

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

EndTerm Examination (Regular/Backlog), November 2016

B. Tech in EC Engineering, Semester V

Roll No.....

ECE 502 : Analog communication

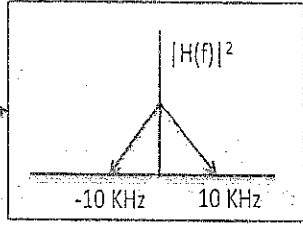
Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A	Objective type multiple choice questions (10 questions @ 1 mark)	10
i.	Which of the following schemes suffer(s) from the threshold effect? a. AM detection using envelope detection b. AM detection using synchronous detection c. FM detection using discriminator d. SSB detection with synchronous detection	
ii.	A PLL can be used to demodulate a. PAM signals b. PCM signals c. FM signals d. DSB-SC signals	
iii.	White Gaussian noise is passed through a linear narrow band filter. The probability density function of the envelope of the noise at the filter output is a. Uniform b. Poisson c. Gaussian d. Rayleigh	
iv.	The auto correlation function of an energy signal has a. No symmetry b. Conjugate symmetry c. Odd symmetry d. Even symmetry	
v.	Noise with uniform PSD of N_0 W/Hz is passed through a filter $H(\omega)=2\exp(-j\omega t_d)$ followed by an ideal low pass filter of bandwidth B Hz. The output noise power in Watts is a. $2N_0B$ b. $4N_0B$ c. $8N_0B$ d. $16N_0B$	

vi.	If $R(\tau)$ is the auto-correlation function of a real, wide-sense stationary process, then which of the following is not true? $R(\tau) = R(-\tau)$ $R(\tau) \leq R(0)$ $R(\tau) = -R(-\tau)$ - The mean square value of the process is $R(0)$	
vii.	$V(t) = 5[\cos(10^6 \pi t) - \sin(10^3 \pi t) \times \sin(10^6 \pi t)]$ represents - DSB-SC signal - AM signal - SSB upper sideband signal - NBFM signal	
viii.	A white noise process $X(t)$ with two sided PSD 1×10^{-10} W/Hz is input to a filter whose magnitude squared response is shown below.  The power of the output process $y(t)$ is given by 5×10^{-7} W 1×10^{-6} W 2×10^{-6} W 1×10^{-5} W	
ix.	A 1MHz sinusoidal carrier is amplitude modulated by a symmetrical square wave of period 100 μsec. Which of the following frequencies will not be present in the modulated signal? 990 KHz 1010 KHz 1020 KHz 1030 KHz	
x.	A modulated signal is given by $s(t) = e^{-at} \cos[(\omega_c + \Delta\omega)t]u(t)$, where a, ω_c and $\Delta\omega$ are positive constants, and $\omega_c \gg \Delta\omega$. The complex envelope of $s(t)$ is given by $\exp(-at)\exp[j(\omega_c + \Delta\omega)t]u(t)$ $\exp(-at)\exp[j\Delta\omega t]u(t)$ $\exp[j\Delta\omega t]u(t)$ $\exp[j(\omega_c + \Delta\omega)t]u(t)$	

Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
a.	Write short note on autocorrelation.	
b.	Show that when n is very large ($n \gg k$) and p is very small ($p \ll 1$), the binomial distribution can be approximated by the Poisson distribution.	
c.	What are the advantages of Noise-temperature?	
d.	Write short note on normalized power.	

