	Reg. No.:	
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Vellore Institute of Technology

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Continuous Assessment Test II – March 2023

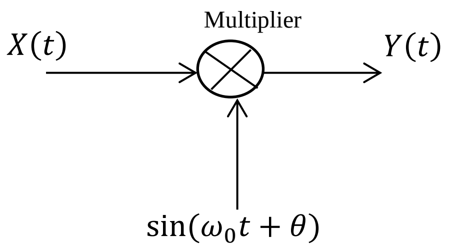
Programme	:	**B.Tech (ECE)**	Semester	:	**WS 2022-23**
Course	:	**Random Processes**	Code	:	**BECE207L**
			Class Nbr	:	**CH2022235000478 CH2022235000481 CH2022235000483 CH2022235000476**
Faculty	:	**Dr Chandrasekaran N, Dr. Jeetashree Aparajeeta, Dr. Kalaivanan K., Ralph Thangaraj**	Slot	:	**B2+TB2**
Time	:	**90 Minutes**	Max. Marks	:	**50**

Answer <u>ALL</u> the questions

<table>
<tr><th>Q.No.</th><th>Sub. Sec.</th><th>Questions</th><th>Marks</th></tr>
<tr><td>1.</td><td></td><td>
Random variables X and Y have the joint characteristic function

$$\phi_{x,y}(\omega_1,\omega_2) = e^{\left(-\frac{1}{2}\left(4\omega_1^2-\omega_1\omega_2+9\omega_2^2\right)\right)}$$

(a) Find the cross correlation of X and Y.
(b) Determine mean of X and Y.
</td><td>5</td></tr>
<tr><td>2.</td><td></td><td>
A random process is defined in the below figure, in which $X(t)$ and $\sin(\omega_0 t+\theta)$ are applied to the multiplier.



Where X(t) is a wide sense stationary random process that amplitude-modulates a carrier of constant angular frequency ω_0 with a random phase θ independent of X(t) and uniformly distributed on (-π, π).

(i) Find E[Y(t)]
(ii) Find the autocorrelation function of Y(t)
(iii)Is Y(t) wide sense stationary?
</td><td>10</td></tr>
<tr><td>3.</td><td></td><td>
A random process is given by

$$Z(t) = 0.4\,X(t) - 0.9\,Y(t)$$

where $X(t)$ and $Y(t)$ are jointly wide sense stationary processes.
(i) Find the power spectral density of $Z(t)$
(ii) Find the power spectral density of $Z(t)$, if $X(t)$ and $Y(t)$ are uncorrelated
</td><td>10</td></tr>
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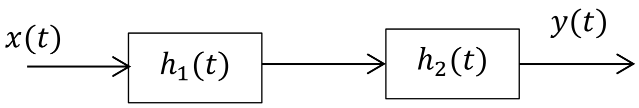
		(iii)Find the cross power spectrum $S_{XZ}(\omega)$ and $S_{YZ}(\omega)$	
4.		Statistically independent, zero-mean random processes $\alpha(t)$ and $\beta(t)$ have autocorrelation function $$R_{\alpha\alpha}(\tau) = A_0 sin(2\pi\tau)$$ and $$R_{\beta\beta}(\tau) = B_0 e^{-9\lvert\tau/2\rvert}$$ respectively. (i) Find the auto correlation function of the sum $W_1(t) = \alpha(t) + \beta(t)$ (ii) Find the auto correlation function of the difference $W_2(t) = \alpha(t) - \beta(t)$ (iii)Find the cross correlation function of $W_1(t)$ and $W_2(t)$	**10**
5.	**a**	X_n is a wide sense stationary discrete-time random sequence with autocorrelation function $$R_x[k] = \delta[k] + (0.1)^{\lvert k\rvert} \text{; for } k = 0, \pm1, \pm2, \ldots,$$ Compute the power spectral density $S_X(\omega)$.	**5**
	b	A discrete time WSS random sequence $X[n]$ has the following autocorrelation sequence $$R_X[m] = \begin{cases} 1 - 0.2\lvert m\rvert, & \lvert m\rvert \le 4 \\ 0, & \lvert m\rvert > 4 \end{cases}$$ Compute the power spectrum $S_X(\omega)$.	**5**
6		Two identical networks are cascaded. Each has impulse response $$h_1(t) = u(t)4t\ \exp(-3t)$$ $$h_2(t) = u(t)3\ \exp(-2t)$$  (i) Find the expression for the response Y(t) of the cascade (ii) If $E[X(t)] = \bar{X} = 6$, Find $\bar{Y}$.	**5**

Course Faculty

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