CBCS SCHEME

USN | | | | | | | | | | 18MAT41

Fourth Semester B.E. Degree Examination, July/August 2022
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. Derive Cauchy-Riemann equation in Polar form. (06 Marks)

b. Find the analytic function f(z) whose real part is
$x \sin x \cosh y - y \cos x \sinh y$ (07 Marks)

c. If f(z) is analytic show that
$$\left[\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}\right]|f(z)|^2 = 4|f'(z)|^2$$ (07 Marks)

OR

2 a. Find the analytic function f(z) given that the sum of its real and imaginary part is
$x^3 - y^3 + 3xy(x-y)$ (06 Marks)

b. Find the analytic function $f(z) = u + iv$ if
$v = r^2\cos 2\theta - r\cos\theta + 2$ (07 Marks)

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

Module-2

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

b. Evaluate $\int_0^{2+i} \bar{z}^2 dz$ along (i) the line $y = \frac{x}{2}$ (ii) The real axis to 2 and then vertically to 2 + i. (07 Marks)

c. Find the bilinear transformation which maps the points 1, i, −1 onto the points i, 0, −i respectively. (07 Marks)

OR

4 a. Discuss the transformation $w = e^z$, with respect to straight lines parallel to x and y axis. (06 Marks)

b. Using Cauchy's integral formula evaluate
$$\int_c \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)(z-2)} dz, \text{ where } c : |z| = 3$$ (07 Marks)

c. Find the bilinear transformation which maps the points 0, 1, ∞ on to the points −5, −1, 3 respectively. (07 Marks)

Module-3

5 a. A random variable X has the following probability function for various values of X.

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) $P(X < 6)$ iii) $P(3 < X \le 6)$ (06 Marks)

b. Out of 800 families with 5 children each, how many families would you expect to have (i) 3 boys (ii) 5 girls (iii) either 2 or 3 boys (iv) atmost 2 girls, assuming equal probabilities for boys and girls. **(07 Marks)**

c. The length in time (minutes) that a certain lady speaks on a telephone is a random variable with probability density function

$$f(x) = \begin{cases} Ae^{-x/5} & \text{for } x > 0 \\ 0 & \text{elsewhere} \end{cases}$$

Find the value of the constant A. What is the probability that she will speak over the phone for (i) More than 10 minutes (ii) Less than 5 minutes (iii) Between 5 and 10 minutes. **(07 Marks)**

OR

6 a. Find the constant C such that the function

$$f(x) = \begin{cases} Cx^2, & 0 < x < 3 \\ 0 & \text{otherwise} \end{cases}$$ is a probability density function. Also compute $P(1 < x < 2)$, $P(x \le 1)$ and $P(x > 1)$ **(06 Marks)**

b. 2% fuses manufactured by a firm are found to be defective. Find the probability that the box containing 200 fuses contains
(i) No defective fuses (ii) 3 or more defective fuses (iii) At least one defective fuse. **(07 Marks)**

c. If x is a normal variate with mean 30 and standard deviation 5 find the probabilities that (i) $26 \le x \le 40$ (ii) $x \ge 45$ (iii) $|x - 30| > 5$
Given that $\phi(1) = 0.3413$, $\phi(0.8) = 0.2881$, $\phi(2) = 0.4772$, $\phi(3) = 0.4987$ **(07 Marks)**

Module-4

7 a. The following table gives the ages (in years) of 10 married couples. Calculate Karl Pearson's coefficient of correlation between their ages:

Age of husband (x)	23	27	28	29	30	31	33	35	36	39
Age of wife (y)	18	22	23	24	25	26	28	29	30	32

(06 Marks)

b. In a partially destroyed laboratory record of correlation data only the following results are available:
Variance of x is 9 and regression lines are $8x - 10y + 66 = 0$, $40x - 18y = 214$. Find
(i) Mean value of x and y
(ii) Standard deviation of y
(iii) Coefficient of correlation between x and y. **(07 Marks)**

c. Fit a parabola of the form $y = ax^2 + bx + c$ for the data

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

(07 Marks)

OR

8 a. Obtain the lines of regression and hence find the coefficient of correlation of the data:

x	1	3	4	2	5	8	9	10	13	15
y	8	6	10	8	12	16	16	10	32	32

(06 Marks)

b. Show that if θ is the angle between the lines of regression

$$\tan\theta = \frac{\sigma_x \sigma_y}{\sigma_x^2 + \sigma_y^2}\left(\frac{1 - r^2}{r}\right)$$ **(07 Marks)**

c. Fit a straight line $y = a + bx$ to the data

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

(07 Marks)

Module-5

9 a. The joint probability distribution of the random variables X and Y is given below.

