CBCS SCHEME

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18MAT41

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Complex Analysis, Probability and Statistical Methods

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Show that $f(z) = \sin z$ is analytic and hence find $f'(z)$. **(06 Marks)**

b. Derive Cauchy Riemann equation in polar form. **(07 Marks)**

c. If f(z) is analytic, prove that $\left(\frac{\partial}{\partial x}|f(z)|\right)^2 + \left(\frac{\partial}{\partial y}|f(z)|\right)^2 = |f'(z)|^2$. **(07 Marks)**

OR

2 a. Find the analytic function whose imaginary part is $e^x(x\sin y + y\cos y)$. **(06 Marks)**

b. Show that $u = \sin x\cosh y + 2\cos x\sinh y + x^2 - y^2 + 4xy$ is harmonic. Also determine the analytic function f(z). **(07 Marks)**

c. Derive Cauchy Riemann equation in Cartesian form. **(07 Marks)**

Module-2

3 a. State and prove Cauchy's integral formula. **(06 Marks)**

b. Discuss the transformation $\omega = z^2$ **(07 Marks)**

c. Find the bilinear transformation which maps the points $z = \infty, i, 0$ into $\omega = -1, -i, 1$. Also find the fixed points of the transformation. **(07 Marks)**

OR

4 a. Evaluate $\int_C |z|^2 dz$ where C is the square with vertices (0, 0), (1, 0), (1, 1), (0, 1). **(06 Marks)**

b. Evaluate $\int_C \frac{e^{2z}}{(z+1)(z-2)}$ where C is the circle $|z| = 3$. **(07 Marks)**

c. Find the bilinear transformation which map the points $Z_1 = i$, $Z_2 = 1$, $Z_3 = -1$ onto the points $\omega_1 = 1$, $\omega_2 = 0$, $\omega_3 = \infty$. **(07 Marks)**

Module-3

5 a. The probability distribution of a random variable X is given by the following table:

x	0	1	2	3	4	5	6	7
P(x)	0	K	2K	2K	3K	K^2	$2K^2$	$7K^2+K$

(i) Find K

(ii) Evaluate $P(X < 6)$ and $P(3 < x \leq 6)$ **(06 Marks)**

b. The number of telephone lines busy at an instant of time is a binomial variate with probability 0.1 that a line is busy. If 10 lines are chosen at random, what is the probability that, (i) no line is busy (ii) all lines are busy (iii) at least one line is busy (iv) Atmost 2 lines are busy. **(07 Marks)**

c. In a certain town the duration of a shower is exponentially distributed with mean 5 minutes. What is the probability that a shower will last for :
   (i) 10 minutes or more
   (ii) Less than 10 minutes.
   (iii) Between 10 and 12 minutes **(07 Marks)**

OR

6 a. The probability density function of a random variable is,

$$P(x)=\begin{cases} Kx^2, & -3\le x\le 3 \\ 0, & \text{Otherwise} \end{cases}$$

Find (i) K (ii) $P(1\le x\le 2)$ (iii) $P(x\le 2)$ **(06 Marks)**

b. The probability that a news reader commits no mistake in reading the news is $\frac{1}{e^3}$. Find the probability that on a particular news broadcast he commits (i) Only 2 mistakes (ii) more than 3 mistakes (iii) atmost 3 mistakes, assuming that mistakes follow Poisson distribution. **(07 Marks)**

c. The marks of 1000 students in an examination follows a normal distribution with mean 70 and standard deviation 5. Find the number of students whose marks will be, (i) less than 65, (ii) more than 75 (iii) between 65 and 75. (Given $\phi(1)=0.3413$) **(07 Marks)**

Module-4

7 a. The ranking of 10 students in two subjects, Field theory (A) and Network Analysis (B) are given below:

Roll No. of the students	1	2	3	4	5	6	7	8	9	10
A	3	5	8	4	7	10	2	1	6	9
B	6	4	9	8	1	2	3	10	5	7

Calculate the Rank correlation coefficient. **(06 Marks)**

b. Fit a parabola $y=a+bx+cx^2$ for the data.

x	0	1	2	3	4
y	1	1.8	1.3	2.5	2.3

(07 Marks)

c. In a partially destroyed Laboratory record of an analysis. The lines of regression of y on x and x on y are available as $4x-5y+33=0$ and $20x-9y-107=0$. Calculate $\bar{x},\bar{y}$ and coefficient of correlation between x and y. **(07 Marks)**

OR

8 a. If θ is the angle between the two regression lines, show that

$$\tan\theta=\frac{1-r^2}{r}\cdot\frac{\sigma_x\sigma_y}{\sigma_x^2+\sigma_y^2}$$

(06 Marks)

b. Fit a straight line in the least square sense for the following data:

x	50	70	100	120
y	12	15	21	25

(07 Marks)

c. Find the coefficient of correlation for the data.

x	10	14	18	22	26	30
y	18	12	24	6	30	36

(07 Marks)

Module-5

9 a. Determine (i) Marginal distribution (ii) Covariance between the discrete random variables X and Y along with the joint probability distribution.

