

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION-2022

B.Tech.-III Semester (ECE, ECM)

COURSE CODE (CREDITS): 18B11MA314 (4)

MAX. MARKS: 35

COURSE NAME: Probability Theory and Random Processes

COURSE INSTRUCTORS: SST

MAX. TIME: 2 Hours

Note: All questions are compulsory. Marks are indicated against each question in square brackets. Use of scientific calculator is allowed.

- Q1.** A WSS Gaussian random process has an autocorrelation function $R_{XX}(\tau) = \exp(-|\tau|)$. Construct the covariance matrix for $X(t)$, $X(t+1)$ and $X(t+2)$. [3](CO-5)
- Q2.** Given that the autocorrelation function for a stationary ergodic process with no periodic components is $R_{XX}(\tau) = 9 + \frac{4}{1+5\tau^2}$. Find the mean value and variance of the random process $\{X(t)\}$. [3](CO-5)
- Q3.** Find the power spectral density of the random telegraph signal $Y(t) = \{X(t), t \geq 0\}$ with $R_{YY}(t, t+\tau) = \exp(-2\lambda|\tau|)$. [5](CO-5)
- Q4.** To determine the effectiveness of drugs against "aids", three types of medicines, allopathic, homeopathic and ayurvedic were tested on 50 persons with the following results:

		Drug			Total
		Allopathic	Homeopathic	Ayurvedic	
Effectiveness	No relief	11	13	9	33
	Some relief	32	28	27	87
	Total relief	7	9	14	30
Total		50	50	50	150

Test the independence of the effectiveness of the drugs at the 0.05 level of significance.

[5](CO-4)

- Q5.** A company claims that alloying reduces resistance of electric wire by more than 0.050 ohm. To test this claim samples of standard wire and alloyed wire are tested yielding the following results:

Type of Wire	Sample Size	Mean Resistance (ohms)	S.D. (ohms)
Standard	32	0.136	0.004
Alloyed	32	0.083	0.005

[P.T.O.]

[5](CO-4)

Q6. Can the claim be substantiated at the 0.05 level of significance?
 For a certain binary communication channel, the probability that a transmitted '0' is received as a '0' is 0.95 and the probability that a transmitted '1' is received as '1' is 0.90. If the probability that a '0' is transmitted is 0.4, find the probability that:

- a) a '1' is received
- b) a '1' was transmitted given that a '1' was received.

[4](CO-1)

Q7. Find:

- a) marginal distributions $f(x)$ and $g(y)$
- b) $E(X)$ and $E(Y)$
- c) $Cov(X, Y)$
- d) $\rho(X, Y)$
- e) Are X and Y independent random variables?, for the following joint distribution:

$X(\downarrow), Y(\rightarrow)$	-4	2	7
1	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{8}$
5	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{8}$

[5](CO-3)

Q8. A mathematics placement test is given to all entering freshmen at a small college. A student who receives a grade below 30 is denied admission to the regular mathematics course and placed in a remedial class. The placement test scores and the final grades for 10 students who took the regular course were recorded. Find the equation of the regression line to predict course grades from placement test scores.

Placement Test	50	29	30	40	55	65	25	60	90	35
Course Grade	53	41	61	56	68	36	11	70	79	59

[5](CO-4)

Percentage Points of the Chi-Square Distribution

Degrees of Freedom	Probability of a larger value of χ^2								
	0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.000	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.115	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09