CBCS SCHEME

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18MAT41

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
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 $w = f(z) = z + e^z$ is analytic and hence find $\frac{dw}{dz}$. **(06 Marks)**

b. Derive Cauchy's – Riemann equations in polar form. **(07 Marks)**

c. If $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$ then find analytic function $f(z) = u + iv$. **(07 Marks)**

OR

2 a. Show that the real and imaginary parts of an analytic function $f(z) = u + iv$ are harmonic. **(06 Marks)**

b. If $f(z)$ is an analytic function then 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)**

c. If $u = \left(r + \frac{1}{r}\right)\cos\theta$ then find the corresponding analytic function $f(z) = u + iv$. **(07 Marks)**

Module-2

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

b. Discuss the conformal transformation $w = f(z) = z^2$. **(07 Marks)**

c. Find the bilinear transformation which maps the points $z = 1, i, -1$ into the points $w = i, 0, -i$. **(07 Marks)**

OR

4 a. Evaluate $\int_C z^2\,dz$ along the curve made up of two line segments, one from $z = 0$ to $z = 3$ and another from $z = 3$ to $z = 3 + i$ **(06 Marks)**

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

c. Find the bilinear transformation which maps the points $z = -1, 0, 1$ into the points $w = 0, i, 3i$. **(07 Marks)**

Module-3

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

$X(=x_i)$	-3	-2	-1	0	1	2	3
P(X)	k	2k	3k	4k	3k	2k	k

Find (i) The value of k, (ii) $P(x \le 1)$, (iii) $P(-1 < x \le 2)$ **(06 Marks)**

b. The probability that a pen manufactured by a factory be defective is 1/10. If 12 such pens are manufactured, what is the probability that (i) Exactly 2 are defective (ii) Atleast 2 are defective (iii) None of them are defective. **(07 Marks)**

c. The length of telephone conversation in a booth has been an exponential distribution and found on an average to be 5 minutes. Find the probability that a random call made from this booth (i) Ends less than 5 minutes (ii) Between 5 and 10 minutes. **(07 Marks)**

OR

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

$$f(x) = \begin{cases} Kx^2 & , \quad 0 < x < 3 \\ 0 & , \quad \text{otherwise} \end{cases}$$

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

b. 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) Ten minutes or more (ii) Less than Ten minutes (iii) Between 10 and 12 minutes. **(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) 65 to 75. [$\phi(1) = 0.3413$] **(07 Marks)**

Module-4

7 a. Compute the rank correlation coefficient for the following data:

x	68	64	75	50	64	80	75	40	55	64
y	62	58	68	45	81	60	68	48	50	70

(06 Marks)

b. Find a best fitting straight line $y = ax + b$ for the data below:

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

(07 Marks)

c. Obtain the lines of regression and hence find the coefficient of correlation for the data below:

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

(07 Marks)

OR

8 a. If θ is the acute angle between the lines of regression then show that

$$\tan\theta = \frac{\sigma_x \sigma_y}{\sigma_x^2 + \sigma_y^2}\left[\frac{1 - r^2}{r}\right]$$

(06 Marks)

b. Find a best fitting second degree parabola of the form $y = ax^2 + bx + c$ for the data below:

x	1	2	3	4	5
y	10	12	13	16	19

(07 Marks)

c. Find the coefficient of correlation for the following data:

x	10	14	18	22	26	30
y	18	12	24	06	30	36

(07 Marks)

Module-5

9 a. The joint probability of discrete random variables X and Y is given below:

X \ Y	1	3	9
2	1/8	1/24	1/12
4	1/4	1/4	0
6	1/8	1/24	1/12

Determine (i) Marginal distribution of X and Y. (ii) Covariance and correlation of X and Y. **(06 Marks)**

b. A survey was conducted in a slum locality of 2000 families by selecting a sample of size 800, it was revealed that 180 families were illiterates. Find the probable limits of the illiterates families in the population of 2000 at 1% level of significance. **(07 Marks)**

c. A group of 10 boys fed at diet A and another group of 08 boys fed on another diet B for a period of 06 months record the following increase in weights in pounds.