X \ Y	1	3	9
2	$\frac{1}{8}$	$\frac{1}{24}$	$\frac{1}{12}$
4	$\frac{1}{4}$	$\frac{1}{4}$	0
6	$\frac{1}{8}$	$\frac{1}{24}$	$\frac{1}{12}$

(06 Marks)

b. In 324 throws of a six faced 'die', an odd number turned up 181 times. Is it possible to think that the 'die' is an unbiased one? **(07 Marks)**

c. A random sample of 10 boys had the following:
I.Q : 70, 120, 110, 101, 88, 83, 95, 98, 107, 100
Does the data support the assumption of a population mean I.Q of 100 at 5% level of significance?
$\left(\text{Note}: t_{0.05} = 2.262 \text{ for g d.f}\right)$ **(07 Marks)**

OR

10 a. Explain the terms : (i) Null hypothesis (ii) Confidence intervals (iii) Type I and II errors **(06 Marks)**

b. The joint probability of the random variable X and Y as follows :

X \ Y	−4	2	7
1	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{8}$
5	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{8}$

Compute :
(i) E(X) and E(Y)
(ii) E(XY)
(iii) σ_X and σ_Y
(iv) COV(X, Y) **(07 Marks)**

c. Fit a Poisson distribution for the data and test the goodness of fit given that $\chi^2_{0.05} = 7.815$ for 3 d.f

x	0	1	2	3	4
f	122	60	15	2	1

(07 Marks)

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CBCS SCHEME

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18MATDIP41

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Find the rank of the matrix

$$A = \begin{bmatrix} 2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$$ by applying elementary row transformations. **(06 Marks)**

b. Solve the following system of equations using Gauss elimination method : $x - 2y + 3z = 2$, $3x - y + 4z = 4$ and $2x + y - 2z = 5$. **(07 Marks)**

c. Find the eigen values of

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$ and also the corresponding eigen vectors. **(07 Marks)**

OR

2 a. Find the rank of the matrix by reducing if to echelon form

$$A = \begin{bmatrix} 1 & 2 & 2 & 4 \\ 2 & 3 & 4 & 6 \\ 3 & 5 & 6 & 10 \\ 4 & -1 & -3 & 2 \end{bmatrix}$$ **(06 Marks)**

b. Test for consistency and solve $5x + 3y + 7z = 4$, $3x + 26y + 2z = 9$, $7x + 2y + 10z = 5$. **(07 Marks)**

c. Solve the following system of equations by Gauss elimination method : $x + 2y + z = 3$, $2x + 3y + 3z = 10$, $3x - y + 2z = 13$. **(07 Marks)**

Module-2

3 a. Find the interpolating polynomial for the following values.

x	0	1	2	3
f(x)	1	2	1	10

And hence evaluate f(4). **(06 Marks)**

b. The Newton- Raphson method to find a real root of the equation $x^3 + x^2 + 3x + 4 = 0$ by performing two iterations. **(07 Marks)**

c. Evaluate $\int_0^1 \frac{x\,dx}{1+x^2}$ by Weddle's rule taking seven ordinates. **(07 Marks)**

OR

4 a. Using Newton's interpolation formula find y(1.4) given

X	1	2	3	4	5
Y	10	26	58	112	194

(06 Marks)

b. Find the real root of the equation cosx = 3x – 1 correct upto three decimal using Regula Falsi method. (07 Marks)

c. Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by using Simpson's 1/3rd rule taking four equal strips. (07 Marks)

Module-3

5 a. Solve $D^3y + 6D^2y + 11Dy + 6y = 0$. (06 Marks)

b. Solve $\frac{d^2y}{dx^2} - 4y = \cosh(2x-1) + 3^x$ (07 Marks)

c. Solve $y'' + 3y' + 2y = 12x^2$ (07 Marks)

OR

6 a. Solve $D^3y - 2D^2y + 4Dy - 8y = 0$. (06 Marks)

b. Solve $y'' + 4y' - 12y = e^{2x} - 3\sin 2x$ (07 Marks)

c. Solve $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 4y = x^2 - 4x - 6$. (07 Marks)

Module-4

7 a. Form the PDE by eliminating the arbitrary constants $z = a\log(x^2 + y^2) + b$. (06 Marks)

b. Solve $\frac{\partial^3 z}{\partial x^2 \partial y} = \cos(2x + 3y)$ (07 Marks)

c. Solve $\frac{\partial^2 z}{\partial x^2} + z = 0$, given that when x = 0, $z = e^y$ and $\frac{\partial z}{\partial x} = 1$. (07 Marks)

OR

8 a. Form the PDE by eliminating the arbitrary function $f\left(\frac{xy}{z}, z\right) = 0$. (06 Marks)

b. Solve $\frac{\partial^2 u}{\partial x^2} = x + y$. (07 Marks)

c. Solve $\frac{\partial^2 z}{\partial y^2} = z$, given the when y = 0, $z = e^x$ and $\frac{\partial z}{\partial y} = e^{-x}$. (07 Marks)