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

Find (i) E[X] and E[Y] (ii) E[XY] (iii) cov(X, Y) iv) $\rho(X, Y)$.
Also, show that X and Y are not independent. (06 Marks)

b. A manufacturer claimed that atleast 95% of the equipment which he supplied to a factory confirmed to specifications. An examination of a sample of 200 pieces of equipment revealed that 18 of them were faulty. Test his claim at a significance level of 1% and 5% ($z_{0.05} = 1.96$, $z_{0.01} = 2.58$). (07 Marks)

c. A certain stimulus administered to each of the 12 patients resulted in the following change in blood pressure 5, 2, 8, –1, 3, 0, 6, –2, 1, 5, 0, 4. Can it be concluded that the stimulus will increase the blood pressure ($t_{0.05}$ for 11 d.f. is 2.201) (07 Marks)

OR

10 a. Define the terms :
(i) Null hypothesis (ii) Type-I and Type – II errors (iii) Significance level (06 Marks)

b. In an experiment of pea breeding the following frequencies of seeds were obtained:

Round Yellow	Wrinkled Yellow	Round Green	Wrinkled Green	Total
315	101	108	32	556

Theory predicts that the frequencies should be in proportions 9:3:3:1
Is the experiment in agreement with theory ($\chi^2_{0.5}$ for 3 d.f is 7.815) (07 Marks)

c. The joint probability distribution of two discrete random variable X and Y is given by $f(x, y) = k(2x + y)$ where x and y are integers such that $0 \le x \le 2$, $0 \le y \le 3$. Find k and the marginal probability distribution of X and Y. Show that the random variables X and Y are dependent. Also, find $P(X \ge 1, Y \le 2)$. (07 Marks)

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CBCS SCHEME

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18MATDIP41

Fourth Semester B.E. Degree Examination, July/August 2022
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
$$A = \begin{bmatrix} 1 & 0 & -3 & -1 \\ 0 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$$
(06 Marks)

b. Solve the system of equations: $x + y + z = 9$; $x - 2y + 3z = 8$; $2x + y - z = 3$ by Gauss elimination method. (07 Marks)

c. Find all the eigen values and corresponding eigen vectors of $\begin{pmatrix} -5 & 9 \\ -6 & 10 \end{pmatrix}$ (07 Marks)

OR

2 a. Find the rank of the matrix
$$\begin{pmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{pmatrix}$$
(06 Marks)

b. Using Gauss elimination method solve the system of equations
$x + 2y + 3z = 6$; $2x + 4y + z = 7$; $3x + 2y + 9z = 14$. (07 Marks)

c. Find the eigen values of the matrix $\begin{pmatrix} 1 & 2 & 3 \\ 0 & -2 & 6 \\ 0 & 0 & -3 \end{pmatrix}$ (07 Marks)

Module-2

3 a. Use an appropriate Interpolation formula to compute f(6).

x	1	2	3	4	5
y	1	-1	1	-1	1

(07 Marks)

b. Evaluate $\int_0^6 3x^2 dx$ by using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule by taking $n = 6$. (07 Marks)

c. Find a real root of the equation $x^3 - 2x - 5 = 0$ by Newton Raphson method. (06 Marks)

OR

4 a. Find solution using Newton's Interpolation formula, at $x = -1$.

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

(07 Marks)

b. Find the real root of the equation $\cos x = 3x - 1$ using Regula Falsi method. (07 Marks)

c. Evaluate $\int_{4}^{5.2} \log_e x$ taking $n = 6$ by Weddle's rule. (06 Marks)

Module-3

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

b. Solve : $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 3y = e^{2x}$ (07 Marks)

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

OR

6 a. Solve : $\frac{d^3y}{dx^3} - 3\frac{dy}{dx} + 2y = 0$ (06 Marks)

b. Solve : $(D^2 - 6D + 9)y = 7e^{-2x} - \log 2$ (07 Marks)

c. Solve : $\frac{d^2y}{dx^2} - 16y = \sin 16x$ (07 Marks)

Module-4

7 a. Form the partial differential equation by eliminating the arbitrary constants from $z = (x - a)^2 + (y - b)^2$ (06 Marks)

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

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

OR

8 a. Form the partial differential equation by eliminating the arbitrary function 'f' from $f(x^2 + y^2, z - xy) = 0$ (06 Marks)

b. Solve the equation $\frac{\partial^2 z}{\partial y^2} = \sin xy$ (07 Marks)

c. Form the partial differential equation by eliminating the arbitrary constants

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$$ (07 Marks)

Module-5

9 a. Define : (i) Mathematical definition of probability
(ii) Mutually exclusive events
(iii) Independent events (06 Marks)

b. If A and B are two events with $P(A) = \frac{1}{2}$, $P(B) = \frac{1}{3}$ and $P(A \cap B) = \frac{1}{4}$.

