Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Third Semester

MA22358 – TRANSFORM AND RANDOM PROCESSES

(Electronics and Communication Engineering)

(Regulation 2022)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Acquire the skill in examining a signal in another domain rather in the original domain by handling Full and Half Range Fourier Series.	**3**
CO 2	Develops the skill of conversion between time domain to frequency domain using the concept of Fourier Transforms and Z-transform.	**3**
CO 3	Express proficiency in handling higher order Partial differential equations.	**3**
CO 4	Reproduce and explain the basic concepts such as probability and random variable and identify the distribution. Acquire skills in handling situations involving more than one random variable.	**3**
CO 5	Apply the relationship within and between random processes.	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Find the value of the Fourier series for $f(x)=\begin{cases} ¿0 \in (-3,0) \\ ¿4 \in (0,3) \end{cases}$ at the point of discontinuity $x = 0$.	1	2
2.	Does $f(x) = \tan x$ possess a Fourier expansion?	1	2
3.	If the Fourier series corresponding to f(x) = x in the interval $(0,2\pi)$ is $\frac{a_0}{2}+\sum_1^\infty \{a_n \cos nx + b_n \sin nx\}$,without finding the values of a_0, a_n, b_n find the value of $\frac{a_0^2}{2}+\sum_1^\infty (a_n^2+b_n^2)$.	1	2
4.	Find the **R.M.S** value of $y = x^4$ in (- 1, 1).	1	2
5.	Find the Fourier transform of $f(x)=\begin{cases} 1, 2<x<4 \\ 0, otherwise \end{cases}$.	2	3
6.	Find the Fourier cosine transform of $e^{-ax}, a>0$.	2	3
7.	Find Z-Transform of $\frac{1}{n}$.	2	2

8.	Find F(z) for the equation f(n+2) - 3f(n+1) + 2f(n)=0, if f(0)=0.	**2**	**2**
9.	Find the PDE of the family of spheres having their centers on the Z-axis.	**3**	**2**
10.	Eliminate the arbitrary function f from $z=f(y/x)$.	**3**	**2**
11.	Form the PDE by eliminating arbitrary constant $z=ax^n+by^n$.	**3**	**2**
12.	Solve$(D^3-3DD'^2+2D'^3)z=0$.	**3**	**2**
13.	Test whether $f(x)=\begin{cases}\lvert x\rvert, -1\le x\le 1\\ 0, otherwise\end{cases}$ can be the probability density function of a continuous random variable? .	**4**	**2**
14.	A random variable X can only take values 2 and 5. Given that the value 5 is twice as likely the value 2, determine the expectation of X.	**4**	**2**
15.	The following table gives the joint probability distribution of X and Y, find the marginal distribution function of X and Y.	**4**	**2**

Y \ X	1	2	3
1	0.1	0.1	0.2
2	0.2	0.3	0.1

16.	The regression equations are 3x + 2y = 26 and 6x + y = 31. Find the means of X and Y.	**4**	**2**
17.	Consider a random process $X(t)=\cos(t+\phi)$, where ϕ is a uniform random variable in $\left(\frac{-\pi}{2},\frac{\pi}{2}\right)$. Check whether the process is stationary.	**5**	**2**
18.	If patients arrive at a clinic according to Poisson process with mean rate of 2 per minute. Find the probability that during a 1 minute interval, no patient arrives.	**5**	**3**
19.	Find the variance of the stationary process $\{X(t)\}$ whose autocorrelation function is given by $R_{XX}(\tau)=25+\frac{4}{1+6\tau^2}$.	**5**	**2**

20.	Determine the function $\frac{\omega^2}{\omega^6+3\omega^2+3}$ can or can't be a valid power density spectrum.	**5**	**2**

PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	Expand $f(x)=\begin{cases} ¿\pi+x, -\pi\le x\le 0 \\ ¿\pi-x, 0\le x\le\pi \end{cases}$ as a Fourier serries and hence deduce that $\sum_1^{\infty}\frac{1}{¿¿}¿$	**(10)**	**1**	**3**
	(OR)			
(b)	The table value of the function $y=f(x)$ is given below. Find a Fourier series up to the second harmonic to represent f(x) in terms of x.	**(10)**	**1**	**3**

X	0	π /3	2 π/ 3	π	4 π/3	5 π/ 3	2 π
Y	1.0	1.4	1.9	1.7	1.5	1.2	1.0

22. (a)	Find the Fourier sine transform and Fourier cosine transform of $f(x)=x^{n-1}$and show that $\frac{1}{\sqrt{x}}$is self reciprocal under both.	**(10)**	**2**	**3**
	(OR)			
(b)	Find $Z^{-1}\left[\frac{8z^2}{(2z-1)(4z+1)}\right]$by convolution theorem.	**(10)**	**2**	**3**
23. (a)	Solve: $(mz-ny)p+(nx-lz)q=ly-mx$.	**(10)**	**3**	**3**
	(OR)			
(b)	Solve: $(D¿¿3-7DD'^2-6D'^3)z=\sin(x+2y)+e^{2x+y}¿$	**(10)**	**3**	**3**
24. (a)	The probability mass function of random variable X is defined as $P(X=0)=3C^2$, $P(X=1)=4C-10C^2$, $P(X=2)=5C-1$, where $C>0$, and $P(X=r)=0$ if $r\neq 0,1,2$. Find (i) The value of C.	**(10)**	**4**	**3**

(ii)$P((0<X<2)\vee(X>0))$. (iii) The distribution function of X.

(iv) The largest value of x for which $F(x)<\frac{1}{2}$.

(OR)

(b) Two random variables have the joint PDF **(10)** **4** **3**

$f(x,y)=\frac{x+y}{3}, 0\leq x\leq 1, 0\leq y\leq 2$. Find the correlation coefficient.

25. (a) Show that the random process $X(t)=A\cos$¿¿ is WSS if $A\wedge\omega$ are constants and θ is uniformly distributed random variable in $(0,2\pi)$. **(10)** **5** **3**

(OR)

(b) The autocorrelation function of random binary transmission $\{X(t)\}$ is given by $R(\tau)=\begin{cases} ¿1-\frac{|\tau|}{T}, |\tau|\leq T \\ ¿0, \text{ elsewhere} \end{cases}$, where T is a constant. Find the power spectrum of the process $\{X(t)\}$. **(10)** **5** **3**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

		Marks	**CO**	**RBT LEVEL**
26.	A random variable X has the following probability distribution	**(10)**	**4**	**3**

X	:	-2	-1	0	1	2	3
$P(X)$	:	0.1	K	0.2	$2K$	0.3	$3K$

(i) Find K.

(ii) Evaluate $P(X<2)$ and $P(-2<X<2)$.

(iii) Find the CDF of X.

(iv) Evaluate the mean of X.