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HirasugarInstitute of Technology, Nidasoshi.

Inculcating Values, Promoting Prosperity

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ECE Dept.
Exam.
Internal Assessment
Even Sem(2017-18)

IMPROVEMENT INTERNAL ASSESSMENT

Sem : IV **Sub: Principles of Communication Systems** **Sub. Code: 15EC45**

Date:01/06/2018 **Time: 3:00PM-4.00PM** **Max. Marks: 25**

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Discription of Question	Marks	CO	RBT LEVEL
1	a	Derive the expression for FM wave assuming both modulating and carrier signals are Cosine waveforms.	6	CO213. 2	L2
	b	The equation of FM wave is $s(t)=10\mathrm{Sin}[5.7\times10^8t+5\mathrm{Sin}12\times10^3t]$. Calculate: i. Carrier frequency ii. Modulating frequency iii. Modulation index iv. Frequency deviation v. Power dissipated in 100 Ohms.	7	CO213. 2	L3
		OR			
2	a	With neat diagram explain FM demodulation using Balanced Slope Detector.	6	CO213. 2	L2
	b	When a 50.0MHz carrier is frequency modulated by a sinusoidal AF modulating signal, the highest frequency reached is 50.075MHz. Calculate: i. The frequency deviation produced ii. Carrier swing of the wave iii. Lowest frequency reached	7	CO213. 2	L3
3	a	Explain linear model of PLL. Also, clearly explain how PLL is helpful in FM modulation and demodulation schemes.	6	CO213. 2	L2
	b	For FM wave represented by $s(t)=5\mathrm{Sin}[2\pi\times88\times10^6t+5\mathrm{Sin}1250t]$. Find β, maximum deviation and BW.	6	CO213. 2	L3
		OR			
4	a	Explain relation between FM and PM. Give BD to obtain one from other and vice-versa.	6	CO213. 2	L2
	b	Give comparison between NBFM and WBFM. Define Carson rule of FM bandwidth calculation. Also explain FM stereo multiplexing.	6	CO213. 2	L3

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ECE Dept.
Exam.
Internal Assessment
Even Sem(2017-18)

THIRD INTERNAL ASSESSMENT

Sem : IV
Date:20/05/2018

Sub: Principles of Communication Systems
Time: 11:00AM-12.00PM

Sub. Code: 15EC45
Max. Marks: 25

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Discription of Question	Marks	CO	RBT LEVEL
1	a	Derive an expression for noise equivalent bandwith with suitable example.	6	CO213. 3	L2
	b	Explain Autocorrelation and its properties. Also, briefly explain cross-correlation.	7	CO213. 3	L2
OR					
2	a	Discuss random processes with expressions and relavant diagrams. Explain their applications in communications.	7	CO213. 3	L2
	b	Explain: i. Axiomatic probability and its properties. ii. Conditional probability with suitable examples and write chain rule.	6	CO213. 3	L2
3	a	Derive the expression for figure of merit of an AM receiver.	6	CO213. 4	L2
	b	Show that the Figure of Merit of DSB-SC is unity. Also, find Figure of Merit in DSB-SC receiver when the depth of modulation (or modulation index) is: a) 100% b) 50% and c) 30%.	6	CO213. 4	L3
OR					
4	a	Derive the expression for figure of merit of an FM receiver.	6	CO213. 4	L2
	b	An FM signal with a deviation of 75KHz is applied to an FM demodulator. When the input SNR is 15dB, the modulating frequency is 10KHz. Estimate the SNR at the demodulator output.	6	CO213. 4	L3

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SCHEME OF EVALUATION

Sem : IV		Subject : principles of Commn Systems	Sub Code : 15EC45	Date : 20/05/2018	
Q. No.	**Bit**	**Description**	**Marks**	**CO's**	**RBT LEVEL**
1	(a)	Suppose that a source of white noise of zero mean and power spectral density $N_0/2$ connected to the input of an arbitrary lowpass filter of transfer function $H(f)$. The resulting average output noise power is therefore, $N_{out} = \int_{-\infty}^{\infty} \lvert H(f)\rvert^2 df$ $= N_0 \int_0^{\infty} \lvert H(f)\rvert^2 df \rightarrow (1)$ With the assumption that the amplitude response $\lvert H(f)\rvert$ is an even function of frequency. In the next step it is assumed that the same white noise source is connected to an ideal low pass filter of zero frequency response $H(0)$ and bandwidth B. In this case, the average output noise power is: $N_{out} = N_0 . B . H^2(0)$ Therefore, equating this average output noise power of (1), the noise equivalent-	06	C213.3	L2

