CBCS SCHEME

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18MAT41

Fourth Semester B.E. Degree Examination, June/July 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. Find analytic function u + iv, where u is given to be $u = e^x[(x^2 - y^2)\cos y - 2xy \sin y]$. **(06 Marks)**

b. Derive Cauchy Reimann equations in polar form. **(07 Marks)**

c. Show that $u = e^{2x}[x\cos 2y - y\sin 2y]$ is harmonic. Find the analytic function f(z) = u + iv. **(07 Marks)**

OR

2 a. Derive Cauchy Reimann equation in Cartesian form. **(06 Marks)**

b. Determine analytic function f(z) = u + iv if $u - v = e^x[\cos y - \sin y]$. **(07 Marks)**

c. Show that $w = z^n$ is analytic and hence find its derivative. **(07 Marks)**

Module-2

3 a. Discuss the transformation $w = z + \frac{1}{z}, z \neq 0$. **(06 Marks)**

b. Find the Bilinear transformation which maps the points z = 1, i, -1 onto w = 0, 1, ∞. **(07 Marks)**

c. Evaluate $\int_0^{2+i} (\bar{z})^2 \, dz$ along i) line y = x/2 ii) real axis to 2 and then vertically to 2 + iy. **(07 Marks)**

OR

4 a. Discuss the transformation $w = z^2$. **(06 Marks)**

b. State and prove Cauchy's integral formula $f(a) = \frac{1}{2\pi i}\int_C \frac{f(z)}{(z-a)} dz$. **(07 Marks)**

c. Evaluate using Cauchy's integral formula.

$$\int_C \frac{e^{2z}}{(z-1)(z-2)} dz \quad C: |z| = 3.$$ **(07 Marks)**

Module-3

5 a. Define: i) Random variable ii) Discrete probability distribution with an example. **(06 Marks)**

b. The probability that man aged 60 will live upto 70 is 0.65. What is the probability that out of 10 men, now aged 60 i) Exactly 9 ii) atmost 9 iii) Atleast 7 will live up to age of 70 years. **(07 Marks)**

c. In a normal distribution, 3% of items are under 45 and 8% are over 64. Find the mean and standard deviation, given that A(0.5) = 0.19 and A(1.4) = 0.42. **(07 Marks)**

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OR

6 a. The probability distribution of a finite random variable X is given by

X :	-2	-1	0	1	2	3
P(x) :	0.1	K	0.2	2K	0.3	K

Find 'K', mean and variance of X. **(06 Marks)**

b. If probability of bad reaction from certain injection is 0.001. Determine the chance that out of 2000 individuals more than two will get bad reaction, and less than two will get bad reaction. **(07 Marks)**

c. The frequency of accidents per shift in a factory is shown in the following table:

Accidents per shift	0	1	2	3	4
Frequency	192	100	24	3	1

Calculate mean numbers of accidents per shift. Find the corresponding Poisson distribution. **(07 Marks)**

Module-4

7 a. Fit a second degree parabola $y = a + bx + cx^2$ for the following data:

x	0	1	2	3	4	5
y	1	3	7	3	21	31

(06 Marks)

b. Find the coefficient of correlation, lines of regression of x on y and y on x. Given,

x	1	2	3	4	5	6	7
y	9	8	10	12	11	13	14

(07 Marks)

c. If θ is an acute angle between line of regression, then show that $\tan\theta = \frac{\sigma x}{\sigma_x^2 + \sigma_y^2}\left(\frac{1-r^2}{r}\right)$.

Indicate the significance of the cases $r = 0$ and $r = \pm 1$. **(07 Marks)**

OR

8 a. Fit the curve of the form ax^b and hence estimate y when x = 8.

x	5	10	15	20	25	30	35
y	2.76	3.17	3.44	3.64	3.81	3.95	4.07

(06 Marks)

b. Find the rank correlation coefficient for the following data:

x	93	44	53	08	71	81	6	10	32	31
y	45	62	12	28	92	84	73	3	51	32

(07 Marks)

c. With the usual notations compute $\bar{x}$, $\bar{y}$ and r from the following lines of regression:
$y = 0.516x + 33.73$ and $x = 0.512y + 32.52$. **(07 Marks)**

Module-5

9 a. The joint probability distribution for following data

X / Y	-2	-1	4	5
1	0.1	0.2	0	0.3
2	0.2	0.1	0.1	0

Determine the marginal distributions of X and Y also calculate E(x), E(y), COV (xy). **(06 Marks)**

b. Define: i) Null hypothesis ii) Confidence limits iii) Type I, Type II errors. **(07 Marks)**

c. The following table gives the distribution of digits in the numbers chosen at random from a telephone directory:

Digits	0	1	2	3	4	5	6	7	8	9
Frequency	1026	1107	997	966	1075	933	1107	972	964	853

Test whether the digits may be taken to occur equally frequently in the directory. (given $\chi^2_{0.05} = 16.92$ at n = 9). **(07 Marks)**

OR

10 a. A fair coin is tossed thrice. The random variable X and Y are defined as follows. X = 0 or 1 according as head or tail occurs on first loss, Y = number of heads.
- i) Determine distribution of X and Y.
- ii) Joint probability distribution of X and Y.
- iii) Expectation of X, Y and XY. **(06 Marks)**

b. It is claimed that a random sample of 49 tyres has a mean life of 15200km. Is the sample drawn from population whose mean is 15,150km and standard deviation is 200km? Test the significance level at 0.05 level. **(07 Marks)**

c. Ten individuals are choosen at random from the population and their height in inches are found to be 63, 63, 66, 67, 68, 69, 70, 70, 71, 71. Test the hypothesis that the mean height of universe is 66′ (value of $t_{0.05} = 2.262$ for 9.D.F). **(07 Marks)**

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18MATDIP41

Fourth Semester B.E. Degree Examination, June/July 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.