Diet A	05	06	08	01	12	04	03	09	06	10
Diet B	02	03	06	08	10	01	02	08	-	-

Test whether diet A and B differ significantly regarding their effect on increase in weight. [$t_{0.05} = 2.12$] **(07 Marks)**

OR

10 a. Explain the terms :
(i) Null hypothesis
(ii) Type-I and Type-II errors
(iii) Level of significance. **(06 Marks)**

b. 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? [$t_{0.05} = 2.201$] **(07 Marks)**

c. A sample analysis of examination, result of 500 students was made, it was found that 220 students had failed, 170 had secured third class, 90 had secured second class, 20 had secured first class. Do these figures support the general examination result which is in the ratio 4 : 3 : 2 : 1 for the respective categories? [$\chi^2_{0.05} = 7.81$]. **(07 Marks)**

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18MATDIP41

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Find the rank of the matrix $\begin{pmatrix} 1 & 3 & -1 & 2 \\ 0 & 11 & -5 & 3 \\ 2 & -5 & 3 & 1 \\ 4 & 1 & 1 & 5 \end{pmatrix}$ by reducing to echelon form. **(06 Marks)**

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

c. Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$. **(07 Marks)**

OR

2 a. Find the rank of the following matrix by applying elementary row transformation
$\begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$ **(06 Marks)**

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

c. Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$ **(07 Marks)**

Module-2

3 a. A function f(x) is given by the following table

x	0	1	2	3	4	5	6
f(x)	176	185	194	203	212	220	229

Obtain the value of f(x) at x = 0.6 by using appropriate interpolation formula. **(06 Marks)**

b. The equation $x^3 - 3x + 4 = 0$ has one real root between -2 and -3. Find the root to three places of decimals by using Regula-Falsi method. **(07 Marks)**

c. Using Simpson's 1/3[rd] rule, evaluate $\int_0^1 e^{-x^2}$ by dividing the interval (0, 1) into 10 sub intervals, (h = 0.1). **(07 Marks)**

OR

4 a. Find f(2.5) by using Newton's backward interpolation formula given that f(0) = 7.4720, f(1) = 7.5854, f(2) = 7.6922, f(3) = 7.8119, f(4) = 7.9252. **(06 Marks)**

b. Find the real root of the equation $xe^x - 2 = 0$, correct to three decimal places by using Newton Raphson method. **(07 Marks)**

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

Module-3

5 a. Solve : $\frac{d^3y}{dx^3} - 6\frac{d^2y}{dx^2} + 11\frac{dy}{dx} - 6y = 0$ **(06 Marks)**

b. Solve : $(D^2 + 7D + 12)y = \cosh x$ **(07 Marks)**

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

OR

6 a. Solve : $\left(D^3 - 4D^2 + 5D - 2\right)y = 0$ **(06 Marks)**

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

c. Solve : $\left(D^2 - 4D + 3\right)y = \sin 3x.\cos 2x$ **(07 Marks)**

Module-4

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

b. Form the partial differential equation by eliminating arbitrary functions "f" from $z = f\left(\frac{xy}{z}\right)$. **(07 Marks)**

c. Solve $\frac{\partial^2 z}{\partial x \partial y} = \sin x.\sin y$, given that $\frac{\partial z}{\partial y} = -2\sin y$ when x = 0 and z = 0 when y is an odd multiple of $\pi/2$. **(07 Marks)**

OR

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

b. Form partial differential equation by eliminating arbitrary functions 'f' and 'g' from the function z = y f(x) + x g(y) **(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)**