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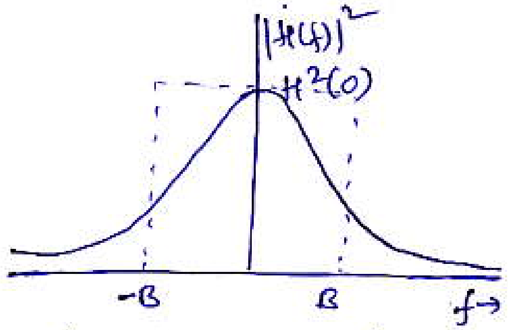
SCHEME OF EVALUATION

Sem : IV	Subject : PCS		Sub Code : 15EC45	Date : 20/05/2018		
Q. No.	**Bit**	**Description**		**Marks**	**CO's**	**RBT LEVEL**
		bandwidth is given by: $$B = \frac{\int_0^\infty \lvert H(f)\rvert^2 df}{H^2(0)}$$ Thus, the procedure for calculating the noise equivalent bandwidth consists of replacing the ~~arbitr~~ arbitrary lowpass filter of transfer function H(f) by an equi- ideal low pass filter of zero frequency response H(0) and bandwidth B.  Figure: Illustration of the defn of Noise eqnt BW		07	CO213.3	L2
1	(b)	The Autocorrelation function of the process X(t) as the expectation of the product of two random variables $X(t_1)$ & $X(t_2)$ obtained by observing X(t) at times t_1 and t_2, respectively as: $$R_X(t_1,t_2) = E[X(t_1)X(t_2)]$$ $$= \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} x_1 x_2 f_{X(t_1),X(t_2)}(x_1,x_2)\,dx_1 dx_2$$				

SCHEME OF EVALUATION

Sem : IV	Subject : PCS	Sub Code : 15EC45	Date : 20/05/2018		
Q. No.	**Bit**	**Description**	**Marks**	**CO's**	**RBT LEVEL**
Q1	(b)	cont'd.... Properties of Autocorrelation: Let $R_X(\tau) = E[X(t+\tau)X(t)]$ $\forall t$, Then i) The mean square value of the process may be obtained from $R_X(\tau)$ simply by putting $\tau = 0$ $\Rightarrow R_X(0) = E[X^2(t)]$ ii) The autocorrelation function $R_X(\tau)$ is an even function of τ, i.e., $R_X(\tau) = R_X(-\tau)$ iii) The autocorrelation function $R_X(\tau)$ has its maximum magnitude at $\tau = 0$, i.e., $\lvert R_X(\tau)\rvert \le R_X(0)$			
Q2	(a)	Random processes: A random process X(t) as an ensemble of time functions together with a probability rule that assigns a probability to any meaningful event associated with an observation of one of the sample functions of the random processes. To calculate expectation, correlation and study the random variables behavior over the time, random processes are described			

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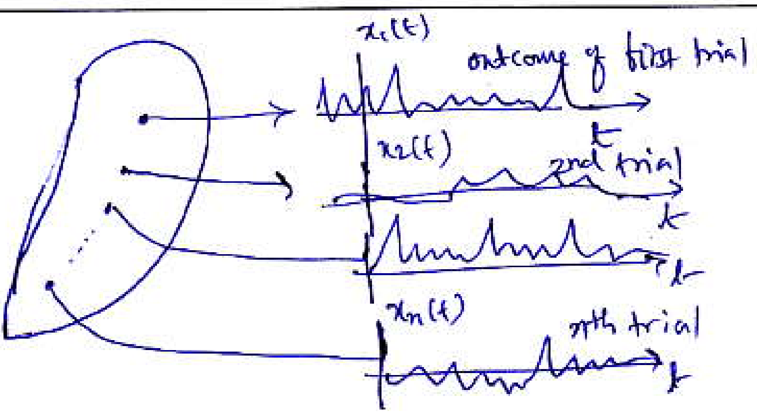
SCHEME OF EVALUATION

Sem : IV	Subject : PCS	Sub Code : 15EC45	Date : 20/05/2018		
Q. No.	**Bit**	**Description**	**Marks**	**CO's**	**RBT LEVEL**
		 Applications in communications: Estimation of mean, Variance, correlation etc. → Modeling of statistical systems.	6	CO213.3	L2
Q 2	(b)	i) Axiomatic probability and its properties The probability of an event A is a real number P(A) assigned to the event A obeying the following axioms (or law of postulates) (i) P(A) is a non-negative number between 0 & 1 i.e., $0 \leq P(A) \leq 1$. ii) probability of sure event is equal to unity i.e., $P(S) = 1$ where S → sample space. iii) If A & B are mutually exclusive (disjoint) events, then $P(A \cup B) = P(A+B) = P(A) + P(B)$.			