Module-5

9 a. If A and B are any two events of S which are not mutually exclusive then prove that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ **(06 Marks)**

b. Define conditional probability. Given for the events A and B, $P(A) = \frac{3}{4}$, $P(B) = 1/5$, $P(A \cap B) = \frac{1}{20}$, find $P\left(\frac{A}{B}\right)$, $P\left(\frac{B}{A}\right)$, $P\left(\frac{\overline{A}}{\overline{B}}\right)$, $P\left(\frac{\overline{B}}{\overline{A}}\right)$ **(07 Marks)**

c. Three machines M_1, M_2 and M_3 produce identical items of their respective output 5%, 4% and 3% of items are faulty, on a certain day, M_1 has produced 25% of the total output, M_2 has produced 30% and M_3 the remainder. An item selected at random is found to be faulty. What are the chances that it was produced by M_3? **(07 Marks)**

OR

10 a. A bag contains 8 white and 6 red balls. Find the probability of drawing two balls of the same colour. **(06 Marks)**

b. State and prove Baye's theorem. **(07 Marks)**

c. If a pair of dice is thrown what is the probability that
   i) The sum of numbers is divisible by 4
   ii) The number on the first is greater than that on the second. **(07 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | **18EC42**

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Analog Circuits

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain the working of classical discrete circuit Bias – voltage divider bias. **(10 Marks)**

b. Design a collector – to – base bias circuit for the specified conditions. Given : $V_{CC} = 15V$, $V_{CE} = 5V$, $I_C = 5mA$, $\beta = 100$. **(10 Marks)**

OR

2 a. Draw and explain the MOSFET biasing circuit using Fixed V_G. **(10 Marks)**

b. Derive the expression for g_m and A_V for the MOSFET amplifier circuit. **(10 Marks)**

Module-2

3 a. Write a note on three basic configuration of a MOSFET amplifier. Derive expression for characterizing parameters of MOSFET amplifier. **(10 Marks)**

b. Draw the high frequency equivalent circuit of a MOSFET and explain the significance of the different elements of the circuit. **(10 Marks)**

OR

4 a. Explain the working of RC – phase shift oscillator using FET. **(10 Marks)**

b. In Hartley oscillator $L_1 = 20\mu H$, $L_2 = 2mH$ and C variable. Find the range of C, if frequency is to be varied from 1 MHz to 2.5 MHz. Neglect the mutual inductance. **(10 Marks)**

Module-3

5 a. Draw the block diagram of current series feedback amplifier and derive an expression for input resistance, voltage gain, and output resistance. **(10 Marks)**

b. How power amplifiers are classified? Explain them briefly. **(10 Marks)**

OR

6 a. Explain the working of class B push pull amplifier with relevant waveforms. Show that maximum conversion efficiency is 78.5%. **(10 Marks)**

b. Explain series – shunt (voltage series) feedback amplifier. Determine input and output resistance of the amplifier. **(10 Marks)**

Module-4

7 a. Explain the working of inverting schmit trigger. Derive the equation for the trigger points. **(10 Marks)**

b. Derive an expression for the output of an inverting summing amplifier with 3 inputs and hence prove the circuit can act averaging amplifier. **(10 Marks)**

OR

8 a. Explain the working of instrumentation amplifier. Mention its applications. **(10 Marks)**

b. Explain the working of practical non-inverting amplifier. **(10 Marks)**

Module-5

9 a. Explain Successive – Approximation type – ADC with neat block diagram. **(10 Marks)**

b. Explain the working of precision full wave rectifier with relevant circuit and waveforms. **(10 Marks)**

OR

10 a. Explain the working of a monostable multifier with relevant circuit and wave forms. Mention few applications of this circuit. **(10 Marks)**

b. Design a second order low-pass Butterworth filter having high cut-off frequency of 1 KHz. Draw its frequency response. **(10 Marks)**

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CBCS SCHEME

USN 1KS20EC028

18EC43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Control Systems

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Control System. Write the differences between open loop control system and closed loop control system. (05 Marks)

b. For the mechanical system shown in Fig.Q.1(b). Write: i) The mechanical network ii) The equations of performance iii) The electrical network based on Force-Current analogy. (08 Marks)

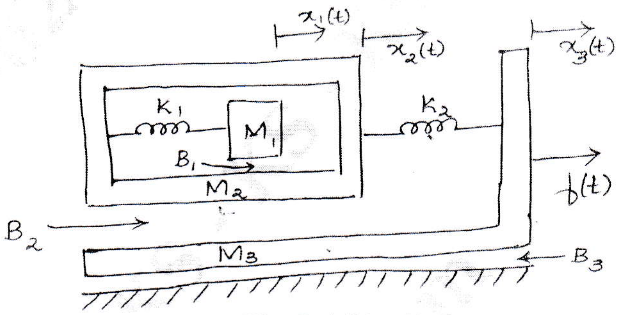

Fig.Q.1(b)

c. Find the transfer function $\frac{X_1(S)}{F(S)}$ for the system shown in Fig.Q.1(c). (07 Marks)

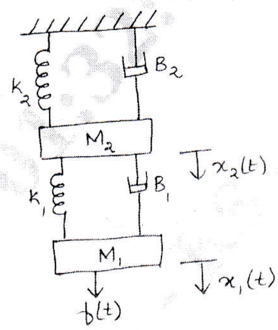

Fig.Q.1(c)

OR

2 a. What are the effects of feedback in control system? (05 Marks)

b. For the rotational system shown in Fig.Q.2(b) draw the mechanical network. Obtain the equations of performance and find the transfer function $\frac{\theta_1(S)}{T(S)}$. (07 Marks)