Find (i) $P(A/B)$ (ii) $P(B/A)$ (iii) $P(\overline{A}/\overline{B})$ (iv) $P(\overline{B}/\overline{A})$ (07 Marks)

c. In a bolt factory there are four machines A, B, C, D manufacturing respectively 20%, 15%, 25%, 40% of the total production. Out of these 5%, 4%, 3%, 2% are defective. If a bolt drawn at random was found defective, what is the probability that it was manufactured by A? (07 Marks)

OR

10 a. State and prove Baye's theorem. **(06 Marks)**

b. A card is drawn at random from a pack of cards. (i) What is the probability that it is a heart? (ii) If it is known that the card drawn is red, what is the probability that it is a heart? **(07 Marks)**

c. An Urn 'A' contains 2 white and 4 black balls. Another Urn 'B' contains 5 white and 7 black balls. A ball is transferred from the Urn A to the Urn B. Then a ball is drawn from the Urn B. Find the probability that it is white. **(07 Marks)**

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18EC42

Fourth Semester B.E. Degree Examination, July/August 2022
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. Explain the working of voltage dividing bias circuit using BJT. **(08 Marks)**

b. Design MOSFET drain to gate feedback circuit to establish I_D = 0.5 mA and V_{DD} = 5V. MOSFET parameters are : V_t = 1 V, $K'_n(W/L) = 1\ mA/V^2$ and λ = 0. Use Standard resistor values and actual values obtained for I_D and V_D . **(06 Marks)**

c. Derive an expression for voltage gain A_V of small signal CE BJT amplifier. **(06 Marks)**

OR

2 a. Explain with neat circuit diagram the MOSFET drain to gate feedback resistor biasing. **(06 Marks)**

b. Design a voltage divider bias network using a supply of 24V, β = 110 and I_{CQ} = 4 mA , V_{CEQ}= 8V. Choose $V_E = V_{CC} / 8$. **(08 Marks)**

c. Explain with neat circuit diagram MOSFET circuit using fixing V_G. **(06 Marks)**

Module-2

3 a. Derive the expression for characterizing parameters of CS MOSFET amplifier without source resistor using hybrid-π equivalent circuit. **(06 Marks)**

b. A phase shift oscillator is to be designed with FET having g_m = 5000 μs, r_d = 40 kΩ while the resistance in the feedback circuit is 9.7 kΩ. Select the proper value of C and R_D to have the frequency of oscillations as 5 kHz. **(08 Marks)**

c. Write a note on three basic configurations of MOSFET amplifier. **(06 Marks)**

OR

4 a. State Barkhausen criteria. **(04 Marks)**

b. A Quartz crystal has constants L = 50 mH, C_1 = 0.02 pF, R = 500Ω and C_2 = 12 pF. Find the values of series and parallel resonant frequencies. Also if the external capacitance across the crystal changes from 5 pF to 6 pF, find the change in frequency of oscillations. **(08 Marks)**

c. Draw and explain the frequency response characteristics of CS MOSFET amplifier. **(08 Marks)**

Module-3

5 a. Briefly explain the four basic feedback topologies with necessary block diagram. **(10 Marks)**

b. Show that the maximum efficiency of series fed, directly coupled class A power amplifier is 25%. **(06 Marks)**

c. An amplifier without negative feedback has a voltage gain of 400 with a distortion of 10%. Determine the amplifier voltage gain and distortion, when a negative feedback is applied with feedback ratio of 0.01. **(04 Marks)**

OR

6 a. With neat circuit diagram, explain the operation of a class B pushpull amplifier with relevant waveforms. Show that the maximum conversion efficiency of class B pushpull amplifier is 78.5%. **(10 Marks)**

b. For a class C tuned amplifier with load resistance of 10 kΩ and V_{CC} = 30V. Calculate
(i) Output power if the output voltage is 30 V_{pp}.
(ii) DC input power if current drain is 0.5 mA.
(iii) Efficiency. **(04 Marks)**

c. Derive the expression for input resistance for a voltage shunt feedback amplifier. **(06 Marks)**

Module-4

7 a. State the ideal characteristics of op-Amp. **(08 Marks)**

b. For a Schmitt trigger shown in the Fig.Q7(b) calculate threshold voltage levels and hysteresis. Assume V_{sat} = 0.9 V_c.

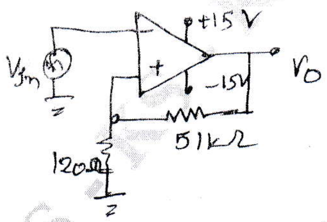

Fig.Q7(b) **(04 Marks)**

c. Draw a practical inverting amplifier and derive the expression for closed loop voltage gain, input resistance and output resistance. **(08 Marks)**

OR

8 a. Draw the circuit of 3 op-Amp instrumentation amplifier and derive expression for its output voltage. **(08 Marks)**

b. Explain the working of zero crossing detector. **(06 Marks)**

c. For a non-inverting amplifier, the values of R_1 and R_f are 1 kΩ and 10 kΩ respectively. The various op-Amp parameters are, open loop gain = 2×10^5, Input resistance = 2MΩ, Output resistance = 75Ω, Single break frequency = 5 Hz , Supply voltages = ±12V , Calculate the closed loop gain, input resistance, output resistance with feedback and bandwidth with feedback. **(06 Marks)**

Module-5

9 a. Draw and explain the working of precision full wave rectifier. **(08 Marks)**

b. Design a low pass filter using op-Amp at a cutoff frequency of 1 kHz with pass gain of 2. **(06 Marks)**

c. Explain the working of pulse width modulator using IC555 with waveforms. **(06 Marks)**