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Module-1

1 a. Find the rank of the matrix by applying elementary row operations :

$$A = \begin{bmatrix} 0 & 2 & 3 & 4 \\ 2 & 3 & 8 & 4 \\ 4 & 8 & 13 & 12 \end{bmatrix}$$

(06 Marks)

b. Test for consistency and solve the system :

$x + y + z = 6$
$x - y + 2z = 5$
$3x + y + z = 8.$

(07 Marks)

c. Find the eigen value and the corresponding eigen vectors of the matrix :

$$A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}.$$

(07 Marks)

OR

2 a. Reduce the matrix A to the echelon firm, where

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

(06 Marks)

b. Find the values of λ and μ such that the system

$x + y + z = 6$
$x + 2y + 3z = 10$
$x + 2y + \lambda z = \mu$

may have

i) unique solution
ii) infinite solution
iii) no solution.

(07 Marks)

c. Solve :

$2x + y + 4z = 12$
$4x + 11y - z = 33$
$8x - 3y + 2z = 20$

By Gauss elimination method.

(07 Marks)

Module-2

3 a. The area of a circle (A) corresponding to diameter (D) is given in the following table :

D	80	85	90	95	100
A	5026	5674	6362	7088	7854

Find the area when D = 105 using an appropriate interpolation formula. **(06 Marks)**

b. Find the real root of the equation $\cos x = 3x - 1$ correct to three decimal places using Regula – Falsi method. **(07 Marks)**

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

OR

4 a. Find $u_{0.5}$ from the data $u_0 = 225$, $u_1 = 238$, $u_2 = 320$, $u_3 = 340$ by using an appropriate interpolation formula. **(06 Marks)**

b. Use Newton – Raphson method to find a real root of the equation $x^3 + 5x - 11 = 0$ correct to the three decimal places. **(07 Marks)**

c. Using Simpson's 1/3rd rule, evaluate $\int_0^1 \frac{dx}{1+x^2}$ by dividing the interval [0, 1] into six equal parts. Hence deduce the value of $\log_e^2$. **(07 Marks)**

Module-3

5 a. Solve $(D^3 - 6D^2 + 11D - 6)\,y = 0$. **(06 Marks)**

b. Solve $(D^2 - 4)y = \cos h\,(2x - 1) + 3^x$. **(07 Marks)**

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

OR

6 a. Solve $\frac{d^3y}{dx^3} + y = 0$. **(06 Marks)**

b. Solve $y'' + 9y = \cos 2x \cdot \cos x$ **(07 Marks)**

c. Solve $y'' - (a + b)y' + aby = e^{ax} + e^{bx}$. **(07 Marks)**

Module-4

7 a. Form a partial differential equation by eliminating the arbitrary constants in $ax^2 + by^2 + z^2 = 1$. **(06 Marks)**

b. Form the partial differential equation by eliminating the arbitrary function from $\ell x + my + nz = \phi(x^2 + y^2 + z^2)$. **(07 Marks)**

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

OR

8 a. Form a partial differential equation by eliminating the arbitrary constructs from :

$z = xy + y\sqrt{x^2 - a^2} + b$. **(06 Marks)**

b. Solve $\frac{\partial^2 z}{\partial x^2} = x + y$ by direct integration. **(07 Marks)**

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

Module-5

9 a. Define :
i) Sample space
ii) Mutually exclusive events
iii) Mutually independent events. **(06 Marks)**

b. A box contains 4 black, 5 white and 6 red balls. If 2 balls are drown at random, what is the probability that :
i) both are red
ii) one black and one white. **(07 Marks)**

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

OR

10 a. If A and B are events with $P(A \cup B) = 7/8$, $P(A \cap B) = 1/4$ and $P(A \cap \bar{B}) = 1/3$.
Find :
i) P(A)
ii) P(B)
iii) $P(\bar{A} \cap B)$. **(06 Marks)**

b. A problem is given to four students A, B, C, D whose chances of solving it are $1/2, 1/3, 1/4, 1/5$ respectively. Find the probability that the problem is solved. **(07 Marks)**

c. Three machines A, B and C produce 50%, 30% and 20% of the items in a factory. The percentage of defective outputs of these machines are 3, 4, and 5 respectively. If an item is selected at random, what is the probability that it is defective? If a selected item is defective, what is the probability that it is from machine A? **(07 Marks)**

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CBCS SCHEME

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Fourth Semester B.E. Degree Examination, June/July 2023
Analog Circuits

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. What is meant by biasing of a transistor? Explain the classical bias arrangement for BJT and derive the expressions for collector current and collector-emitter voltage. **(08 Marks)**

b. Design a collector-base feedback bias circuit to obtain $I_E = 1$ mA and $V_{CE} = 2.3$ V, assuming $V_{CC} = 10$ V, $\beta = 100$ and $V_{BE} = 0.7$ V. **(06 Marks)**

c. For the conceptual amplifier circuit shown in Fig. Q1 (c), draw the hybrid - π model. Suppose if $I_C = 1$ mA, $\beta = 100$ and $V_T = 26$ mV, calculate the input resistance at the base and voltage gain.