Module-5

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

b. Three machines A, B, C produces 50%, 30%, 20% of the items in a factory. The percentage of defective outputs are 3, 4, 5. If an item is selected at random, what is the probability that it is defective? What is the probability that it is for A? **(07 Marks)**

c. A can hit a target 3-times in 5 shots, B – 2 times in 5 shots and C – 3 times in 4 shots. They fire a volley. What is the probability that i) two shots hit ii) atleast two shots hit? **(07 Marks)**

OR

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

b. State the axiomatic definition of probability. For any two arbitrary events A and B, prove that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. **(07 Marks)**

c. If A and B are two events with $P(A) = \frac{1}{2}$, $P(B) = \frac{1}{3}$, $P(A \cap B) = \frac{1}{4}$. Then find $P(A/B)$, $P(B/A)$, $P(\overline{A}/\overline{B})$, $P(\overline{B}/\overline{A})$ and $P(A/\overline{B})$. **(07 Marks)**

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18EC42

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. Derive the expression for Emitter current of a voltage divider bias and also discuss how to make I_E insensitive to variation in β and temperature. **(10 Marks)**

b. Design a collector to Base feedback resistor bias to obtain a dc current of 1 mA and to ensure $\pm 2V$ signal swing at the collector with $V_{CE} = 2.3V$. Assume $V_{CC} = 10$ V and $\beta = 100$. **(07 Marks)**

c What is trans-conductance of BJT and mention its significance? **(03 Marks)**

OR

2 a. Obtain the following expression of a BJT of small signal analysis.
i) Total instantaneous collector current
ii) Input resistance at the base **(10 Marks)**

b. Discus the following biasing scheme used in MOS
i) By fixing V_{GS}
ii) By fixing V_{GS} and connecting a resistance in the source. **(10 Marks)**

Module-2

3 a. Discuss the basic configuration of MOSFET. **(06 Marks)**

b. For a common source amplifier shown in Fig Q3(b), determine R_{in}, AV_0, R_0 and G_V

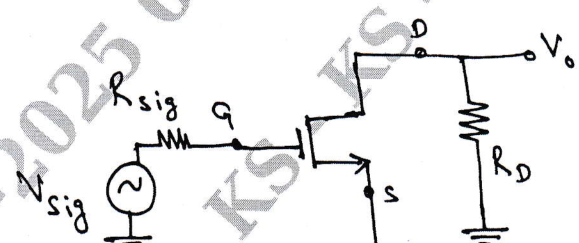

Fig Q3(b) **(14 Marks)**

OR

4 a. For an n-channel MOSFET with $t_{ox} = 10$nm, L = 1.0 μm, W = 10 μm, $L_{OV} = 0.05$ μm, $C_{sbo} = C_{dbo} = 10$ fF, $V_0 = 0.6$ V, $V_{SB} = 1$ V and $V_{DS} = 2$ V. Calculate C_{ox}, C_{ov}, C_{gs}, C_{gd}, C_{sb} and C_{db}. **(10 Marks)**

b. Explain the working of FET based phase shift oscillator and also mention the necessary conditions for sustained oscillation. **(10 Marks)**

Module-3

5 a. Explain the following properties of Negative. Feedback.
i) Gain, De-sensitivity ii) Bandwidth Extension iii) Noise reduction **(14 Marks)**

b. A negative feedback amplifier has a $A_f = 100$ and $A = 10^5$. What is the feedback factor? If a manufacturing error results in a reduction of A to 10^3, what is the closed loop voltage Gain? What is the percentage change in A_f? **(06 Marks)**

OR

6 a. Explain the working of class B output stage. **(08 Marks)**

b. For emitter follower Class A output stage $V_{cc} = 10V$, I = 100 mA and $R_L = 100\ \Omega$. If the output voltage is an 8 V – peak sinusoid, find :
i) Power delivered to load
ii) Average power drawn from the supplies
iii) Power conversion efficiency ignore the loss on Q_3 and R. **(06 Marks)**

c. Explain how cross over distortion can be eliminated to class AB output stage. **(06 Marks)**