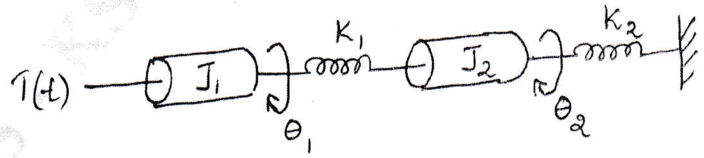

Fig.Q.2(b)

c. For the mechanical system shown in Fig.Q.2(c). Find the analogous electrical network based on Force-Voltage analogy. (08 Marks)

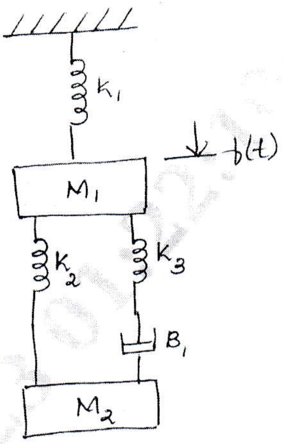

Fig.Q.2(c)

Module-2

3 a. Obtain the transfer function of the system shown in Fig.Q.3(a) using block diagram reduction technique.

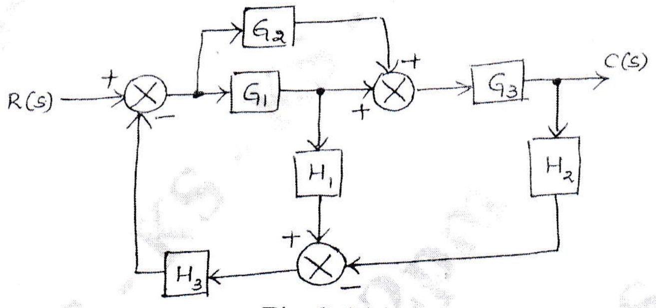

Fig.Q.3(a)

(10 Marks)

b. Find $\frac{C(S)}{R(S)}$ for the signal flow graph shown in Fig.Q.3(b) using Mason's Gain formula. (10 Marks)

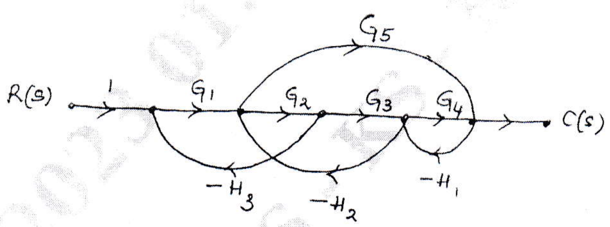

Fig.Q.3(b)

OR

4 a. Draw the corresponding SFG for the block diagram shown in Fig.Q.4(a) and obtain the transfer function using Mason's Gain formula. (10 Marks)

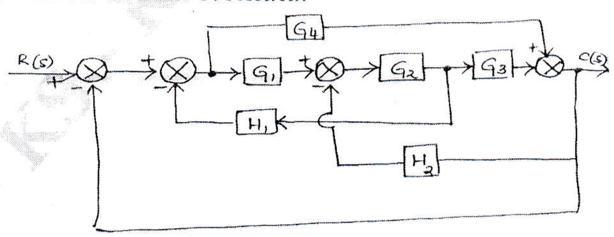

Fig.Q.4(a)

b. Find $\frac{C}{R}$ using block diagram reduction technique. (10 Marks)

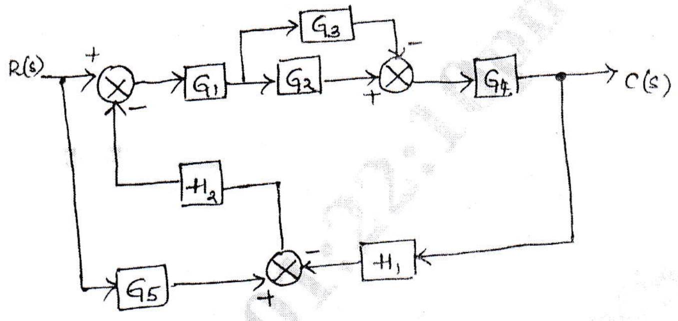

Fig.Q.4(b)

Module-3

5 a. Explain the following test signals with the help of graph and mathematical expression:
i) Step signal ii) Ramp signal iii) Parabolic signal. (06 Marks)

b. Derive the expression for the underdamped response of a second order feedback control system for step input. (08 Marks)

c. Derive the expression for rise time (T_r) of an underdamped second order system. (06 Marks)

OR

6 a. A unity feedback control system is characterized by an open loop transfer function $G(S)H(S) = \frac{K}{S(S+10)}$. Determine the system gain K, so that the system will have a damping ratio of 0.5. For this value of K, find the rise time, peak time, settling time and peak overshoot. Assume the system is subjected to a step of 1V. (10 Marks)

b. Find the position, velocity and acceleration error constants for a control system having open loop transfer function $G(S) = \frac{50}{S(S+5)}$. Also calculate, percentage overshoot for a unit step input, settling time for a unit step input and steady state error for an input defined by the polynomial $r(t) = 2 + 4t + 6t^2, t \geq 0$. (10 Marks)