OR

10 a. Explain the functional block diagram of IC555. **(08 Marks)**

b. Design a monostable 555 timer circuit to produce an output pulse of 10 sec wide. Draw the circuit diagram. **(04 Marks)**

c. Explain with neat circuit diagram the operation of R-2R digital to analog converter. **(08 Marks)**

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18EC43

Fourth Semester B.E. Degree Examination, July/August 2022
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. What is Control System? Distinguish between open loop and closed loop system. Give one example for each. **(08 Marks)**

b. Write the differential equations governing the mechanical system shown in Fig.Q.1(b). Draw the force-voltage and force-current electrical analogous circuits. **(12 Marks)**

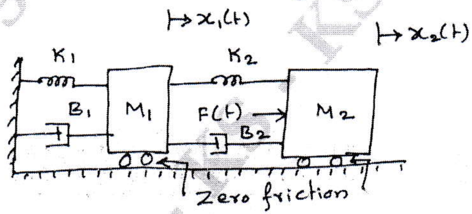

Fig.Q.1(b)

OR

2 a. Write the differential equations governing the mechanical rotational system shown in Fig.Q.2(a). Obtain the transfer function of the system. **(10 Marks)**

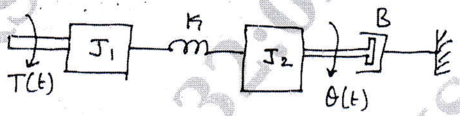

Fig.Q.2(a)

b. Write the differential equations governing the mechanical rotational system shown in Fig.Q.2(b). Draw the torque-voltage analogous circuit. **(10 Marks)**

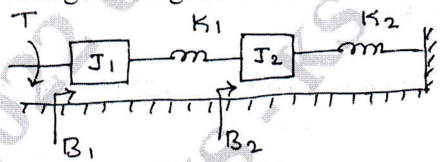

Fig.Q.2(b)

Module-2

3 a. Determine the overall transfer function $\frac{C(S)}{R(S)}$ for the system shown in Fig.Q.3(a) using block diagram reduction technique. **(10 Marks)**

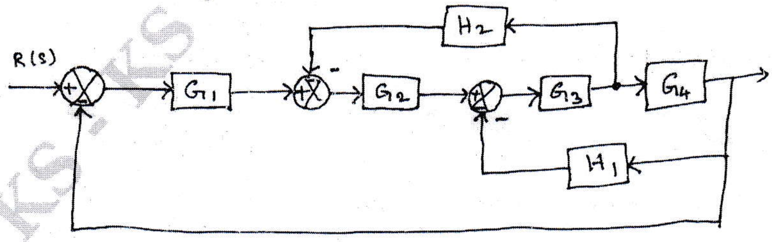

Fig.Q.3(a)

b. Find the overall T.F by Mason's gain formula for the SFG given in the Fig.Q.3(b). (10 Marks)

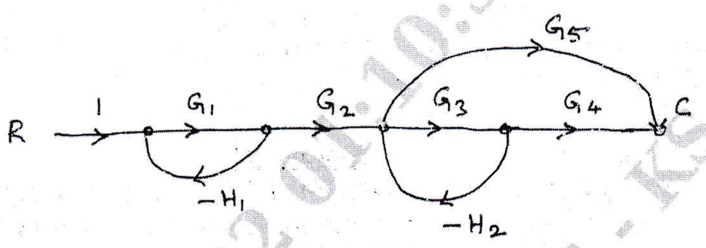

Fig.Q.3(b)

OR

4 a. Draw the SFG and obtain the FF transfer function for a system which is described by the set of following algebraic equations.

$y_2 = a_{12}y_1 + a_{32}y_3$

$y_3 = a_{23}y_2 + a_{43}y_4$

$y_4 = a_{24}y_2 + a_{34}y_3 + a_{44}y_4$

$y_5 = a_{25}y_2 + a_{45}y_4$ (10 Marks)

b. Find out the transfer function shown in Fig.Q.4(b) using Mason's gain formula. (10 Marks)

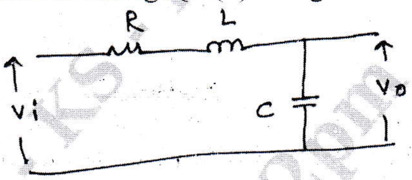

Fig.Q.4(b)

Module-3

5 a. Derive the expression of response of first order system for unit step input. (10 Marks)

b. With neat graph explain the time domain specifications of second order system. (10 Marks)

OR

6 a. Obtain the response of unity feed back system whose open loop transfer function $G(S) = \frac{4}{S(S+5)}$ and when input is unit step. (10 Marks)

b. A unity feed back system with $G(S) = \frac{100}{S^2(S+1)(S+2)}$

i) What is the type of system?

ii) Find static error coefficients.

iii) Find steady state error if the input is $r(t) = 2t^2 + 5t + 1$. (10 Marks)

Module-4

7 a. Derive the expression for condition of stability of control system. (05 Marks)

b. Explain Routh-Hurwitz criterion for stability of the system and what are its limitations. (05 Marks)

c. Find the range of K so that the system with characteristic equation as: $s^4 + 25s^3 + 15s^2 + 20s + k = 0$ is stable. Also find frequency of oscillation at marginal value of K. (10 Marks)