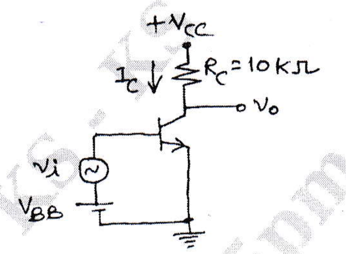

Fig. Q1 (c) **(06 Marks)**

OR

2 a. In the classical MOSFET bias arrangement, explain how the source resistor provides negative feedback action. How does this stabilize the variations in the bias current? **(04 Marks)**

b. Design a voltage divider biasing arrangement to establish a drain current of 2 mA. The MOSFET has $V_t = 1$ V, K_n' W/L = 1 mA/V^2. Assume $V_{DD} = 12$ V, $V_{DS} = 5$ V and $V_S = 2$ V. **(10 Marks)**

c. Starting from the conceptual MOSFET amplifier circuit, draw the small-signal model of MOSFET with $\lambda \neq 0$ and derive the expressions for g_m and A_V. **(06 Marks)**

Module-2

3 a. With a neat circuit diagram and ac equivalent circuit, derive the expressions for R_{in}, R_o, A_{VO} and A_V in a common–source MOSFET amplifier with un-bypassed source resistor. **(07 Marks)**

b. For the common drain circuit shown in Fig. Q3 (b), if $I_D = 8$ mA, $V_{OV} = 1$ V and $\lambda = 0$, determine the values of R_{in}, R_0, A_{VO} and A_V. Draw the ac equivalent circuit.

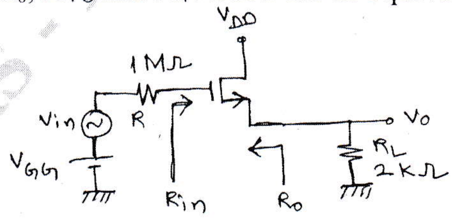

Fig. Q3 (b) **(07 Marks)**

c. For n-channel MOSFET with $t_{OX} = 10$ nm, W = 10 μm, L = 1 μm, $L_{OV} = 0.05$ πm, $C_{Sbo} = C_{dbo} = 10$ fF, $V_O = 0.6$ V, $V_{SB} = 1$ V and $V_{DS} = 2$ V, calculate C_{OX}, C_{OV}, C_{gs}, C_{gd}, C_{sb} and C_{db} in saturation region. Assume $\varepsilon_{OX} = 3.45 \times 10^{-11}$ F/m. **(06 Marks)**

OR

4 a. Draw and explain the high frequency response of a common-source amplifier. Derive the expression for its upper cut off frequency. **(10 Marks)**

b. Design an RC phase-shift oscillator using MOSFET having $g_m = 5000\ \mu S$, $r_d = 40\ K\Omega$ and feedback circuit resistor $R = 10\ K\Omega$. Select the value of capacitor to get 1 kHz oscillations. Find R_D to get a gain of 40. **(06 Marks)**

c. Explain the series and parallel resonance actions with equivalent circuits and expressions of a crystal oscillator. **(04 Marks)**

Module-3

5 a. Draw the four basic negative feedback topologies and explain each in brief. **(12 Marks)**

b. Determine the voltage gain, input resistance and output resistance with feedback for a voltage series feedback amplifier having $A = 10{,}000$, $R_i = 10\ K\Omega$ and $R_o = 20\ K\Omega$ if $\beta = 0.5$. **(04 Marks)**

c. By deriving the relevant expressions, prove that negative feedback de-sensitizes the gain and increases the bandwidth. **(04 Marks)**

OR

6 a. What is the function of output stage? Discuss the classification of output stage based on the collector current. **(10 Marks)**

b. A transformer coupled class-A amplifier draws a current of 200 mA from the collector supply voltage of 10 V, when the signal is not applied. If the load across the secondary is 10 Ω and the turns ratio is 5 : 1, determine (i) max output power (ii) max collector efficiency. **(04 Marks)**

c. Explain the class-B output stage. Prove that the maximum conversion efficiency of class-B transformer coupled amplifier is 78.5%. **(06 Marks)**

Module-4

7 a. With circuit diagram and waveform, explain the inverting amplifier using op-amp. Derive the expressions for the exact and ideal closed-loop voltage gains. **(08 Marks)**

b. An op-amp having $A = 2\times10^5$, $R_i = 2\ M\Omega$, $R_O = 75\ \Omega$, $f_O = 5$ Hz is connected as non-inverting amplifier with $R_f = 47\ K\Omega$ and $R_1 = 2.2\ K\Omega$. Compute the values of A_f, R_{if}, R_{of} and f_F. **(08 Marks)**

c. Give two reasons why an open loop op-amp is not suitable for linear applications. How is this overcome by using negative feedback? **(04 Marks)**

