.

Duration: 3hrs **[Max Marks:80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1 Attempt any FOUR [20]

a What are the advantages & disadvantages of negative feedback?

b Draw block diagram of oscillator. State and explain Barkhausens criteria

c Write a short note on current mirror circuit

d Derive efficiency of Class A transformer coupled power amplifier

e Compare voltage amplifier and power amplifier

2 a Determine the lower cut off frequency due to the effect of coupling and bypass capacitors for an amplifier in figure 1 with the following specifications: [10]

Vcc = 20V, R1 = 40KΩ, R2 = 10KΩ, Rc = 4KΩ, RE = 2KΩ, RL = 2.2KΩ
CC1 = 10μF, CC2 = 1μF, CE = 20μF, Assume ro = ∞ and β = 100

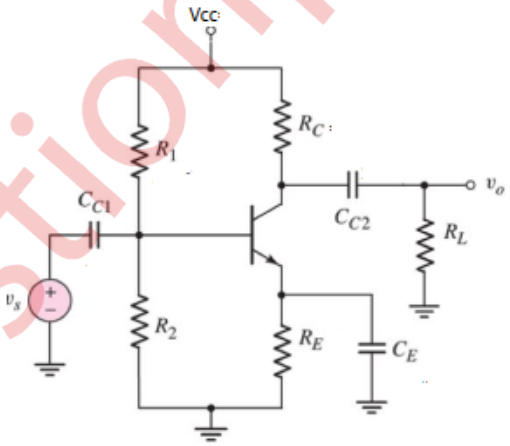

Figure. 1

b Write a short note on FET Cascode amplifier (CS-CG). [10]

3 a Explain voltage series negative feedback amplifier with help of block diagram and derive expression for Rif, Rof and Af. [10]

b Explain the Hartley oscillator with neat labelled diagram. Describe its advantages, disadvantages and applications. [10]

4 a Explain in brief MOSFET differential amplifier with active load and small signal analysis of MOSFET active load circuit [10]

b Explain Class-B power amplifier and crossover distortion. Drive expression for its efficiency. [10]

5 a Explain the Low frequency response of CS amplifier with proper equations. [10]

b Write a short note on types of coupling used in multistage amplifiers [10]

6 a For the differential amplifier in Figure 2, the parameters are: $V^+ = 5\,\text{V}, V^- = -5\,\text{V}, R_1 = 80\text{k}\Omega$, and $R_D = 40\text{k}\Omega$. The transistor parameters are $\lambda = 0$ and $V_{TN} = 0.8\,\text{V}$ for all transistors, and $K_{n3} = K_{n4} = 100\mu\text{A/V}^2$ and $K_{n1} = K_{n2} = 50\mu\text{A/V}^2$. Determine the range of the common-mode input voltage. [10]

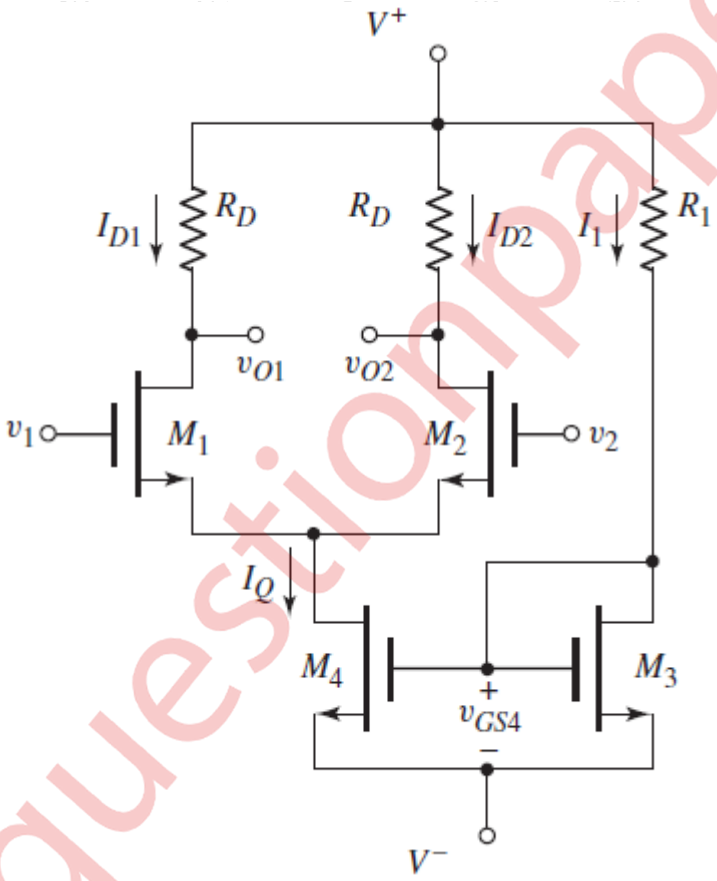

Figure 2.

b Calculate AC Power delivered to the 8Ω speaker, DC input power, power dissipated by the transistor and efficiency of the circuit shown in figure 3. [10]