OR

8 a. Sketch the root Locus plot for all values of K ranging from 0 to ∞ for a negative feed back control system characterized by $GH(S)=\dfrac{K(S+6)}{S(S+1)(S+2)}$. **(10 Marks)**

b. Plot the Bode diagram for open loop transfer function

$G(S)=\dfrac{10}{S(1+0.4s)(1+0.1s)}$ and obtain the gain and phase cross over frequencies. **(10 Marks)**

Module-5

9 a. Using Nyquist stability criterion, investigate the stability of a closed loop system whose OLTF is given by

$G(S)H(S)=\dfrac{K}{(S+1)(S+2)}$. **(10 Marks)**

b. Distinguish between classical method and state space approach. **(10 Marks)**

OR

10 a. A negative feed back control system is characterized by an open loop transfer function.

$GH(S)=\dfrac{5}{S(S+1)}$

Investigate the closed loop stability of the system using Nyquist stability criterion. **(10 Marks)**

b. Write a state model for differential equation

$$4\frac{d^3}{dt^3}y+8\frac{d^2}{dt^2}y+24\frac{dy}{dt}+4y=32\,U(t)$$

Using phase variable canonical form. **(10 Marks)**

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CBCS SCHEME

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18EC44

Fourth Semester B.E. Degree Examination, July/August 2022
Engineering Statistics and 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 an uniform random variable. Obtain the characteristic function of an uniform random variable and using the characteristic function derive its mean and variance. **(08 Marks)**

b. If the probability density function of a random variable is given by

$$f_X(x) = \begin{cases} C\exp(-x/4), & 0 \le x < 1 \\ 0, & \text{otherwise} \end{cases}$$

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

c. The density function of a random variable is given as

$$f_X(x) = a\,e^{-bx} \quad x \ge 0$$

Find the characteristic function and the first two moments. **(06 Marks)**

OR

2 a. Define a Poisson random variable. Obtain the characteristic function of a Poisson random variable and hence find mean and variance using the characteristic function. **(08 Marks)**

b. Suppose 'X' is a general discrete random variable with following probability distribution. Calculate mean and variance for X.

X	0	1	3	5	7
P(X)	0.05	0.2	0.6	0.1	0.05

(06 Marks)

c. The number of defects in a thin copper wire follows Poisson distribution with mean of 2.3 defects per millimeter. Determine the probability of exactly two defects per millimeter of wire. **(06 Marks)**

Module-2

3 a. Define and explain Central Limit theorem and show that the sum of the two independent Gaussian random variables is also Gaussian. **(08 Marks)**

b. Let 'X' and 'Y' be exponentially distributed random variable with

$$f_X(x) = \begin{cases} \lambda e^{-\lambda x} & x \ge 0 \\ 0 & x < 0 \end{cases}$$

Then obtain the characteristic function and Pdf of W = X + Y. **(06 Marks)**

c. Determine a constant b such that the given function is a valid joint density function.

$$f_{XY}(x,y) = \begin{cases} b(x^2+4y^2) & 0 \le |x| < 1 \text{ and } 0 \le y < 2 \\ 0 & \text{elsewhere} \end{cases}$$

(06 Marks)

OR

4 a. Explain briefly the following random variables :

(i) Chi-square Random Variable

(ii) Rayleigh Random Variable. **(04 Marks)**

b. The joint density function of two random variables X and Y is

$$f_{X,Y}(x,y) = \begin{cases} \frac{(x+y)^2}{40}, & -1 < x < 1 \text{ and } -3 < y < 3 \\ 0, & \text{elsewhere} \end{cases}$$

Find (i) the variances of X and Y (ii) the correlation coefficient. **(08 Marks)**

c. Gaussian random variables X_1 and X_2 whose $\overline{X}_1 = 2$, $\sigma^2_{X_1} = 9$, $\overline{X}_2 = -1$, $\sigma^2_{X_2} = 4$ and $C_{X_1X_2} = -3$ are transformed to new random variables Y_1 and Y_2 such that

$Y_1 = -X_1 + X_2$

$Y_2 = -2X_1 - 3X_2$

Find (i) $\overline{X_1^2}$ (ii) $\overline{X_2^2}$ (iii) $\rho_{X_1X_2}$ (iv) $\sigma^2_{Y_1}$ (v) $\sigma^2_{Y_2}$ (vi) $C_{Y_1Y_2}$ (vii) $\rho_{Y_1Y_2}$ **(08 Marks)**

Module-3

5 a. With the help of an example, define Random process and discuss distribution and density functions of a random process. Mention the differences between Random variable and Random process. **(08 Marks)**

b. Define the Autocorrelation function of the random process X(t) and discuss its properties. **(06 Marks)**

c. A stationary ergodic random process has the autocorrelation function with periodic components as $R_{XX}(\tau) = 25 + \frac{4}{1+6\tau^2}$

Find the mean and variance of X(t). **(06 Marks)**

OR

6 a. The autocorrelation function of a wide sense stationary process.