OR

8 a. With circuit diagram, explain the working of inverting scaling amplifier, averaging circuit and summing amplifier. Derive the expressions for output voltage. **(07 Marks)**

b. Explain the operation of instrumentation amplifier using transducer bridge, with diagram and relevant expressions. **(08 Marks)**

c. Draw and explain the basic non-inverting comparator circuit with waveform. **(05 Marks)**

Module-5

9 a. Explain the working of R-2R DAC with circuit diagram, graph and expressions. **(06 Marks)**

b. For a 4-bit binary weighted resistor DAC with $R = 10\ K\Omega$, $R_f = 1.2\ K\Omega$ and $V_R = 5$ V, determine the step size and full scale output voltage. **(04 Marks)**

c. With circuit diagram and waveform, explain the working of small-signal half wave rectifier using (i) one diode, (ii) two diodes. What is the use of the second diode? **(10 Marks)**

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OR

10 a. Define the terms pass-band, stop-band, cut-off frequency and gain roll-off rate with references to the filters. What is the relation between the order and gain roll-off rate? **(05 Marks)**

b. Design a second order Butterworth high-pass filter to have a cut-off frequency of 1.2 kHz, choosing $C_1 = C_2 = 4.7$ nF. Draw the circuit and plot the frequency response. **(10 Marks)**

c. An astable multivibrator circuit using 555 timer has R_A = 2.2 KΩ, R_B = 3.9 KΩ and C = 0.1 μF. Determine the frequency and duty cycle of the output waveform. Draw the circuit diagram. **(05 Marks)**

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CBCS SCHEME

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18EC43

Fourth Semester B.E. Degree Examination, June/July 2023
Control Systems

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. Define control system and explain with an example. **(04 Marks)**

b. Compare open loop and closed loop control system. **(06 Marks)**

c. Find the transfer function of the electromechanical system shown in Fig.Q1(c).

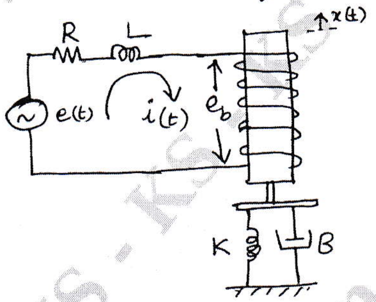

Fig.Q1(c) **(10 Marks)**

OR

2 a. What are the effects of feedback in a control system? **(06 Marks)**

b. Write the differential equation for the given mechanical system shown in Fig.Q2(b). Find the analogous electrical circuit based on Force-Voltage analogy.

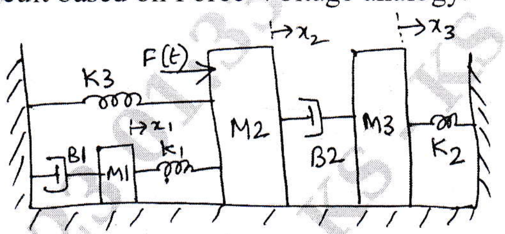

Fig.Q2(b) **(10 Marks)**

c. Find the Torque - Voltage Analogous circuit for the Fig.Q2(c) shown.

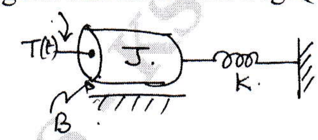

Fig.Q2(c) **(04 Marks)**

Module-2

3 a. Find the overall transfer function $\frac{C(s)}{R(s)}$ for the block diagram shown in Fig.Q3(a).

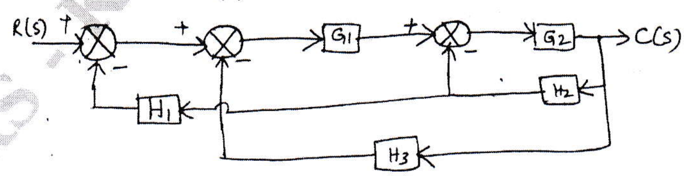

Fig.Q3(a) **(10 Marks)**

b. Find the transfer function by constructing a block diagram for the circuit shown in Fig.Q3(b)

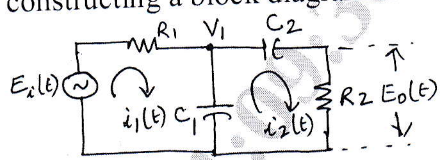

Fig.Q3(b)

(10 Marks)

OR

4 a. Find $\frac{C(s)}{R(s)}$ when $N(s) = 0$ for the diagram shown in Fig.Q4(a).

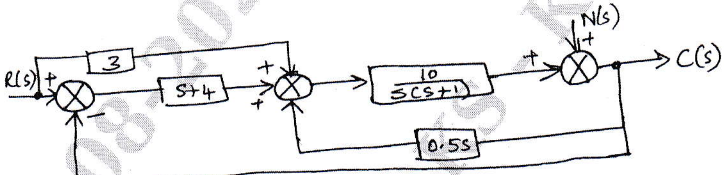

Fig.Q4(a)

(10 Marks)

b. Find $\frac{C}{R}$ using Mason's Gain formula for the signal flow graph shown in Fig.Q4(b).