Module-4

7 a. For the characteristic equation given by $S^4 + 25S^3 + 15S^2 + 20S + K = 0$. Determine: i) The range of value of K, so that the system is asymptotically stable ii) The value of K so that the system is marginally stable and find the frequencies of sustained oscillations. (06 Marks)

b. The open loop transfer function of a control system is given by

$G(S).H(S) = \frac{K}{S(S+1)(S+2)}$. Sketch the complete Root Locus. (14 Marks)

OR

8 a. Define:
i) Gain Margin
ii) Phase Margin
iii) Phase Cross Over Frequency. (06 Marks)

b. Plot the Bode diagram for the open loop transfer function of a unity feed back system given by $G(S) = \frac{100(0.1S+1)}{S(S+1)^2(0.01S+1)}$. Find Gain Margin and phase Margin. Also comment on the closed loop stability of the system. (14 Marks)

Module-5

9 a. Explain the steps involved in using Nyquist criterion. (06 Marks)

b. Represent the electrical circuit shown in Fig.Q.9(b) by a state model. (10 Marks)

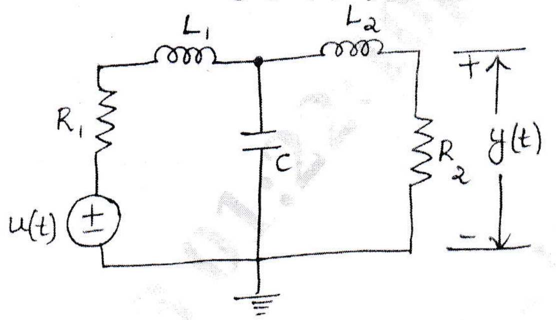

Fig.Q.9(b)

c. Write a short note on advantages of state variable approach. (04 Marks)

OR

10 a. Find the state transition matrix for

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

(10 Marks)

b. Obtain state model for the given mechanical system shown in Fig.Q.10(b). (10 Marks)

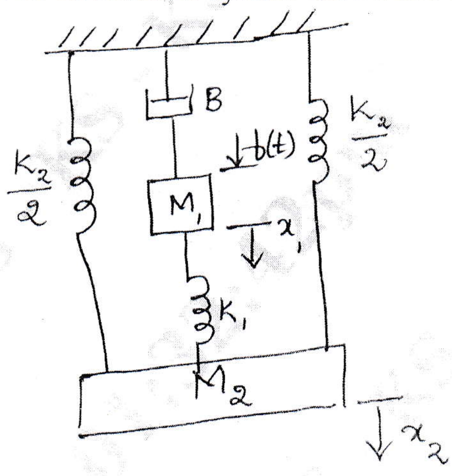

Fig.Q.10(b)

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CBCS SCHEME

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18EC44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Engineering Statistics & Linear Algebra

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define cdf, pdf and pmf with example. **(06 Marks)**

b. The following is the pdf for random variable U,

$$f_U(u) = \begin{cases} C\exp\left(-\dfrac{u}{2}\right), & 0 \le u < 1 \\ 0, & \text{otherwise} \end{cases}$$

Find the value that C must have and evaluate $F_U(0.5)$. **(06 Marks)**

c. Given the data in the following table :

k	x_k	$P(x_k)$
1	2.1	0.21
2	3.2	0.18
3	4.8	0.20
4	5.4	0.22
5	6.9	0.19

(i) Plot pdf and cdf of the discrete random variable X.

(ii) Write expression for $f_X(x)$ and $F_X(x)$ using unit delta functions and unit step function. **(08 Marks)**

OR

2 a. Define Expectation, Variance and characteristic functions. **(04 Marks)**

b. Explain the probability models for Gaussian and exponential random variables. **(08 Marks)**

c. The random variable X is uniformly distributed between 0 and 4. The random variable Y is obtained from X using $y = (x-2)^2$. Evaluate CDF and PDF for Y. **(08 Marks)**

Module-2

3 a. Obtain the expressions for different bivariate expectations. **(06 Marks)**

b. It is given that E[X] = 2.0 and that $E[X^2] = 6$. Find the standard deviation of X. Also if $Y = 6X^2+2X-13$, find μ_Y. **(07 Marks)**

c. The mean and variance of random variable X are -2 and 3 ; the mean and variance of Y are 3 & 5. The covariance $COV[XY] = -0.8$. Find correlation co-efficient ρ_{XY} and correlation E[XY]. **(07 Marks)**

OR

4 a. The joint pdf of a bivariate random variable X and Y is given by,

$$F_{XY}(x,y) = \begin{cases} k(x+y), & 0 < x, y < z \\ 0, & \text{otherwise} \end{cases}$$ where k is constant.

(i) Find the value of k.

(ii) Find the marginal pdf's of X and Y.