$$R_X(\tau) = \begin{cases} 1 - \frac{|\tau|}{T}, & -T \le |\tau| \le T \\ 0, & \text{elsewhere} \end{cases}$$

Obtain the Power Spectral Density of the process. **(06 Marks)**

b. Show that the random process X(t) = A cos($w_c t + \theta$) is wide sense stationary. Here θ is uniformly distributed in the range $-\pi$ to π. **(08 Marks)**

c. X(t) and Y(t) are independent, jointly wide sense stationary random processes given by

$X(t) = A\cos(w_1 t + \theta_1)$

$Y(t) = B\cos(w_2 t + \theta_2)$

If $W(t) = X(t) \cdot Y(t)$ then find the Autocorrelation function $R_W(\tau)$. **(06 Marks)**

Module-4

7 a. Define vector subspaces and explain the four fundamental subspaces. **(06 Marks)**

b. Show that the vectors (1, 2, 1), (2, 1, 0), (1, −1, 2) form a basis of R^3. **(06 Marks)**

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

OR

8 a. Determine the null space of each of the following matrices:

(i) $A = \begin{bmatrix} 2 & 0 \\ -4 & 10 \end{bmatrix}$ (ii) $\begin{bmatrix} 1 & -7 \\ -3 & 21 \end{bmatrix}$ **(06 Marks)**

b. Determine whether the vectors (2, –2, 4), (3, –5, 4) and (0, 1, 1) are linearly dependent or independent. **(06 Marks)**

c. Find the QR-decomposition for the matrix

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

and write the result in the form of $A = QR$. **(08 Marks)**

Module-5

9 a. If $A = \begin{bmatrix} 4 & 2 & -2 \\ -5 & 3 & 2 \\ -2 & 4 & 1 \end{bmatrix}$

find eigen values and corresponding eigen vectors for matrix A. **(08 Marks)**

b. Diagonalize the following matrix:

$$A = \begin{bmatrix} 1 & 3 & 3 \\ -3 & -5 & -3 \\ 3 & 3 & 1 \end{bmatrix}$$

Find an invertible matrix P and a diagonal matrix D such that $A = PDP^{-1}$. **(08 Marks)**

c. What is the positive definite matrix? Mention the methods of testing positive definiteness. **(04 Marks)**

OR

10 a. Factorize the matrix A into $A = U \Sigma V^T$ using SVD.

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

(08 Marks)

b. If $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ show that A is positive definite matrix. **(04 Marks)**

c. Find a matrix P, which transforms the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$ to diagonal form. **(08 Marks)**

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CBCS SCHEME

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

Fourth Semester B.E. Degree Examination, July/August 2022

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. Differentiate between Energy and Power signals. Identify whether u(t) is energy or power signals. Compute its energy / power. **(08 Marks)**

b. Given the signals x(t) & y(t) in the Fig. Q1(b), sketch
i) $x(t - 2) + y(1 - t)$ ii) $x(t) - y(t + 2)$. **(08 Marks)**

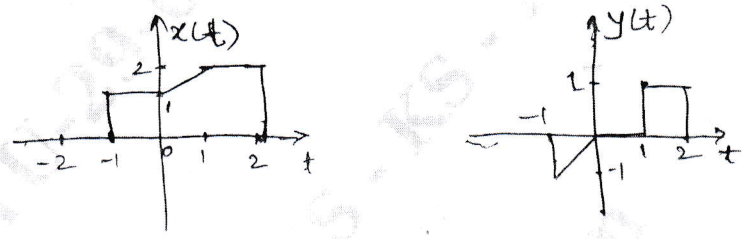


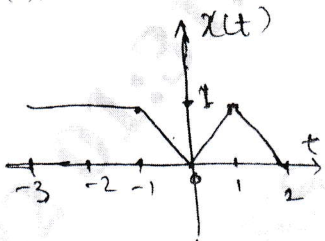
Fig. Q1(b)

c. Sketch the signal $Z(t) = r(t + 2) - r(t + 1) - 2u(t) + u(t - 1)$. **(04 Marks)**

OR

2 a. For the signal shown in Fig. Q2(a), sketch its Even and Odd components. **(06 Marks)**

Fig. Q2(a)



b. Identify whether the following signals are periodic of not? If Periodic what is the period of it? i) $x(t) = \cos\sqrt{2}\,t + \sin 2\pi t$ ii) $x(t) = \cos 8\pi t$ iii) $x(n) = \sin\frac{\pi}{6}n + \sin\frac{\pi}{3}n$. **(08 Marks)**

c. Sketch the signals : i) $u(t - 2) - 2u(t) + u(t + 2)$ ii) $e^{-2t}\{u(t) - u(t - 2)\}$. **(06 Marks)**

Module-2

3 a. Check whether the following system is linear, time variant , causal , static and stable.
$Y[n] = 2x[1 - n] + 2$. **(08 Marks)**

b. Compute the following convolutions :
i) $y(t) = x(t) * h(t)$, where $x(t) = u(t + 2)$ and $h(t) = e^{-2t}u(t)$.
ii) $y(t) = x(t) * h(t)$, where $x(t) = e^{-l+l}$ and $h(t) = u(t)$. **(12 Marks)**