Module-4

7 a. For the voltage Seri feedback amplifier, derive the expressions of
i) Exact voltage Gain ii) Input resistance with feedback iii) Output resistance with feedback **(14 Marks)**

b. For the inverting amplifier $R_1 = 470\ \Omega$ and $R_F = 4.7\ K\Omega$. Assume A = 200000, $R_i = 2\ M\Omega$, $R_o = 75\ \Omega$ and $f_o = 5$ Hz. Calculate A_F, R_{iF}, R_{OF} and f_F. **(06 Marks)**

OR

8 a. Explain the working of instrumentation amplifier using Transducer bridge with necessary equations. **(08 Marks)**

b. Explain the working of Inverting Schmitt trigger with input and output waveforms. **(08 Marks)**

c. For a Differential configuration summer R = 1 KΩ, $V_a = 2V$, $V_b = 3V$, $V_c = 4V$, $V_d = 5V$ and supply voltage of ± 15V. Determine the output voltage V_o. **(04 Marks)**

Module-5

9 a. Derive the expression of output voltage of a 4-bit Binary weighted resistor type DAC. Mention its disadvantages. **(10 Marks)**

b. Draw the block diagram of successive approximation ADC and explain it. **(10 Marks)**

OR

10 a. Explain the working of First order active Lowpass filter with the help of magnitude voltage gain and also design to get a cutoff frequency of 1 KHz with a passband gain of 2. **(10 Marks)**

b. Explain the working of Astable multi-vibration using 555 Timer and also derive the expression of Frequency of oscillation. **(10 Marks)**

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CBCS SCHEME

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Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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 CDF of a Random variable. Mention its properties and types. **(10 Marks)**

b. Given the data in the Table Q1(b)
 i) Plot the PDF and CDF of the discrete random variable
 ii) Write expressions for $f_X(x)$ and $F_X(x)$ using unit delta functions and unit step functions :

x	x_a	x_b	x_c	Total
P[X = x]	0.24	0.32	0.44	1

Table Q1(b) **(10 Marks)**

OR

2 a. Summarize the properties of PDF. Prove that the total area under PDF curve is unity. **(10 Marks)**

b. Given the data in the Table Q2(b).
 i) What are the mean and variance of 'X' ii) If $Y = X^2 + 2$, what are μ_y and σ_y^2.

K	1	2	3	4	5
X_k	2.1	3.2	4.8	5.4	6.9
$P(x_k)$	0.21	0.18	0.2	0.22	0.19

Table Q2(b) **(10 Marks)**

Module-2

3 a. Explain the following with respect to Bivariate Random variable.
 i) Correlation ii) Covariance iii) Uncorrelated X and Y iv) Orthogonal X and Y
 v) Independent X and Y. **(10 Marks)**

b. Let X is a random variable, $\mu_x = 4$ and $\sigma_x = 5$ and Y is a random variable, $\mu_y = 6$ and $\sigma_y = 7$. The correlation coefficient is -0.7. If U = 3x + 2y, what are i) Var [U] ii) CoV [UX] iii) CoV [UY]. **(10 Marks)**

OR

4 a. Briefly explain the following random variables
 i) Chi-square RV ii) Student-T RV iii) Cauchy RV iv) Rayleigh RV. **(10 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 constant C
 ii) What is the PDF's for X and Y
 iii) What is $F_{XY}(x, y)$ 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)**

Module-3

5 a. Interpret the following with respect to random process i) Random process ii) Ensemble iii) PDF iv) Independence v) Expectations vi) Stationary. **(12 Marks)**

b. The magnitude of a zero mean white noise spectrum is $K = 3.6 \times 10^{-8}\ V^2\text{-}S$. This noise is the input to a low pass RC circuit: $R = 38\ k\Omega$, $C = 0.1\ \mu F$. Find the networks output PSD, $S_y(w)$. **(08 Marks)**