(iii) Are X and Y independent? **(06 Marks)**

b. The random variable U has a mean of 0.3 and a variance of 1.5

(i) Find the mean and variance of Y if $Y = \frac{1}{53}\sum_{i-1}^{53} u_i$

(ii) Find the mean and variance of Z if $Z = \sum_{i-1}^{53} u_i$

In these two sums, the u_i's are IID. **(04 Marks)**

c. Explain briefly Chi square random variable. **(10 Marks)**

Module-3

5 a. Explain Random process, stationarity and wide sense stationarity random process. **(06 Marks)**

b. X(t) and Y(t) are independent, jointly wide sense stationarily random processes given by $X(t) = A\cos(\omega_1 t + \theta_1)$ and $Y(t) = B\cos(\omega_2 t + \theta_2)$. If W(t) = X(t).Y(t), find Auto Correlation function $R_W(Z)$. **(06 Marks)**

c. Define Auto Correlation Function (ACF) of a random process. List and prove the properties of Auto Correlation. **(08 Marks)**

OR

6 a. Explain Wiener-Kenchin relations. **(06 Marks)**

b. A PSD is shown in Fig. Q6 (b) where constants are a = 55, b = 5, $\omega_0 = 1000$, $\omega_1 = 100$.

Solve the values for $E[X^2(t)]$, σ_X^2 and μ_X.

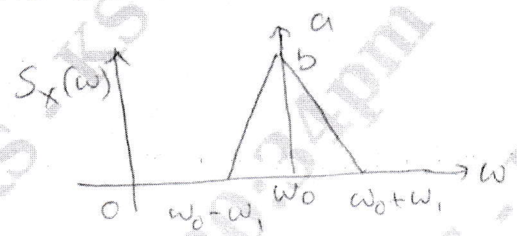

Fig. Q6 (b) **(06 Marks)**

c. Assume that the following table is obtained from a windowed sample function obtained from a random Ergodic process. Solve for the ACF for Z = 0, 2 and 4 ms.

x(t)	1.5	2.1	1.0	2.2	−1.6	−2.0	−2.5	2.5	1.6	1.8
k	0	1	2	3	4	5	6	7	8	9

(08 Marks)

Module-4

7 a. Define vector space and axioms of vector spaces. **(06 Marks)**

b. Let W be the subspace of R^5 spanned by,

$x_1 = (1 \;\; 2 \;\; -1 \;\; 3 \;\; 4)$, $x_2 = (2 \;\; 4 \;\; -2 \;\; 6 \;\; 8)$, $x_3 = (1 \;\; 3 \;\; 2 \;\; 2 \;\; 6)$

$x_4 = (1 \;\; 4 \;\; 5 \;\; 1 \;\; 8)$, $x_5 = (2 \;\; 7 \;\; 3 \;\; 3 \;\; 9)$

Find the basis and dimension of W. **(06 Marks)**

c. If vectors $u = \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix}$, $v = \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix}$, $w = \begin{bmatrix} 2 \\ 1 \\ -2 \end{bmatrix}$

Then show that the vectors U, V and W form orthogonal pairs. Also find the length of vectors U, V and W. **(08 Marks)**

OR

8 a. Determine whether the vectors $(1 \quad 4 \quad 9)$, $(3 \quad 1 \quad 9)$ and $(9 \quad 3 \quad 12)$ are linearly dependent or independent. **(06 Marks)**

b. List and explain four fundamental subspaces. **(06 Marks)**

c. Apply Gram-Schmidt process to vectors to obtain an orthonormal basis for $v_3(R)$ with the standard inner product. $v_1 = (2 \quad 2 \quad 1)$, $v_2 = (1 \quad 3 \quad 1)$, $v_3 = (1 \quad 2 \quad 2)$ **(08 Marks)**

Module-5

9 a. Reduce the matrix A to U. Find det(A). $A = \begin{bmatrix} 2 & 5 & 3 \\ 1 & 2 & 4 \\ -1 & 3 & 6 \end{bmatrix}$. **(04 Marks)**

b. Find Eigen values and Eigen vectors of matrix, $A = \begin{bmatrix} 4 & 2 & -2 \\ -5 & 3 & 2 \\ -2 & 4 & 1 \end{bmatrix}$. **(10 Marks)**

c. What is positive definite matrix? Mention the methods of testing positive definiteness. Check the following matrix for positive definiteness.

$S_1 = \begin{bmatrix} 5 & 6 \\ 6 & 7 \end{bmatrix}$. **(06 Marks)**

OR

10 a. Compute A^TA and AA^T. Find eigen values and unit Eigen vectors for $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \\ -1 & 1 \end{bmatrix}$. Multiply the three matrices. $U\sum V^T$ to recover A. **(12 Marks)**

b. Expand the determinant $A = \begin{bmatrix} 3 & 1 & 4 & 2 \\ 1 & 5 & 2 & 6 \\ 2 & 3 & 7 & 1 \\ 4 & 1 & 2 & 3 \end{bmatrix}$ **(08 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | | **18EC45**

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Signals and Systems

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Determine even and odd components of a signals shown in Fig Q1(a)

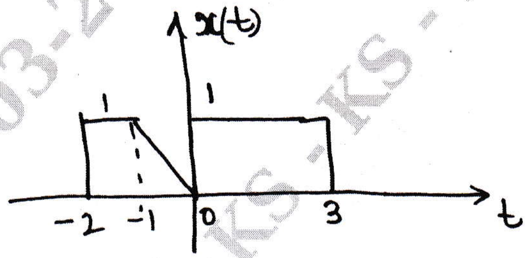

Fig Q1(a) **(06 Marks)**

b. Sketch the signals x(n), $y_1(n)$ and $y_2(n)$, where $x(n) = (n-6)[u(n) - u(n-6)]$, $y_1(n) = x(2n)$ $y_2(n) = x(2n-3)$. **(08 Marks)**

c. Determine the energy of the signals $y(t) = \frac{d}{dt}x(t)$, where $x(t) = \text{Sin } 10\pi t\,[u(t) - u(t-0.2)]$. **(06 Marks)**