OR

4 a. The system is described by the differential equation

$$\frac{dy(t)}{dt} = 2x(t) + \frac{d}{dt}x(t).$$

State whether this system is linear , time variant , causal and static. **(08 Marks)**

b. i) Evaluate $y(n) = x(n) * h(n)$, if $x(n) = \alpha^n u(n)$ $\alpha < 1$ & $h(n) = u(n)$.

ii) Evaluate $y(t) = x(t) * h(t)$, if x(t) & h(t) are as shown in Fig. Q4(b(ii)). **(12 Marks)**

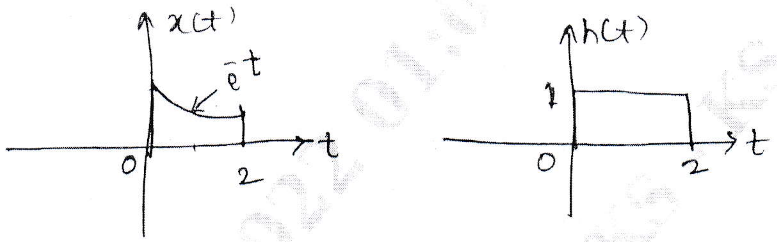


Fig. Q4(b(ii))

Module-3

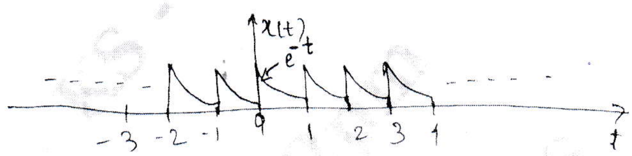
5 a. Impulse responses of the various systems are described below. Identify whether these systems are memoryless, causal and stable.

i) $h(n) = 2\delta(n)$ ii) $h(t) = e^{-2t} u(t + 2)$ iii) $h(t) = 2\{u(t) - u(t - 2)\}$. **(10 Marks)**

b. Obtain the Fourier representations of the signals :

i) $x(n) = \cos 2\pi n + \sin 4\pi n$ with $\Omega_0 = 2\pi$ ii) x(t) shown in Fig. Q5(b(ii)). **(10 Marks)**

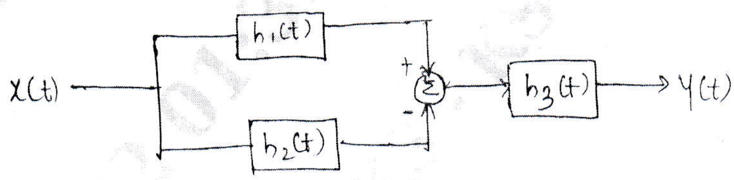
Fig. Q5(b(ii))



OR

6 a. Find the overall impulse response of the system shown in Fig. Q6(a). **(08 Marks)**

Fig. Q6(a)



where $h_1(t) = u(t + 1)$, $h_2(t) = u(t - 2)$, $h_3(t) = e^{-3t} u(t)$.

b. State and prove time shift property of Fourier Series. **(06 Marks)**

c. Obtain DTFS coefficients of x(n) if $\Omega_0 = 3\pi$.

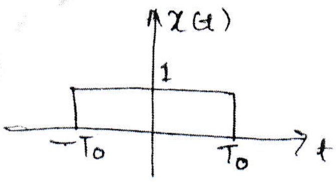
i) $x(n) = \sin 6\pi n$ ii) $x(n) = \cos 3\pi n + \sin 9\pi n$. **(06 Marks)**

Module-4

7 a. State and prove Convolution property of DTFT. **(06 Marks)**

b. Find F.T. of the signal shown in Fig. Q7(b). **(06 Marks)**

Fig. Q7(b)



c. Find the time domain signal x(t) if its F.T. X(jw) given below :

i) $X(jw) = \dfrac{jw}{(jw)^2 + 5jw + 6jw}$ ii) $X(jw) = \dfrac{1 - jw}{1 + w^2}$ **(08 Marks)**

OR

8 a. State and prove Parseval's theorem for Fourier transform. (06 Marks)

b. Using properties, find the DTFT of the signals.

i) $x(n) = (\frac{1}{2})^n u(n+2)$ ii) $x(n) = n \cdot a^n u(n)$. (06 Marks)

c. Obtain the signal x(t), if its Fourier transform is

i) $X(jw) = \frac{1}{2 + j(w-3)}$ ii) $X(jw) = e^{-j3w} \frac{1}{jw+2}$ (08 Marks)

Module-5

9 a. Find the Z – transform of the signals.

i) $x(n) = (\frac{1}{2})^n u(n) - (\frac{3}{2})^n u(-n-1)$ ii) $x(n) = (-\frac{1}{3})^n u(n)$. (07 Marks)

b. State and prove differentiation in the Z – domain property of Z – transform. (06 Marks)

c. Use Partial fraction expansion to find the inverse Z – transform of

$$X(z) = \frac{z^2 - 3z}{z^2 - \frac{3}{2}z - 1} \quad |\tfrac{1}{2}| < |z| < |2|$$ (07 Marks)