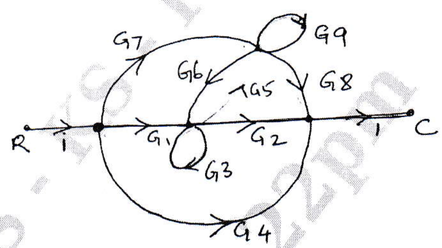

Fig.Q4(b)

(10 Marks)

Module-3

5 a. A unity feedback system is characterized by an open loop transfer function

$$G(s) = \frac{K}{s(s+10)}$$

Find the value of K so that the system will have a damping ratio of 0.6, for this value of K find M_p, T_p and T_s for a unit step input. **(08 Marks)**

b. Find the error constants k_p, k_v and k_a for the unity feedback control system whose open loop transfer function

$$G(s) = \frac{100}{s^2(s+2)(s+5)}$$

Find the steady state error when the input $r(t) = 1 + t + 2t^2$. What is the type and order of the system? **(08 Marks)**

c. With the neat diagram write a note on PID controller. **(04 Marks)**

OR

6 a. Starting from output equation C(t), derive the expression for peak time, peak overshoot, settling time of an under damped second order system subjected to unit step input. **(10 Marks)**

b. Obtain rise time, peak time, % peak overshoot, settling time for the unit step response of a closed loop system given by

$$\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$$

Also find the expression for the output. **(10 Marks)**

Module-4

7 a. For a unity feedback system whose open loop transfer function is $G(s) = \frac{k(s+4)}{s(s+1)(s+2)}$

Find the range of k that keeps the system stable using R-H criteria. **(08 Marks)**

b. Sketch the Root Locus diagram for the unity feedback control system with

$G(s) = \frac{k}{s(s^2+8s+17)}$. Determine the value of k for a damping ratio of 0.5. **(12 Marks)**

OR

8 a. For a system having open loop transfer function given by $G(s) = \frac{10(1+0.125s)}{s(1+0.5s)(1+0.25s)}$

Draw the Bode magnitude and phase plot. Determine the Phase margin and Gain margin. Comment on the stability. **(10 Marks)**

b. Find the transfer function of the system whose Bode diagram is shown in Fig.Q8(b).

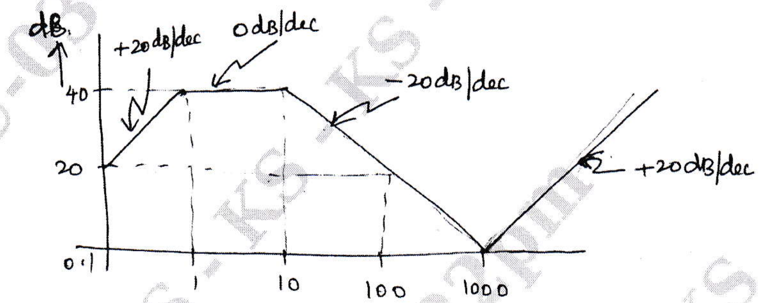

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. The open loop transfer function of a unity negative feedback control system is given by

$$G(s) = \frac{k(s+3)}{s(s^2+2s+2)}$$

using Nyquist criteria find the value of k for which the closed loop system is stable. **(10 Marks)**

b. Explain lead-lag compensating network. **(04 Marks)**

c. Represent the differential equation given below in state model

$$\frac{d^3y(t)}{dt^3} + 3\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 7y(t) = 2u(t)$$ **(06 Marks)**

OR

10 a. Mention the properties of State Transition Matrix. **(04 Marks)**

b. Obtain the state model of the given network shown in Fig.Q10(b) in standard form.

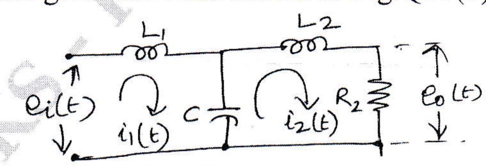

Fig.Q10(b) **(08 Marks)**

c. Find the state transition matrix for the state equation given below.

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 1\end{bmatrix}u(t)$$ **(08 Marks)**

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CBCS SCHEME

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18EC44

Fourth Semester B.E. Degree Examination, June/July 2023
Engineering Statistics and Linear Algebra

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. Discuss the CDF and PDF of a random variable. List the properties of PDF. **(08 Marks)**

b. Given the data in the following table:

k	1	2	3	4	5
y_k	2.1	3.2	4.8	5.4	6.9
$P\{y_k\}$	0.2	0.21	0.19	0.14	0.26

i) Plot the PDF and CDF of the discrete random variable Y.

ii) Write expressions for PDF and CDF using unit delta and unit-step functions. **(08 Marks)**

c. A continuous random variable X has a PDF, $f_x(x) = 3x^2 \quad 0 \le x \le 1$. Find 'a' such that $P\{x > a\} = 0.05$. **(04 Marks)**

OR

2 a. Define an exponential random variable. Obtain the characteristic function of an exponential random variable and using the characteristic function derive its mean and variance. **(10 Marks)**

b. Given the data in the following table:

k	1	2	3	4	5
y_k	2.1	3.2	4.8	5.4	6.9
$P(y_k)$	0.2	0.21	0.19	0.14	0.26

i) What are the mean and variance of Y.