OR

2 a. Verify the following signals are periodic or non-periodic, if periodic find the fundamental period of a signals

i) $x(t) = \cos 20\pi t \cdot \text{Sin } \sqrt{2}\,\pi t$ ii) $x(n) = \text{Cos } 100\pi n + \text{Sin } 5\pi n$. **(06 Marks)**

b. Sketch the signals $y_1(t) = x(2t-5)$ and $y_2(t) = x(2t+5)$. Where x(t) shown in Fig Q2(b)

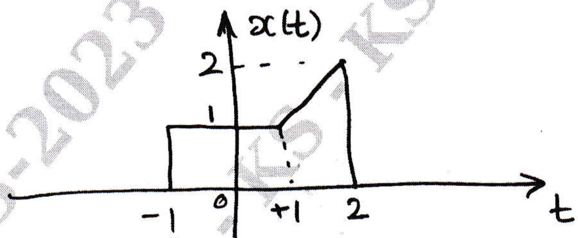

Fig Q2(b) **(08 Marks)**

c. Explain x(t) interms and elementary signals as shown in Fig Q2(c)

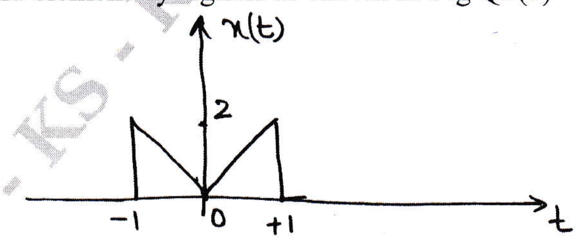

Fig Q2(c) **(06 Marks)**

Module-2

3 a. Verify the following systems are Linear, time invariant causal stable.
i) $y(t) = tx(t)$ ii) $y(n) = x(-n)$ **(08 Marks)**

b. Determine the convolution integral of $e^{-2t}u(t) * e^{-t}u(t)$. **(06 Marks)**

c. Find response of a system whose input and impulse response given by

$$x(t) = \begin{cases} 1, & 0 \le t \le 4 \\ 0 & \text{otherwise} \end{cases} \text{ and } y(t) = \begin{cases} 1 & -2 \le t \le 1 \\ 0 & \text{otherwise} \end{cases}.$$ **(06 Marks)**

OR

4 a. Evaluate the convolution sum of $(2)^n u(-n) * \left(\frac{1}{3}\right)^n u(n)$ **(08 Marks)**

b. Verify the following systems are linear, time invariant and stable
i) $y(n) = e^{x(n)}$ ii) $y(t) = e^{tx(t)}$ **(06 Marks)**

c. Determine the convolution sum using graphical method where
$x(n) = [\underset{\uparrow}{1}, 1, 1, 1]$ $h(n) = [\underset{\uparrow}{2}, 2, -2, -2]$ **(06 Marks)**

Module-3

5 a. State and prove associate property and convolution integral. **(06 Marks)**

b. Verify the following LTI systems are stable, causal and memory less.
i) $h(t) = e^{-t}u(t)$ ii) $h(n) = (n-2)[u(n+1) - u(n-2)]$ **(06 Marks)**

c. Determine the Fourier series coefficient of the signal $x(t) = \text{Cos}(10\pi t)\ \text{Sin}\ (20\pi(t)$; sketch magnitude and phase spectrum. **(08 Marks)**

OR

6 a. Determine the step response of the following signals
i) $h(n) = \left(\frac{1}{2}^{|n|}\right)$ ii) $h(t) = t[u(t) - u(t-1)]$ **(08 Marks)**

b. Determine the Fourier series coefficient of the signals $x(t) = 10\text{Cos}10\pi t + 2\ \text{Sin}\ 100\pi t$, Sketch magnitude and phase spectrum. **(06 Marks)**

c. Determine the impulse response of the system given by the input and output relationship below. Also determine whether the system is stable or unstable. Assume h(n) is causal
$y(n) = x(n) + \frac{1}{2}y(n-1)$ **(06 Marks)**

Module-4

7 a. Determine the Fourier transform of the signal

$$x(t) = \begin{cases} 1, & 0 \le t \le 4 \\ 0 & \text{otherwise} \end{cases}$$ Sketch magnitude and phase spectrum. **(08 Marks)**

b. State and prove Time scaling property of Fourier transform. **(05 Marks)**

c. Determine the DTFT of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n)$. sketch magnitude and phase spectrum. **(07 Marks)**

OR

8 a. State and prove Parsevals property and Fourier transform. **(05 Marks)**

b. Determine the DTFT and the signal $x(n) = [\underset{\uparrow}{1}, 1, 1, 1, 1]$ sketch magnitude and phase spectrum. **(08 Marks)**

c. Determine the Fourier transform of the signal $x(t) = e^{-|t|}$. Sketch magnitude and phase spectrum. **(07 Marks)**

