Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, APR / MAY 2024

Third Semester
MA5301 TRANSFORM TECHNIQUES AND STATISTICS
(Regulations 2019)
(Students are allowed to use statistical tables)

Time: 3hrs — Max.Marks: 100

CO 1	It enables the students to represent any periodic function as a sum of trigonometric sines and cosines.
CO 2	It enables the students to calculate the frequency spectrum of a signal that changes over time using Fourier transforms.
CO 3	It familiarizes the students with probability distributions that are apt for various real time situations.
CO 4	It equips the students to determine the correlation and regression for bivariate random variables with given probability distributions.
CO 5	It imparts the knowledge of various test statistics used in hypothesis testing for mean and variances of large and small samples.

BL – Bloom's Taxonomy Levels
(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	If $f(x)$ is periodic with period 5 such that $f(1) = -2, \quad f(2) = -3 \quad \& \; f(3) = -4$, what is $f(2024)$?	2	CO1	L1
2	If $f(x) = \sin(x)$ $(0 \le x \le \pi)$, find the root mean square value of the function.	2	CO1	L1
3	State Parseval's identity for Fourier Transform.	2	CO2	L1
4	State Fourier integral theorem.	2	CO2	L1
5	If $f(x) = k + 1$ $(0 \le x \le 1)$ is a probability density function (p.d.f), find the value of k.	2	CO3	L1
6	If the following table furnishes a probability mass function (p.m.f), find the value of k. x: 1, 2, 3, 4, 5 $p(x)$: k+1, $k+2$, k+3, k+4, k+5	2	CO3	L1
7	What do you mean by a joint probability mass function (joint pmf) of a discrete two dimensional random variable?	2	CO4	L1
8	Does $f(x) = e^{-(x+y)}$ $(0 \le x < \infty \;\&\; 0 \le y < \infty)$ represent a joint probability density function (joint pdf)? Justify your answer.	2	CO4	L1
9	What is a population?	2	CO5	L1
10	What is the level of significance in Hypothesis testing?	2	CO5	L1

PART- B (5 x 13 = 65 Marks)

Q. No	Questions	Marks	CO	BL
11 (a) (i)	Find the Fourier series of the function $$f(x) = x^2 \quad (-\pi < x < \pi).$$	8	CO1	L3
(ii)	Find the half-range Fourier sine series of the function	5	CO1	L3

	$f(x) = x \quad (0 < x < \pi)$.			
	(OR)			
11 (b) (i)	Find the Fourier series of the function $f(x) = \lvert x \rvert \;\; (-\pi < x < \pi)$.	8	CO1	L3
(ii)	Find the half-range Fourier cosine series of the function $f(x) = x \quad (0 < x < \pi)$.	5	CO1	L3
12 (a) (i)	Find the Fourier transform of the function $f(x) = 1 - \lvert x \rvert \, (-1 < x < 1)$ and hence evaluate $\int_0^\infty \left[\frac{\sin x}{x}\right]^4 dx$.	8	CO2	L3
(ii)	Find the Fourier transform of the function $f(x) = 1 \;\; (-1 < x < 1)$.	5	CO2	L3
	(OR)			
12 (b) (i)	Use Fourier transform technique to evaluate $\int_0^\infty \left[\frac{1}{(x^2+16)(x^2+25)}\right] dx$.	8	CO2	L3
(ii)	Find the Fourier Transform of the function $f(x) = 1 - x^2 \, (-1 < x < 1)$.	5	CO2	L3
13 (a) (i)	If X is a continuous random variable that is uniformly distributed, find the Mean and Variance of X.	8	CO3	L3
(ii)	A random variable follows binomial distribution with mean 4 and variance 2. Find the parameters n, p and q.	5	CO3	L3
	(OR)			
13 (b) (i)	If X follows Poisson distribution, find the Mean and Variance of X.	8	CO3	L3
(ii)	Find the mean and variance from the Moment Generating function (MGF) of normal distribution.	5	CO3	L3
14 (a) (i)	If the random variable (X, Y) has the following joint probability density function, find the correlation between X and Y. $f(x, y) = x + y \qquad (0 < x < 1 \;\&\; 0 < y < 1)$.	8	CO4	L3
(ii)	What is the point of intersection of two regression lines? In a correlation analysis, the regression lines are $x + y = 7 \;\; \& x - y = 1$ Find the means of X and Y.	5	CO4	L3
	(OR)			
14 (b) (i)	The joint probability density function of (X, Y) is given by $f(x) = ke^{-(x+y)}$. Are X and Y independent? Justify your answer.	8	CO4	L3
(ii)	Describe regression lines of X on Y and of Y on X.	5	CO4	L3
15 (a) (i)	The average marks scored by 32 boys is 72 with a standard deviation of 8 while the average marks scored by 36 girls is 70 with a standard deviation of 6. Test at 0.01 level of significance whether the boys perform better than girls. (Critical value $z_\alpha = 2.33$)	8	CO5	L3
(ii)	Explain TypeI Error and TypeII error.	5	CO5	L3
	(OR)			
15 (b) (i)	Given the following data, test at 0.01 level of significance whether the two attributes literacy and smoking are independent.	8	CO5	L3

	Smokers	NonSmokers
Literates	83	57
Illiterates	45	68

(Critical value = 3.84)

PART- C (1 x 15 = 15 Marks)
(Q.No.16 is compulsory)

Q. No	Questions	Marks	CO	BL
16 (i)	Given the following joint probability mass function (joint pmf), compute the marginal probability mass functions of X and Y. Are the variables X and Y independent? Justify your answer.	8	CO4	L5

p(x,y)	y=0	y=1	Y=2
x=0	0.10	0.04	0.06
x=1	0.06	0.20	0.02
x=2	0.08	0.30	0.14

Q. No	Questions	Marks	CO	BL
16 (ii)	Using the following data, compute the first two harmonics in the Fourier series of the function $f(x)$. Assume that period of the function is 2π.	7	CO1	L5

x	0	$\pi/2$	π	$3\pi/2$	2π
$f(x)$	0	2	0	0	2