ii) If $W = y^2 + 1$, what are mean and variance of W. **(10 Marks)**

Module-2

3 a. Define correlation coefficient of random variables x and y. Show that it is bounded by limits ±1. **(05 Marks)**

b. The joint PDF $f_{xy}(x, y) = C$, a constant when $0 < x < 3$ and $0 < y < 3$ and is '0' otherwise.

i) What is the value of the constant 'C'?

ii) What are the PDFs for X and Y?

iii) What $F_{xy}(x, y)$ when $0 < x < 3$ and $0 < y < 3$?

iv) What are $F_{xy}(x, \infty)$ and $F_{xy}(\infty, y)$?

v) Are x and y independent? **(10 Marks)**

c. Prove that COV (ax, by) = ab cov(xy). **(05 Marks)**

OR

4 a. Define central limit theorem and show that the sum of two independent Gaussian random variables is also Gaussian. **(06 Marks)**

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b. For a bivariate random variable CDF is given by $c(x+1)^2(y+1)^2$ for $\begin{Bmatrix} -2 < x < 4, \\ -1 < y < 2 \end{Bmatrix}$ and "0" outside. Find:
   i) The value of 'c'
   ii) Bivariate PDF
   iii) $F_x(x)$ and $F_y(y)$
   iv) Evaluate $P\{(x \le 2) \cap (y \le 1)\}$
   v) Are there variables independent? **(10 Marks)**

c. Explain briefly the following random variables:
   i) Chi-square random variable
   ii) Student-t random variable. **(04 Marks)**

Module-3

5 a. Define random process, with help of examples discuss different types of random processes. **(08 Marks)**

b. Explain strict-sense-stationary and wide-sense-stationary random process. **(04 Marks)**

c. A random process is defined by $x(t) = A \sin(w_c t + \ominus)$ where A, w_c are constants and $\ominus$ is a uniformly distributed random variable, distributed between $-\pi$ and π. Check whether x(t) is WSS. If yes list its mean and ACF. **(08 Marks)**

OR

6 a. Define Auto Correlation Function (ACF) of a random process and discuss its properties. **(10 Marks)**

b. The random process x(t) and y(t) are jointly wide-sense stationary and independent. Given that W(t) = x(t) + y(t) and

$R_x(\tau) = 10e^{-\frac{|\tau|}{3}}$

$R_y(\tau) = 10^{\left(\frac{3-|\tau|}{3}\right)}$ $-3 \le \tau \le 3$
   = 0 (otherwise).

For W(t), find i) ACF ii) Total power iii) ac power iv) dc power v) check whether W(t) is W.S.S. **(10 Marks)**

Module-4

7 a. Define vector space and explain four fundamental subspaces with example. **(08 Marks)**

b. Determine the column space and null space of the matrix $B = \begin{bmatrix} 0 & 0 & 3 \\ 1 & 2 & 3 \end{bmatrix}$. **(06 Marks)**

c. Reduce the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ to the Echelon (u) form and find the rank of the matrix. **(06 Marks)**

OR

8 a. What is basis for a vector space? Explain. **(06 Marks)**

b. Given the vectors (1, -3, 2), (2, 1, -3) and (-3, 2, 1). Identify the basis. Verify they are independent or not. **(08 Marks)**

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c. Determine orthonormal vectors for $u = \begin{bmatrix} 4 \\ 2 \\ -1 \end{bmatrix}$ and $v = \begin{bmatrix} 1 \\ -3 \\ -2 \end{bmatrix}$. **(06 Marks)**

Module-5

9 a. By applying row operations to produce upper triangular matrix u, compute $|A|$ (det A).

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

b. For the given upper triangular matrix, determine i) $|u|$ ii) $|u^T|$ iii) $|u^{-1}|$.

$$u = \begin{bmatrix} 4 & 4 & 2 & 8 \\ 0 & 1 & 2 & 2 \\ 0 & 0 & 2 & 6 \\ 0 & 0 & 0 & 2 \end{bmatrix}$$ **(06 Marks)**

c. What is cofactor? Explain with an example. **(06 Marks)**

OR

10 a. Find x, y and z using CRAMER's rule for the system of equations,

$x + 4y - z = 1$

$x + y + z = 0$

$2x + 3z = 0.$ **(06 Marks)**

b. Determine the eigen values of matrix $A = \begin{bmatrix} 3 & 2 \\ -1 & 0 \end{bmatrix}$. **(04 Marks)**

c. i) List the properties of Singular Value Decomposition (SVD).

ii) Prove that Identity matrix is positive definite using all required tests. **(10 Marks)**

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CBCS SCHEME

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18EC45

Fourth Semester B.E. Degree Examination, June/July 2023
Signals and Systems

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. Define signals and systems, briefly explain the classifications of signals. **(08 Marks)**

b. Determine whether the discrete time signal $x(n) = \cos\left(\frac{\pi n}{5}\right)\sin\left(\frac{\pi n}{3}\right)$ is periodic, of periodic find the fundamental period. **(06 Marks)**

c. Find and sketch the following signals and their derivatives.
i) $x(t) = u(t) - u(t - a)$; $a > 0$
ii) $y(t) = t[u(t) - u(t - a)]$; $a > 0$. **(06 Marks)**

OR

2 a. Let $x_1(t)$ and $x_2(t)$ be the two periodic signals with fundamental periods T_1 and T_2 respectively. Under what conditions the sum $x(t) = x_1(t) + x_2(t)$ is periodic and what is the fundamental period of x(t), if it is periodic? **(06 Marks)**

b. Calculate the average power of the signal $x(t) = A\cos(\omega_0 t + \theta)$, $-\infty < t < \infty$. Also classify whether signal is power or energy. **(06 Marks)**

c. A continuous time m signal x(t) is shown in Fig.Q2(c). Sketch and label each of the following : i) $x(t-2)$ ii) $x(2t)$ iii) $x(t/2)$ iv) $x(-t)$.