OR

6 a. Discuss the Auto correlation and cross correlation functions with their properties. **(12 Marks)**

b. A Random process is described by $y(t) = A \cos(w_c t + \theta)$ where A and w_c are constants, but θ is a random variable distributed uniformly between $\pm\pi$. Determine :
   i) PDF of random variable 'θ'
   ii) Mean of y(t)
   iii) Auto correlation function $R_y(\tau)$
   iv) Mean power and Auto variance of y(t) **(08 Marks)**

Module-4

7 a. Illustrate vector space with its properties in detail. **(08 Marks)**

b. Apply Gram-Schmidt process to

$$a = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \quad b = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} \quad \text{and } c = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

Write the result in the form of A = QR. **(12 Marks)**

OR

8 a. Outline the four fundamental suspaces of matrices. **(08 Marks)**

b. Determine : i) matrix U and Rank ii) rref (R) iii) Null space of matrix and identify free variables in null space for the matrix given $A = \begin{bmatrix} 1 & 3 & 3 & 2 \\ 2 & 6 & 9 & 7 \\ -1 & -3 & 3 & 4 \end{bmatrix}$ **(12 Marks)**

Module-5

9 a. Define determinants with its properties in detail. **(13 Marks)**

b. Determine the Eigen values of matrix $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$ **(07 Marks)**

OR

10 a. Diagnolize the matrix $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ and hence find A^4, Also find the matrix 'P' such that $P^{-1}AP$ is diagonal. **(14 Marks)**

b. Reduce the matrix A to U and find det A using pivots of A.

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

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CBCS SCHEME

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18EC45

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
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. Check whether the following signals are periodic or not. If periodic find the fundamental period.

i) $x(t) = \sin\left(\frac{\pi}{3}t\right) + 2\cos\left(\frac{8\pi}{3}t\right)$

ii) $x[n] = \sin\left(\frac{3\pi n}{4}\right)\text{Sin}\left(\frac{\pi}{3}n\right)$

iii) $x(t) = e^{j}\frac{12\pi}{7}t + e^{j}\frac{12\pi}{5}t$ **(10 Marks)**

b. Calculate the energy and power of the following signals as applicable:

i) $x[n] = (j)^n + (j)^{-n}$

ii) $x[n] = 8\,(0.5)^n\, U[n]$ **(06 Marks)**

c. Determine and sketch the even and odd parts of the signal depicted in Fig.Q.1(c). **(04 Marks)**

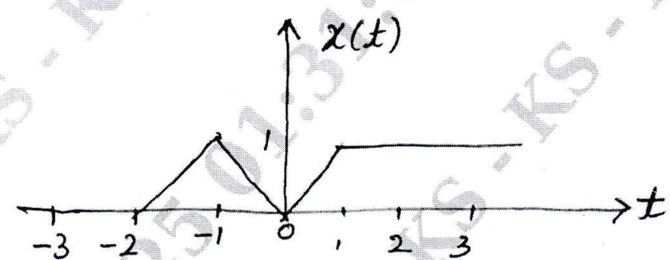

Fig.Q.1(c)

OR

2 a. A trapezoidal pulse x(t) is defined by

$$x(t) = \begin{cases} 5-t, & 4 \le t \le 5 \\ 1, & -4 \le t \le 4 \\ t+5, & -5 \le t \le -4 \\ 0, & \text{otherwise} \end{cases}$$

is applied to a differentiator having the input-output relation $y(t) = \frac{dx(t)}{dt}$. Find the energy of y(t). **(04 Marks)**

b. Show that the product of two even signals or two odd signals is an even signal, while the product of an even and odd signal is an odd signal. **(06 Marks)**

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.

c. From the signals indicated in Fig.Q.2(c), derive the following signals:
   i) $x(t-1)\,y(-t)$
   ii) $x(t)\,[\delta(t-1)+\delta(t-2)] + y(t)\,s(t+2)$
   iii) $x(t)\,y(t-1)$
   iv) $x(t)\,y(-t-1)$ **(10 Marks)**

