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21MAT41

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
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.

Module-1

- 1 a. Derive C-R equation in polar form. (06 Marks)
b. Show that f(z) = sin z is analytic function and hence find its derivative. (07 Marks)

c. Evaluate integral from (0,3) to (2,4) of (2y + x^2)dx + (3x - y)dy along with the parabola x = 2t, y = t^2 + 3. (07 Marks)

OR

- 2 a. Construct the analytic function f(z) = u + iv given that the real part u = e^{2x}(x cos 2y - y sin 2y) by the Milnes method. (06 Marks)
b. State and prove Cauchy's Integral formula. (07 Marks)
c. Evaluate integral over C of e^{2z}/((z+1)(z-2)) dz where C is the circle |z| = 3. (07 Marks)

Module-2

- 3 a. Show that J_{1/2}(x) = sqrt(2/pi x) sin x. (06 Marks)
b. Find the series solution of the Legendre's differential equation: (1-x^2)d^2y/dx^2 - 2x dy/dx + n(n+1)y = 0. (07 Marks)
c. Express x^3 + 2x^2 - 4x + 5 in terms of Legendre's polynomial. (07 Marks)

OR

- 4 a. If alpha and beta are two distinct roots of J_n(x) = 0, then prove that integral from 0 to 1 of x J_n(alpha x) J_n(beta x) dx = 0. (06 Marks)
b. Obtain series solution of Bessel Differential Equation: x^2 d^2y/dx^2 + x dy/dx + (x^2 - n^2)y = 0. (07 Marks)
c. Show that P_3(cos theta) = 1/8 [3 cos theta + 5 cos 3 theta]. (07 Marks)

Module-3

- 5 a. Fit a straight y = ax + b for the data :

Table with x and y values: x [1, 3, 4, 6, 8, 9, 11, 14], y [1, 2, 4, 4, 5, 7, 8, 9]

(06 Marks)

- b. The lines of regression are x + 2y = 5 and 2x + 3y = 8. Find :
i) Means of variables x and y
ii) Coefficient of correlation. (07 Marks)

- c. Fit a second degree parabola of the form y = a + bx + cx^2 to the following data :

Table with x and y values: x [1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0], y [1.1, 1.3, 1.6, 2.0, 2.7, 3.4, 4.1]

(07 Marks)

OR

- 6 a. Obtain the lines of regression and hence find coefficient of correlation for the following data:

Table with x and y values: 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. Fit a curve of the form y = ax^b for the following data :

Table with x and y values: x [1, 5, 7, 9, 12], y [10, 15, 12, 15, 21]

(07 Marks)

- c. Ten participants contest are ranked by two judges as follows calculate the rank correlation coefficient.

Table with x and y values: x [1, 6, 5, 10, 3, 2, 4, 9, 7, 8], y [6, 4, 9, 8, 1, 2, 3, 10, 5, 7]

(07 Marks)

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Module-4

- 7 a. Find : i) K ii) Evaluate P(x < 6), P(x >= 6) and P(3 < x <= 6)

Table with x and p(x) values: x [0, 1, 2, 3, 4, 5, 6, 7], p(x) [0, K, 2K, 2K, 3K, K^2, 2K^2, 7K^2 + K]

(06 Marks)

- b. Find the mean and variance of Poisson distribution. (07 Marks)
c. The probability that a person aged 60 years will live up to 70 is 0.65. What is the probability that out of 10 persons aged 60 atleast 7 of them will live up to 70. (07 Marks)

OR

- 8 a. Find the values of C such that f(x) = { x/6 + c, 0 <= x <= 3; 0, elsewhere } is a probability density function.

Also find P(1 <= x <= 2). (06 Marks)

- b. If the probability of a bad reaction from a certain injection is 0.001, determine the chance that out of 2000 individuals, more than two will get a bad reaction. (07 Marks)
c. In a normal distribution 31% of the items are under 45 and 8% of the items are over 64. Find the mean and S.D of the distribution. (07 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.

Module-5

- 9 a. The joint distribution of two random variables X and Y is as follows :

	y	-4	2	7
x				
1		$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{8}$
5		$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{8}$

Compute :

- i) $E(X)$ and $E(Y)$
 - ii) $E(XY)$
 - iii) σ_x and σ_y
 - iv) $COV(X, Y)$
 - v) $\rho(X, Y)$. (06 Marks)
- b. A 'die' is thrown 9000 times and a throw of 3 or 4 was observed 3240 times. Show that die cannot be regarded as an unbiased one at $Z_{0.01}$. (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? (07 Marks)
($t_{0.05}$ for 11 d.f = 2.201).

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OR

- 10 a. The joint probability distribution table for two random variables X and Y is as follows :

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

Determine the marginal probability distribution of X and Y. also compute :

- i) $E(X)$, $E(Y)$ and $E(XY)$
 - ii) σ_x and σ_y
 - iii) $COV(X, Y)$
 - iv) $\rho(X, Y)$. (06 Marks)
- b. Define the terms :
- i) Null hypothesis
 - ii) Type-I and Type-II errors
 - iii) Level of significance. (07 Marks)
- c. A sample analysis of examination results 500 students was made. It was found that 220 students had failed, 170 had secured third class, 90 had secured second class and 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 ($\chi^2_{0.05} = 7.81$ for 3 d.f). (07 Marks)