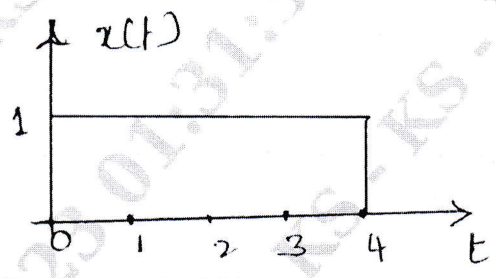

Fig.Q2(c) **(08 Marks)**

Module-2

3 a. For a system describe by $T\{x(n)\} = ax + b$, check for the following properties :
i) Stability ii) Causality iii) Linearity iv) Time – Invariance. **(06 Marks)**

b. Given : $x(t) = u(t) - u(t-3)$, and $h(t) = u(t) - u(t-2)$ evaluate and sketch $y(t) = x(t) * h(t)$. **(10 Marks)**

c. Find the convolution sum of x(n) and h(n) where $x(n) = [\underset{\uparrow}{0}, 1, 2, 3]$ and $h(n) = [1, \underset{\uparrow}{2}, 1]$. **(04 Marks)**

OR

4 a. Find the integral convolution of the following two continuous time signals $h(t) = e^{-2t}u(t)$ and $x(t) = u(t+2)$. Also sketch the output. **(08 Marks)**

b. Find the convolution sum of the following signals, where $x(n) = u(n)$ and $h(n) = (1/2)^n u(n)$. **(06 Marks)**

c. State and prove the following properties of convolution sum :
i) Commutative ii) Associative iii) Distributive. **(06 Marks)**

Module-3

5 a. Find the overall impulse response of the system shown in the Fig.Q5(a).

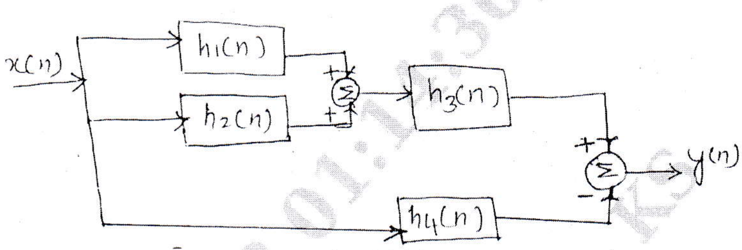

Fig.Q5(a)

Where $h_1(n) = u(n)$, $h_2(n) = u(n+2) - u(n)$

$h_3(n) = \delta(n-2)$ and $h_4(n) = a^n u(n)$. **(04 Marks)**

b. Check for memory, causal and stability of the following systems :
$h(n) = (0.5)^n u(n)$ ii) $h(n) = 3^n u(n+2)$ iii) $h(t) = e^{-t}u(t)$. **(09 Marks)**

c. Find the Fourier series coefficient x(k) for x(t) shown in the Fig.Q5(c).

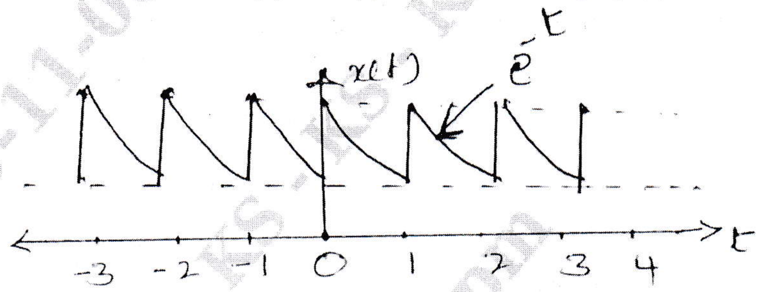

Fig.Q5(c) **(07 Marks)**

OR

6 a. Find the step response of a system whose impulse response is given by $h(n) = (1/2)^n u(n-3)$. **(08 Marks)**

b. Find the complex Fourier coefficients for x(t) given below :

$$x(t) = \cos\left(\frac{2\pi t}{3}\right) + 2\cos\left(\frac{5\pi t}{3}\right).$$ **(06 Marks)**

c. Find the step response of the system whose impulse response is given by $h(t) = e^{-3t}u(t)$. **(06 Marks)**