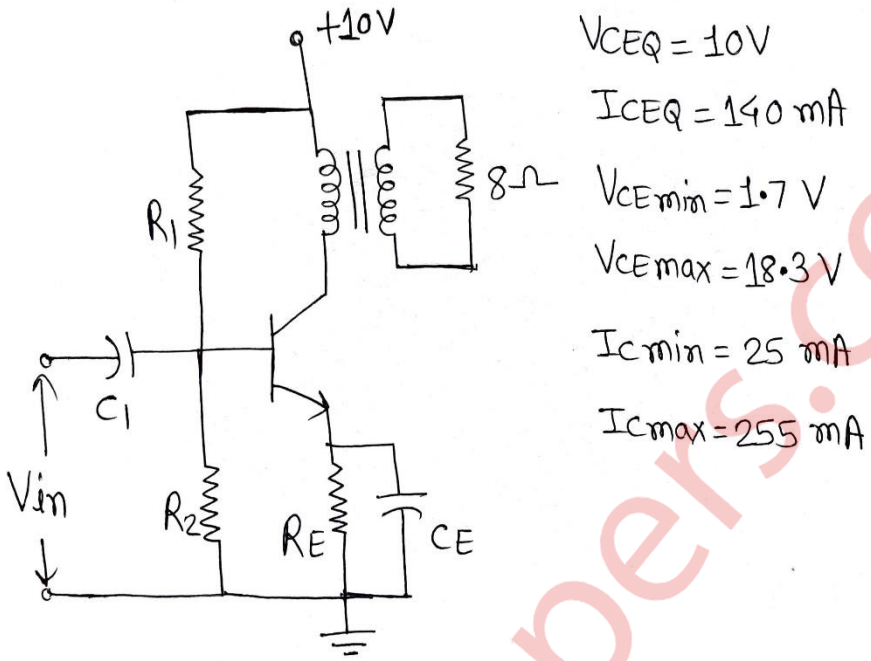

Figure 3.

Duration: 3hrs **[Max Marks:80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1		Attempt any FOUR	
	a	Give five points of comparison for RISC and CISC software architecture.	[5]
	b	Explain T state, Instruction Cycle and Machine Cycle	[5]
	c	Explain any five Data transfer instruction of 8051 micro controller	[5]
	d	Describe the following SFR's i) IE, ii) IP, iii) SCON, iv) SBUF, v) TMOD	[5]
	e	Explain Embedded C data types in detail.	[5]
2	a	Explain Memory organization of 8051 with proper diagram.	[10]
	b	Explain the Interrupt structure for 8051.	[10]
3	a	Write a program to transmit letter 'M' serially with a baud rate of 9600.	[10]
	b	Explain Addressing modes of 8051 with a example	[10]
4	a	Using internal Timers write program in assembly language program to generate a square wave of 10 KHz frequency and 50% duty cycle on port p2.5.use crystal frequency of 11.0592 MHz.	[10]
	b	Draw and explain Architecture of 8051.	[10]
5	a	Interface stepper motor with 8051 and write a program to rotate the motor Clockwise and anticlockwise.	[10]
	b	Write a note on Low power modes of 8051.	[10]
6	a	Design 8051 based system for following specifications i)32 KB ROM ii)32 KB RAM Show detail memory mapping and draw an interfacing diagram in detail	[10]
	b	Interface 7-segment LED display to 8051 and write a program to display digit 0 t0 9.	[10]

Time: 3 Hours **Max. Marks: 80**

Note: -1. Question no. 1 is compulsory.
2. Answer any three out of remaining questions.
3. Figures to right indicate full marks.
4. Assume suitable data wherever necessary.

Q.1 a) state whether the signal x(n) is energy or power signal, $x(n)= (0.5)^n u(n)$ [5]

b) A discrete time signal is given x(n) [5]

$x(n)= \{1, 1, \underset{\uparrow}{1}, 1, 2\}$

sketch i) x(n-2), ii)x(n+1) iii)x(3-n) iv) x(n) u(n-1)

c) Find the Laplace Transform of $x(t)= 5 e^{4t}+6t^3- 3\sin5t+2\cos2t$ [5]

d) Determine Z transform & ROC of signal $x(n)=[3(4)^n-5(3)^n] u(n)$ [5]

Q.2 a) Determine whether the system described by Y(t) = x(0.5t) is [10]
i) Linear ii)Memoryless iii)Causal iv)Time invariant v)stable

b) Perform the convolution [10]

i) x(t) = t. u(t) $h(t) = e^{-t}$ for $t\geq 0$

ii) x(t)= u(t-1) h(t) = u(t-2)

Q3 a) Given the Laplace Transform of $x(s) = \frac{2s}{s^2+2}$ where x(t)=0 for t≤0 [10]

Determine the Laplace Transform of the following using properties

i)x(3t) ii) convolution $x(t)* \frac{dx(t)}{dt}$ iii) x(t-2) iv) $e^{-t}x(t)$ v) 2t x(t)

b) Obtain inverse Laplace Transform of $x(s) = \frac{3S+7}{s^2-2S-3}$

For ROC Re(s)>3, Re(s)<-1, -1<Re(s)<3 [10]

Q 4 a) i) State and prove Time scaling property of Z transform [5]

ii) Obtain Z transform of signal $x(n) = n a^n u(n)$ [5]

b) Obtain Transfer function, Find Impulse response, ROC & stability for given system

$Y(n)= - 0.5y(n-1)+ x(n)$ where $x(n) = 3^n u(n)$ [10]

Q5 a) Determine the spectra of periodic signal x(n) = {1,1,1,0} with period N=4 using discrete Time Fourier series [10]

b) Obtain the Fourier Transform& sketch amplitude spectrum of rectangular pulse of duration T & amplitude A [10]

rect(t/T)= A for –T/2 to T/2

= 0 elsewhere

Q6 a) Find Fourier transform of (10)

i) Delta function ii) Signum function.

b) Explain necessary conditions for the existing of Fou rier series. (5)

c) Define ROC for Laplace transform and state all the properties of L. T. (5)

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