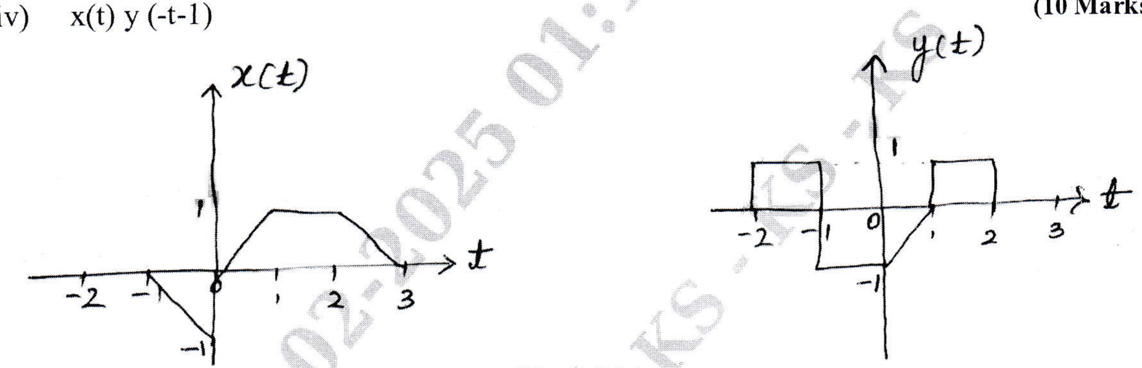

Fig.Q.2(c)

Module-2

3 a. Determine whether the system described by the following input-output relation is i) Linear ii) Causal iii) Time-invariant iv) Memoryless v) Stable.
$$y(t) = 2x(t) + 3$$ **(06 Marks)**

b. Perform the convolution operation on the following signals:
$$x(t) = e^{-2t}\,u(t)$$
$$h(t) = \mu(t+2)$$ **(08 Marks)**

c. Show that
   i) $[x(n) * h_1(n)] * h_2(n) = x(n) * [h_1(n) * h_2(n)]$
   ii) $x(n) * h(n) = h(n) * x(n)$ **(06 Marks)**

OR

4 a. Given $x[n] = \alpha^n\,U[n]$ and $h[n] = \beta^n\,U[n]$, perform $x[n] * h[n]$. **(08 Marks)**

b. Determine whether the following systems represented by input-output relations are invertible. If invertible then represent their inverse system
   i) $y(t) = s^{t0}\{x(t)\}$ ii) $y(t) = \frac{1}{L}\int_{-\infty}^{t} x(z)\,dz$
   iii) $y(t) = x^2(t)$ iv) $y(t) = 2x(t)$ **(08 Marks)**

c. Perform convolution operations on the following signals and sketch the output:
$$x[n] = \delta(n+1) + 2\delta(n) + 3\delta(n-1) - 2\delta(n-2) + \delta(n-3)$$
$$h[n] = \left(\frac{1}{2}\right)^n [U[n] - U[n-4]]$$ **(04 Marks)**

Module-3

5 a. Determine whether the following systems represented by impulse responses are stable, causal and memoryless.
   i) $h(n) = U(n-1) - U(n-5)$
   ii) $h(t) = e^{-t}\,\mu(+t)$
   iii) $h(n) = 0.5^{|n|}$
   iv) $h(t) = \mu(t-1)$ **(08 Marks)**

b. Show that step response of an LTI system is running integral of impulse response. **(04 Marks)**

c. Evaluate the Fourier series representation for the signal $x(t) = \sin(2\pi t) + \cos(3\pi t)$. Sketch the magnitude and phase spectra. **(08 Marks)**

OR

6 a. State and prove convolution property for continuous time Fourier series. **(04 Marks)**

b. Find the Fourier series representation for the given signal and draw its magnitude and phase spectra. **(10 Marks)**