OR

10 a. Use properties to find Z – transform of the following signals :

i) $x(n) = 3^n u(n-2)$ ii) $x(n) = n \sin\left(\frac{\pi}{2} n\right) u(n)$. (08 Marks)

b. Find the Inverse Z - transform.

i) $X(z) = \frac{1}{1 - \frac{1}{2} z^{-1}} + \frac{2}{1 - 2z^{-1}} \quad |z| > |2|$.

ii) $X(z) = \frac{2 + z^{-1}}{1 - \frac{1}{2} z^{-1}} \quad |z| < |\tfrac{1}{2}|$, Use Power Series Expansion method. (12 Marks)

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CBCS SCHEME

USN | | | | | | | | | | |

18EC46

Fourth Semester B.E. Degree Examination, July/August 2022

Microcontrollers

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Write the block diagram of 8051 and explain its main features. **(08 Marks)**

b. What is an embedded system and write its characters. **(06 Marks)**

c. Write the starting address and ending address of internal RAM used in 8051 and how it is classified. **(06 Marks)**

OR

2 a. Show how 8K RAM and 8K EPROM can be interfaced to 8051 micro controller. Assume the EPROM starts from address 0000H. **(08 Marks)**

b. How many ports are present in 8051 and explain the different functions of each port. **(06 Marks)**

c. Compare microprocessor and micro controllers. **(06 Marks)**

Module-2

3 a. How the instruction set of 8051 is classified depending on the addressing mode and explain all of them with example. **(08 Marks)**

b. List the different SFR's present in 8051 and also write the address of them. **(04 Marks)**

c. Write an assembly level program to multiply the number present in external memory location 800AH and 8050H. Store the lower byte of result obtained in R0 and higher byte in R1. **(08 Marks)**

OR

4 a. Explain the different rotate instructions present in 8051 μC with an example. Also explain the working of SWAP instruction. **(08 Marks)**

b. Explain the working of the following instructions and also find the time required to execute each instruction :

i) MOVC A, @A+PC XTAL = 12 MHz used
ii) XCHD A, @R1 XTAL = 11.0592 MHz used
iii) ADDC A, R5 XTAL = 10MHz used
iv) DIV AB XTAL = 11.0592MHz. **(08 Marks)**

c. Write an assembly level program to set the bits 1, 4, 6, 7 of port 0 use bit level instructions to set the bits. **(04 Marks)**

Module-3

5 a. Explain the working of PUSH and POP instruction with necessary diagram. **(04 Marks)**

b. Write a program to toggle all bits of P1 every 200ms. Assume crystal frequency is 11.0592MHz. Show all the calculations. **(08 Marks)**

c. Write an assembly level program to count the number 1's and 0's present in the content of external memory location 8000H. Store the count of number 1's in reg. R0 and count of number of 0's in reg. R1. **(08 Marks)**

OR

6 a. What is the need of subroutine and explain the instructions associated with subroutine. **(08 Marks)**

b. Write an assembly level program to mutually exchange the 10 bytes of data stored in external memory location starting from 8000H and 8020H. **(06 Marks)**

c. Find the delay produced in the 8051 program.

```
Delay : MOVR3, # 200
Here :  NOD
        NOP
        DJN2 R3, here
        RET
```

Assume XTAL used 11.0592 MHz. **(06 Marks)**

Module-4

7 a. Explain all the bits of TMOD and TCON register. **(08 Marks)**

b. Assuming XTAL frequency as 11.0592MHz write a program to generate 4 KHz square wave on P2.1. Use timer 0 in model show all the calculations. **(08 Marks)**

c. Write the steps to program the timer of 8051 in mode 2. **(04 Marks)**

OR

8 a. In asynchronous method of communication how the framing is done explain with necessary diagram. Also mention the different pins of DB – 9 pin connector. **(08 Marks)**

b. A switch is connected to pin 2.0 monitor the status of the switch if SW = 0. Write an 8051C program to send the message 'READ' and if SW = 1 send the message 'WRITE' XTAL frequency = 11.0592MHz. **(08 Marks)**

c. Compare parallel and serial data transfer. **(04 Marks)**

Module-5

9 a. Name the external hardware interrupts present in 8051 and how the activation of them will be done. **(06 Marks)**

b. Write a program to read the data from port P1 and send it to P2 continuously. While incoming data from the serial port is sent to P0. Assume XTAL = 11.0592MHz set the baud rate at 2400. **(06 Marks)**

c. Write the interrupt priority upon reset in 8051. Also explain how the priority of the interrupts can be set using IP register. **(08 Marks)**

OR

10 a. Write a table to find the digital value to be send to DAC for generating sine wave in steps of 30°. Using the table write an assembly level program to generate a sine wave using DAC interfaced to microcontroller 8051. Assume full scale voltage for DAC is 10V and XTAL = 11.0592MHz. **(10 Marks)**

b. How draw the diagram to inter face a stepper motor to 8051MC. Also write a program to monitor the status of switch connected to port P2.7. If SW = 0. The stepper should rotate clockwise else it should rotate in anticlockwise direction. **(10 Marks)**

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