Graphic Era HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

End Term (Odd) Semester Examination, November 2025

Roll no.....

Name of the Course: B.Tech. in Civil Engineering
Semester: III
Name of the Paper: Mathematics III
Paper Code: TMA 302
Time: 3:00 Hours **Maximum Marks: 100**

Note:
(i) All questions are compulsory.
(ii) Answer any two sub-questions among a, b and c.
(iii) Total marks of each main question are 20. Each sub-question of a main question carries 10 marks.

Q1. (10 × 2=20 Marks)

a. Using Fourier sine integral to show that $\int_0^\infty \frac{(1-\cos\lambda\pi)}{\lambda}\sin\lambda x\, d\lambda = \begin{cases}\frac{\pi}{2}, & if\ 0<x<\pi \\ 0, & if\ x>\pi\end{cases}$. (CO1)

b. Find the Fourier transform of $f(x) = \begin{cases}1-x^2, & if\ |x|\le 1 \\ 0, & if\ |x|>1\end{cases}$ and hence deduce that

$\int_0^\infty \frac{(x\cos x-\sin x)}{x^3}\cos(x/2)\,dx = -\frac{3}{16}\pi$. (CO1)

c. Find the Fourier sine transform of $f(x)=\frac{e^{-ax}}{x}$. (CO1)

Q2. (10 × 2=20 Marks)

a. Prove that $u = x^2 - y^2 - 2xy - 2x + 3y$ is harmonic and find a function v such that $f(z) = u + iv$ is analytic. (CO2)

b. If $u = x^2 - y^2$, find the corresponding analytic function $f(z) = u + iv$. (CO2)

c. Evaluate the following integral using the Cauchy integral formula
$\int_C \frac{4-3z}{z(z-1)(z-2)}dz, \quad C: |z| = \frac{3}{2}$. (CO2)

Q.3 (10 × 2=20 Marks)

a. Show that $f(x) = x^3 + 4x^2 - 10 = 0$ has a root in $[1, 2]$ and use the Bisection method to find the approximation root correct up to 3 decimal places. (CO3)

b. Find the value of the integral $\int_0^6 \frac{dx}{1+x^2}$ by using Simpson's 1/3 and Simpson's 3/8 Rule (Assume that step length, h=1). (CO3)

c. Using the Newton-Raphson method, find the cube root of 3, correct up to 3 decimal places? (CO3)

Q.4 (10 × 2=20 Marks)

a. Explain the *p.m.f* for Binomial distributions. If 7 coins are tossed simultaneously, what is the probability of getting at least 4 heads, and the probability of getting exactly 4 heads? (CO4)

b. Three urns contain 6 red, 4 black; 4 red, 6 black; 5 red, 5 black balls respectively. One of the urns is selected at random, and a ball is drawn from it. Suppose the ball drawn is found to be red. Find the probability that it is from the first urn. (CO4)

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c. A random variable X has the following probability function: (CO4)

x	0	1	2	3	4	5	6	7
p(x)	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2 + k$

(i) Find the value of k?

(ii) Evaluate $p(x < 6)$ *and* $p(0 < x < 5)$.

Q.5 (10×2=20marks)

a. From the following data, Compute the line of regression for estimating Age (X) on Weight (Y) and estimate the most probable age of a weight 37 kg. (CO5)

X	5	15	30	45	50	60
Y	10	35	50	65	55	45

b. Calculate the correlation coefficient for the following heights (in inches) of fathers(X) and their sons(Y). (CO5)

X	65	66	67	67	68	69	70	72
Y	67	68	65	68	72	72	69	71

c. Describe Skewness and kurtosis for any data set. If the first four moments of a distribution are 0, 2.5, 0.7, and 18.75. Examine the skewness and kurtosis of the distribution. (CO5)