Q.3A	In a random experiment, a trial consists of four successive tosses of a coin. If we define a random variable X as the number of heads appearing in a trail, determine $P(X=x_i)$ and CDF $F_X(x)$.	05
Q.3B	The PDF of a random variable is given by, $f_x(x) = \begin{cases} K, & a \leq x \leq b \\ 0, & \text{otherwise} \end{cases}$ Where, k is constant a. Determine the value of k b. Let $a = -1$ and $b = 2$ calculate $P(x \leq c)$ for $c = 1/2$	05
Q.4A	Define the term 'variance' for the random variable X. Calculate the same if PDF for X is given by,	05
	$f_{xy}(x, y) = \frac{1}{2} e^{- x } \quad \text{for } -\infty < x < \infty$	
Q.4B	Two resistor $22K\Omega$ and $47K\Omega$ are at room temperature. calculate for a bandwidth of 100KHz, the thermal noise voltage (a) for each resistor, (b) for two resistor in series (c) for two resistor in parallel.	05
Q.5A	The antenna current of an AM broadcast transmitter, modulated to a depth of 40 percent by an audio sine wave is 11A. It increases to 12A as a result of sinusoidal modulation by another audio sine wave. What is the modulation index to second wave?	05
Q.5B	Find out the noise equivalent bandwidth for low-pass filter (LPF).	05
Q.6A	Derive the expression of CDF for Gaussian distribution.	05
Q.6B	Suppose that X and Y are independent normalized normal random variables. Find the pdf of $Z = X + Y$.	05
	OR	
Q.6B	Explain the difference in ensemble average and time average.	05
Q.7A	Mean and variance of sum of two statistical independent random variables is sum of individual means and variances. Justify your answer.	05
Q.7B	Show that the random process $X(t) = A \cos(\omega_c t + \theta)$ where, θ is a random variable uniformly distributed in the range $(0, 2\pi)$, is a wide-sense stationary process.	05
	OR	
Q.7B	The noise output of a resistor is amplified by a noiseless amplifier having gain of 60 and a bandwidth of 20 KHz. A meter connected to output of the amplifier reads one millivolt (RMS).	05
	a. If the bandwidth of the amplifier is now reduced to 5 KHz, its gain remaining	

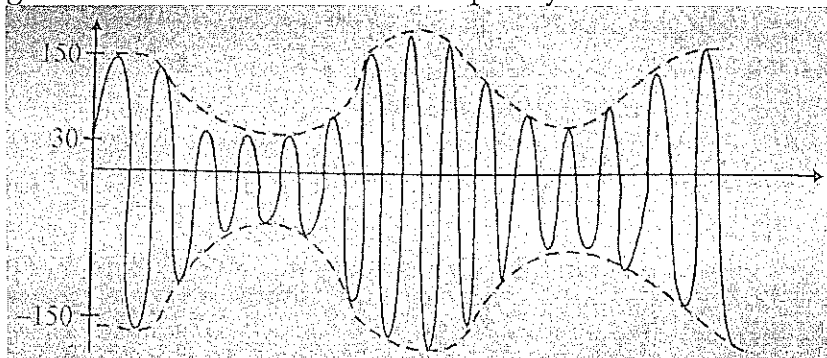
constant, what does the meter read?

b. If the resistor is operated at 80°C , what is its resistance?

Q.8A	Define SNR. Consider a DSB-SC signal corrupted by additive white Gaussian noise and demodulated by a synchronous detector having phase error of ϕ . Find the output SNR.	10
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Q.9A	Show that the performance of an SSB system using synchronous detection is equivalent to performance of both DSB and base band systems.	10
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Q.9B	When a sinusoidal test tone of frequency ω_m (in radian) is applied to the input of the modulation in AM broadcasting (DSB-FC), the modulated waveform is shown in figure below where the carrier frequency is ω_c .	10
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- Find the modulation index and the expression of modulated signal.
- Determine the total average power of the modulating signal, the carrier power, the USB power and the LSB power.
- Determine the modulating efficiency
- Determine the amplitude and phase of additional carrier which must be added to the waveform to attain a modulation index of (i) 20% (ii) 80%.

OR

Q.9B	Consider a single-tone AM system using envelope detection in which the average power per unit bandwidth measured at the receiver input is 10^{-3} W/Hz . The carrier power is 80 KW and the two sidebands have 10KW each. The modulating signal frequency is 80 KHz. Determine the output SNR. How does this result compare to that of a DSB-SC system?	10
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Good Luck