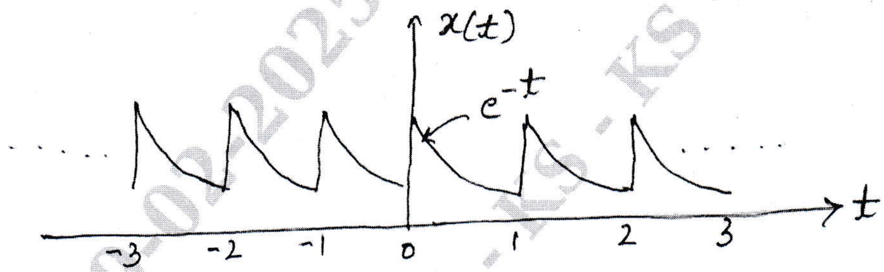

Fig.Q.6(b)

c. Find the unit step response of the systems given by their impulse responses

i) $h(n) = \left(\frac{1}{2}\right)^n U(n)$ ii) $h(t) = e^{-|t|}$ **(06 Marks)**

Module-4

7 a. State and prove the following properties applicable to continuous time Fourier transform
i) Time shift ii) Frequency differentiation **(06 Marks)**

b. Find the continuous time Fourier transform of $x(t) = e^{-at}\,u(t);\ a > 0$. Draw its magnitude and phase spectra. **(08 Marks)**

c. Find the discrete time Fourier transform of the following signals:
i) $x(n) = (-1)^n\,U(n)$
ii) $x(n) = a^{|n|}$. **(06 Marks)**

OR

8 a. State and prove Parseval's theorem with respect to discrete time Fourier transform and indicate the importance of it. **(06 Marks)**

b. The discrete time Fourier transform of a real signal x(n) is $x(\Omega)$. How is the discrete time Fourier transform of the following signals related to $x(\Omega)$.
i) $y_1(n) = x(-n)$
ii) $y_3(n) = x(n) * x(-n)$
iii) $y_2(n) = (1 + \cos n\pi)\,x(n)$
iv) $y_4(n) = (-1)^{n/2}\,x(n)$. **(08 Marks)**

c. Find the continuous time Fourier transform of
i) $x(t) = \cos(w_o t)$

ii) $x(t) = \begin{cases} 1; & -T < t < T \\ 0; & \text{otherwise} \end{cases}$ **(06 Marks)**

Module-5

9 a. Find the Z-transform of the following sequences and plot it's ROC.

i) $x(n) = \left(\frac{1}{2}\right)^n U(n-2)$

ii) $x(n) = 3\left(\frac{-1}{2}\right)^n U(n) - 2[3^n U(-n-1)]$ **(06 Marks)**

b. If x(n) is causal, then prove that

i) $x(0) = \underset{Z \to \infty}{Lt} X(z)$

ii) $x(\infty) = \underset{Z \to 1}{Lt} [X(Z)(Z-1)]$ **(08 Marks)**

c. A LTI system is given by the system function

$$H(Z) = \frac{3 - 4z^{-1}}{(1 - 3.5z^{-1} + 1.5z^{-2})}$$

Specify the ROC of H(z) and h(n) for the following conditions:

i) The system is stable

ii) The system is causal. **(06 Marks)**

OR

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

i) $a^{-n}U(-n)$

ii) $\left(\frac{1}{2}\right)^n U(n) * \left(\frac{1}{3}\right)^n U(n)$

iii) $\left(\frac{1}{3}\right)^n U(n) + \left(-\frac{1}{2}\right)^n U(n)$ **(08 Marks)**

b. Find the inverse Z-transform of

$X(Z) = \frac{Z(Z^2 - 4Z + 5)}{(Z-3)(Z-2)(Z-1)}$ for the ROC $2 < |Z| < 3$ using partial fraction method. **(06 Marks)**

c. Determine the impulse response h(n) and system function H(z) of the system that gives the output

$y(n) = \left(\frac{1}{3}\right)^n U(n)$ for an input $x(n) = \left(\frac{1}{2}\right)^n U(n) - \frac{1}{4}\left(\frac{1}{2}\right)^{n-1} U(n-1)$. **(06 Marks)**