Module-4

7 a. Find the DTFT of a signal $x(n) = a^n u(n)$. Also find the magnitude and phase angle. **(08 Marks)**

b. Find the Fourier transform of a rectangular pulse described below :

$$x(t) = \begin{cases} 1, & |t| < a \\ 0, & |t| > a \end{cases}$$

Also find magnitude and phase spectrum. **(12 Marks)**

OR

8 a. Find the Fourier transform of a signal $x(t) = e^{-at}u(t)$. Also calculate its magnitude and phase angle. **(06 Marks)**

b. State and prove the following properties of DTFT
i) Linearity ii) Time – shift iii) Frequency differentiation. **(09 Marks)**

c. Using the properties of Fourier transforms find the Fourier transform of the signal :
$x(t) = \sin(\pi t)\, e^{-2t}\, u(t)$. **(05 Marks)**

Module-5

9 a. Find the z – transform or a signal $x(n) = 3^n u(n)$. Also plot RoC with poles and zeros. **(08 Marks)**

b. Give the significance of the properties of RoC. **(06 Marks)**

c. Using the properties of Z – transform find the Z – transform of the signal $x(n) = n\,a^{n-1}\,u(n)$. **(06 Marks)**

OR

10 a. State and prove the following properties of Z – transform
i) Linearity
ii) Time – shift
iii) Time – reversal. **(06 Marks)**

b. Find the inverse Z – transform of x(z) using partial fraction expansion approach,

$$x(z) = \frac{z+1}{3z^2 - 4z + 1};\ \text{RoC}\,|z| > 1.$$ **(06 Marks)**

c. Using power series expansion technique find the inverse Z – transform of the following x(z):

i) $$x(z) = \frac{z}{2z^2 - 3z + 1};\quad \text{RoC}\,|z| < \frac{1}{2}$$

ii) $$x(z) = \frac{z}{2z^2 - 3z + 1};\quad \text{RoC}\,|z| > 1.$$ **(08 Marks)**

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CBCS SCHEME

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18EC46

Fourth Semester B.E. Degree Examination, June/July 2023
Microcontrollers

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. Write and explain the pin diagram of 8051 microcontroller. **(10 Marks)**

b. With a neat diagram, explain the Block diagram 8051 microcontroller. Also explain PSW, RAM memory organization. **(10 Marks)**

OR

2 a. Describe the features of 8051 microcontroller with a neat diagram. **(10 Marks)**

b. Explain the external interfacing of 16KB of ROM, 32KB of RAM to 8051 microcontroller such that the starting address of ROM is 0000H and RAM 8000H. **(10 Marks)**

Module-2

3 a. What are the addressing modes supported by 8051? Explain with example. **(10 Marks)**

b. Write an assembly language program along with flow chart to divide the data in RAM location 41H by the data in 20H. Store the quotient on 70H and remainder in 71H. **(10 Marks)**

OR

4 a. Explain the following instructions with example
i) DJNZ Rn, rel ii) MOVC A, @A + DPTR iii) RRC A iv) PUSH 02 v) DAA. **(10 Marks)**

b. Write a program segment to copy the value 55h into RAM memory locations 40h to 44h using i) Direct addressing mode ii) Register indirect addressing mode without a loop iii) and with a loop. **(10 Marks)**

Module-3

5 a. Explain the role of CALL and subroutines in 8051 microcontroller programming. Give an example. **(10 Marks)**

b. Write on ALP along with flow chart to find smallest number in an array of 10bytes of data stored in external memory location starting with 3000H. Store the result in internal memory 30H. Show the results obtained with sample data given. **(10 Marks)**

OR

6 a. Explain the operation of PUSH, POP, LCALL, ACALL and RET instructions of 8051 giving all the steps involved with suitable examples. **(10 Marks)**

b. Write an assembly language program to toggle all the bits of P0, P1 and P2 every $1/4^{th}$ of a second. Assume crystal frequency is 11.0592MHz. **(10 Marks)**

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Module-4

7 a. Explain TMOD register format of 8051. **(04 Marks)**

b. Explain MODE-1 programming of timers in 8051. **(06 Marks)**

c. Write an ALP to generate square wave of frequency 1KHz on P1.3. Assume crystal frequency, XTAL = 22MHz. User Timer 1 in mode 1. **(10 Marks)**

OR

8 a. Write an 8051 program to transfer "YES" serially at 9600 baud, 8 bit data, 1 stop bit, do this continuously. **(05 Marks)**

b. Explain SCON register with its bit pattern. **(05 Marks)**

c. Write the steps required for programming 8051 to transmit and receive the data serially and what is the role of PCON register in serial communication. **(10 Marks)**

Module-5

9 a. Assume that the INTI pin is connected to a switch that is normally high. Whenever it goes low, it should turn on the LED. The LED is connected to P1.3 and is normally off. When it is turned on it should stay on for a fraction of a second. As long as the switch is pressed low, the LED should stay on. Write on ALP for this. **(05 Marks)**

b. Write a program in which the 8051 reads data from P1 and writes it to P2 continuously; while giving a copy of it to the serial comport to be transferred serially. Assume that XTAL = 11.0592MHz. Set the baud rate at 9600. **(05 Marks)**

c. Explain the structure of Interrupt Priority (IP) and Interrupt Enable (IE) SFR. **(10 Marks)**

OR

10 a. Explain DAC interface with diagram and also write a program to generate stair case waveform. **(10 Marks)**

b. Explain stepper motor interface with diagram and also write C program to monitor the status of switch and rotate clockwise if status of switch is zero and anticlockwise if status of switch is one. **(10 Marks)**

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