Module-5

9 a. Determine the z-transform of the signal $x(n) = -2^n u(-n-1) + \left(\frac{1}{3}\right)^n u(n)$. also sketch RoC. **(08 Marks)**

b. Find the inverse z-transform of $X(z) = \frac{1}{z^2 - 5z + 6}$ for all possible RoC. **(08 Marks)**

c. State any four properties of RoC. **(04 Marks)**

OR

10 a. Determine the impulse response of the system given below
$y(n) - \frac{5}{6}y(n-1) + \frac{1}{6}y(n-2) = x(n) - 2x(n-1)$. Determine h(n) for the following condition
i) Stable ii) Causal. **(12 Marks)**

b. Determine inverse z-transform using long division method or power series.
$X(z) = \frac{1}{1 - \frac{1}{2}z^{-1}}$ $(z) > \frac{1}{2}$ ii) $X(z) = \frac{1}{1 - \frac{1}{2}z^{-1}}$ $(z) < \frac{1}{2}$. **(08 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | | **18EC46**

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Microcontroller

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Differentiate between microcontrollers and microprocessor (any five). **(05 Marks)**

b. Explain the following pins of 8051 microcontroller i) $\overline{EA}$ ii) ALE iii) $\overline{PSEN}$ iv) XTAL1 and XTAL2 v) $\overline{RD}$. **(05 Marks)**

c. With a neat block diagram, explain the architecture of 8051 microcontroller briefly. **(10 Marks)**

OR

2 a. Explain in brief with respect to 8051 microcontroller:
i) Program status word ii) Dual function of port 3 pins. **(04 Marks)**

b. Show neat schematic to interface 8KBROM (External) and 8KB external Data RAM to 8051 microcontroller. **(06 Marks)**

c. Write circuit diagram of port 1, Explain input, output operations in 8051 using port 1. **(10 Marks)**

Module-2

3 a. Define addressing mode, explain the addressing modes of 8051 with examples (any 4). **(10 Marks)**

b. Explain the following instructions of 8051 with an example for each instruction:
i) SUBBA, addr ii) Movc A, @ A + DPTR iii) PUSH addr iv) SETB psw . 4
v) RL A **(10 Marks)**

OR

4 a. Write an ALP in 8051 to exchange the contents of registers R7 and R6 in register Bank 0 in five different ways. **(10 Marks)**

b. Explain the different types of conditional and unconditional jump instructions of 8051. Specify the different range associated with jump instruction. **(10 Marks)**

Module-3

5 a. Assume that the RAM locations 40h-44h have the following values. Write an ALP to find the sum of the values. Store the low byte of the result in A register and high byte of the result in R7 register, (involving loops in program)
40h – (70)
41h = (EBG)
42h = (C5h)
43h = (5Bh)
44h = (30h) **(10 Marks)**

b. Write an ALP in 8051 to move a block of data stored in external memory location 9000h to a location starting from foooh. Block length N = 5. **(10 Marks)**

OR

6 a. Using registers write a subroutine to get
   i) A delay of 5 msec, assume the crystal oscillator frequency is 22MHZ show delay calculations.
   ii) A delay of 200msec, assume the crystal frequency is 11.0592MHZ show the delay calculations. **(10 Marks)**

b. Design a circuit to interface a simple LED and a switch to 8051μc. Write an ALP in 8051 to turn LED ON/OFF, if the content of the internal bit addressable memory location 20h content is 01 or ooh respectively. LED is connected to pin p2.0, switch (sw) connected to p1.0. **(05 Marks)**

c. Briefly explain about stack and stack operations. **(05 Marks)**

Module-4

7 a. With regard to timers of 8051
   i) Explain TMOD and TCON registers with its bit pattern.
   ii) Indicate how to start/stop timer if GATE control is also used. **(10 Marks)**

b. Explain mode 2 programming with neat sketch and specify the program steps. **(05 Marks)**

c. Write an assembly language program in 8051 to generate a pulse using mode-1 on a port pin p1.4 with delay of pulse as 1ms, crystal frequency of 11.0592 MHz. Show delay calculation. **(05 Marks)**

OR

8 a. List the advantages of serial communication over parallel communication. **(06 Marks)**

b. Explain briefly the asynchronous serial communication format with an example. **(04 Marks)**

c. Write an 8051 ALP and C program for the 8051 to transfer the letter 'A' serially at 4800 baud rate continuously. Use 8 bit data and 1 stop bit. **(10 Marks)**

Module-5

9 a. With regard to the interrupt of 8051:
   i) Give the vector addresses of the interrupts.
   ii) Briefly explain the procedure of enabling/disabling the entire interrupt system and enabling/disabling of individual interrupts.
   iii) What are the steps micro controller to perform up on activation of an interrupt. **(10 Marks)**

b. Show the interfacing of a stepper motor to 8051. A switch is connected to (SW) pin P3.2. Write an assembly language program to monitor the status of SW and perform the following:
   i) If SW = 0 the stepper motor moves clockwise
   ii) If SW = 1 the stepper motor moves anti clockwise. **(10 Marks)**

OR

10 a. Write an ALP to generate a square wave of 5kHz on pin P1.2. Using an interrupt generated from timer 0 of 8051μc, crystal frequency 22MHZ. **(08 Marks)**

b. Interface an LCD display to 8051 and write an ALP to display the characters 'A' 'B' 'C'. **(12 Marks)**

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