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CBCS SCHEME

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18EC46

Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Microcontroller

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 micro-processor and microcontroller with respect to their architecture and instructor. **(08 Marks)**

b. Explain the significance of process status word. Briefly discuss PSW register of 8051. **(06 Marks)**

c. Explain the functions of the following pins of 8051 i) EA ii) ALE iii) RST. **(06 Marks)**

OR

2 a. With the help of neat diagram, explain the internal block diagram of 8051. **(10 Marks)**

b. Briefly explain the dual functions of port 3 pins of 8051. **(04 Marks)**

c. With the help of diagram, explain how to interface 8 KB EPROM and 8K RAM to 8051 micro-controller. **(06 Marks)**

Module-2

3 a. Explain with examples the different addressing modes used in 8051. **(08 Marks)**

b. Explain the operations of the 8051 instructions
i) DAA ii) MUL AB **(08 Marks)**

c. Explain the different types of jump instructions in 8051. **(04 Marks)**

OR

4 a. Name the addressing modes of the following instruction and give an example for each.
i) CJNE dest, source target
ii) ACALL target
iii) DJNZ R1, rel
iv) SWAP A
v) DA A **(04 Marks)**

b. Explain with examples the PUSH and POP instructions. **(08 Marks)**

c. Explain the operations performed by the following instructions.
i) MOVC A, @ A + DPTR ii) SWAP A iii) XCHD A, @ Rp iv) MUL AB. **(08 Marks)**

Module-3

5 a. Write an ALP in 8051 to count number of positive and negative numbers present in the internal memory block starting with address 20H, containing N bytes. Store the counts after the last data byte in the memory block. **(12 Marks)**

b. Write a program in 8051 to find the sum of 20 bytes of data stored in an array of external RAM staring with address 2000H. Store the 16 bit sum at the end of array. **(08 Marks)**

OR

6 a. Write an ALP to reach the given byte in the list of 50 numbers stored in consecutive memory locations 2000H. Assume that byte is 76H. If byte is not found store 00 at 2300 H and 2301H, if found store its address. **(08 Marks)**

b. Write an ALP to find Fibonacci series of N given terms. **(06 Marks)**

c. Write a program segment to realize the following :

i) Exchange contents of external data memory 8100 h with contents of internal data memory 40 h.

ii) Exchange contents of A-register and B-register using stack. **(06 Marks)**

Module-4

7 a. Explain Mode – 1 programming of timers in 8051. **(05 Marks)**

b. Write an ALP and C program to generate a frequency of 100 Hz square wave, using timer 0 in mode 1. Assume crystal frequency is 11.0592MHz. **(10 Marks)**

c. What is serial communication? Explain function of RS232C pins of DB-9 connector. **(05 Marks)**

OR

8 a. Write on 8051 assembly language program to transfer the message "HELLO" serially at 9600 baud, 8 bit data, 1 stop bit. **(08 Marks)**

b. Explain the importance of TI and RI flags. **(06 Marks)**

c. Write an 8051 C program to toggle all bits of port 0 continuously. Use time '0' generate the delay of 1 sec between each toggle. **(06 Marks)**

Module-5

9 a. Write an 8051 C to display the message 'VERY GOOD' on LCD display and show the interfacing circuit with functional pins of LCD. **(10 Marks)**

b. Interface a 4 × 4 keys keyboards to 8051 and write an ALP to send to key code to port whenever a key is pressed. **(10 Marks)**

OR

10 a. Interface 8 bit, 8 channel ADC to 8051. Write an assembly language program to convert CH0, CH3 and CH7 and store result in external memory location starting from C000H. Repeat procedure for every 1 Sec. **(10 Marks)**

b. Show the interfacing of a stepper motor to 8051 and write a program to rotate stepper motor 5 rotations in clockwise direction and 10 rotations in anticlockwise direction with a delay between each step. **(10 Marks)**

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