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SCHEME OF EVALUATION

Sem : IV	Subject : PCS	Sub Code : 15EC45	Date : 20/05/2018		
Q. No.	**Bit**	**Description**	**Marks**	**CO's**	**RBT LEVEL**
Q2	(b)	ii) Conditional probability with suitable example & chain rule.	06	C02B.3	L2
Q3	(a)	Noise figure of AM receiver	06	C02B.4	L2

Q2 (b) ii) Conditional probability with suitable example & chain rule.

The probability of some event B occuring given that some other event A has already occured is defined as conditional probability & given by

$$P(B/A) = \frac{P(AB)}{P(A)} \text{ or } P(A/B) = \frac{P(AB)}{P(B)}$$

Then chainrule is given by:

$$P(AB) = P(B/A)\,P(A) \text{ or } P(A/B)\,P(B)$$

|||^{ly} $P(A_1A_2A_3 \ldots A_n) = P(A_1)\,P(A_2/A_1)\cdot P(A_3/A_1A_2) \cdots P(A_n/A_1A_2 \ldots A_{n-1})$

E.g. 1) Probability of raining at two different cities given that one city has already received rain)

2) prob. of receiving bit '0' given that transmitted bit is also '0'.

Q3 (a) Noise figure of AM receiver

$$(SNR)_{C,AM} = \frac{A_c^2(1+k_a^2P)}{2WN_0}$$

$$\& \ (SNR)_{O,AM} = \frac{A_c^2 k_a^2 P}{2WN_0}$$

$$\Rightarrow \left.\frac{(SNR)_o}{SNR_c}\right|_{AM} = \frac{k_a^2 P}{1+k_a^2 P} < 1$$

SCHEME OF EVALUATION

Sem :	Subject :	Sub Code :	Date :

Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
Q3	(b)	see below	06	CO213.4	L3
Q4	(a)	see below	06	CO213.4	L2

Q3 (b)

$$(SNR)_{C,\,DSBSC} = \frac{C^2 A_c^2 P}{2 W N_0}$$

$$\& \; (SNR)_{O,\,DSBSC} = \frac{C^2 A_c^2 P}{2 W N_0}$$

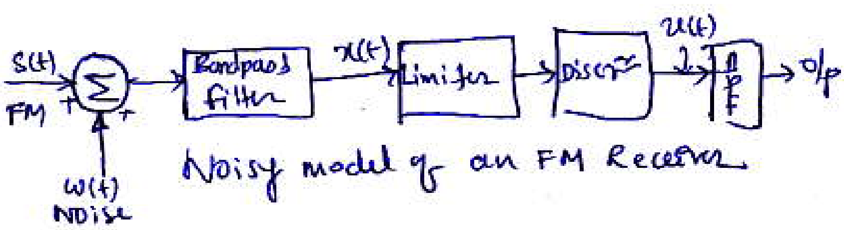
$$\Rightarrow \left.\frac{(SNR)_0}{(SNR)_c}\right|_{DSB\text{-}SC} = 1$$

⇒ Since noise figure in case of DSB-SC is always unity, i.e., independent of 'μ' for all cases it is unity.

Also μ is always unity for DSB-SC

⇒ a) 100% b) 50% & c) 90% $F = 1$

Q4 (a)



Noisy model of an FM Receiver

$$(SNR)_{C,\,FM} = \frac{A_c^2}{2 W N_0}$$

$$(SNR)_{O,\,FM} = \frac{3 A_c^2 k_f^2 P}{2 N_0 W^3}$$

$$\Rightarrow \left.\frac{(SNR)_0}{(SNR)_c}\right|_{FM} = \frac{3 k_f^2 P}{W^2}$$

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SCHEME OF EVALUATION

Sem : IV | Subject : PCS | Sub Code : 15EC45 | Date :

Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
Q4	(b)	Given: $\Delta f = 75\,kHz \rightarrow$ FM Demod	06	CO2,3,4	L3

Given: $\Delta f = 75\,kHz \rightarrow$ FM Demodⁿ

$SNR = 15\,dB \rightarrow$ input SNR

$f_m = 10\,kHz \cong W$ Band limited

$(SNR) \rightarrow o/p = ?$

$$(SNR)_o = (SNR)_{i/p} \times \frac{3 k_f^2 P}{W^2}$$

$$\beta = \frac{\Delta f}{W} = \frac{k_f \sqrt{P}}{W}$$

Also $k_f^2 P = \frac{(\Delta f)^2}{2}$

$$= 10\log_{10}(15) \times \frac{3 \times \Delta f^2}{2 W^2}$$

$$= 29.96\,dB.$$