Question Paper

Exam Date & Time: 11-Oct-2020 (02:00 PM - 05:30 PM)

BMS COLLEGE OF ENGINEERING

Autonomous Institute Affiliated to VTU, Supplementary Semester End Examination October 2020

Communication Theory - 1 [16EC5DCCT1]

Marks: 100 **Duration: 210 mins.**

Electronics and Communication Engineering, V SEM

Answer all the questions.

Instructions: 1. Answer Five Full questions using given internal choices.
2. Missing data, if any, may be suitably assumed.

1)		What is Gaussian distribution? Define and sketch the probability density function and distribution function of a normalized Gaussian random variable.	(6)
	a)		
	b)	Let a random process, $X(t) = A\cos(2\pi f_c t + \theta)$ where A and f_c are constants θ is a random variable uniformly distributed over the interval $(0, 2\pi)$. Compute the mean and autocorrelation of random variable X(t).	(6)
	c)	Define thermal noise and shot noise.	(4)
	d)	What is white noise? Explain the power spectral density characteristics with a diagram.	(4)
2)			(8)
	a)	An amplitude modulated signal is defined by: $S(t) = 10\cos(2\pi 10^6 t)\,[\,1 + 0.6\cos(2000\pi t) + 0.4\cos(4000\pi t)\,]$ (i) Find the various frequency components of AM signal. (ii) Draw the amplitude spectrum of AM signal and find its bandwidth. (iii) Find frequency and amplitude of each sideband signal.	
	b)	Explain the working of an envelope detector used for AM demodulation with relevant circuit diagram and waveforms.	(6)
	c)	An AM receiver using envelope detector, operating with sinusoidal modulating wave and 60% modulation, has an output signal-to-noise ratio of 30 dB. What is the corresponding figure of merit and channel signal-to-noise ratio?	(6)
[OR]		Compare the features of AM and DSBSC modulation schemes.	(4)
3)			
	a)		
	b)	Derive an expression for the Figure of merit for a DSBSC receiver with coherent detector.	(10)
	c)		(6)

An DSBSC modulated signal defined by $s(t) = 10\cos(8000\pi t)\cos(2\pi 10^5 t)$ is fed to a coherent detector. The local oscillator signal is $c(t) = 10\cos(2\pi 10^5 t)$. Compute the detector output. Assume the cut-off frequency of the low-pass filter (LPF) in detector is 5 kHz. Draw the block diagram of the detector.

4) (8)

Calculate the Hilbert transform of the following signals:

a) *i)* $f(t) = \cos(2\pi f_c t)$

i) ii) $g(t) = \sin(2\pi f_c t)$.

iii) $v(t) = \cos(2\pi f_c t) + \sin(2\pi f_c t)$.

b) With a neat block diagram and mathematical expressions, explain the phase discrimination method for generating an SSB modulated wave. (8)

c) A modulating signal consists of three sinusoidal components of frequencies 1kHz, 2kHz and 3kHz. This modulating signal is used to modulate a carrier signal of frequency 100 kHz generating a SSBSC signal with only upper sideband. Sketch the spectrum of the modulating signal and modulated signal. Assume equal amplitude for all components. (4)

5) With a neat block diagram, explain the generation of wide band FM wave using indirect method (Armstrong's method). An Armstrong FM modulator uses Oscillators of frequencies 100kHz and 10MHz. If the required output carrier frequency is 100 MHz with a deviation of 75 kHz, find the suitable multiplying factors of the frequency multipliers. Assume that initial stage frequency deviation $\Delta f_1 = 20$ Hz. (10)

a)

b) A sinusoidal modulating wave of peak-amplitude 5volt and frequency 1000Hz is applied to a FM modulator using a carrier signal of frequency 100 kHz. (10)
The frequency sensitivity of the modulator is 100Hz/volt.
(i) Calculate the frequency deviation and modulation index of the FM signal.
(ii) Derive the time domain expression for the resulting FM signal.
(iii) Find the bandwidth of the FM signal.
(iv) Compute and draw the frequency spectrum of the FM wave.

[OR]

6) Explain the FM stereo multiplexing system with a relevant block diagram. (7)

a)

b) What is the need for Pre-emphasis in FM system? With circuit diagram and frequency response explain the working of Pre-emphasis circuit in FM system. (8)

c) An FM signal with a frequency deviation of 75 kHz is applied to an FM demodulator where the input SNR is 15dB. If the sinusoidal modulating signal frequency is 10 kHz, estimate the SNR (in dB) at the demodulator output. (5)

7) (8)

State the Nyquist sampling theorem for low pass signals.

a) Specify the minimum sampling rate for each of the following signals:

(i) $x(t) = 5\sin(3500\pi t)$ (ii) $y(t) = 3\cos^2(500\pi t)$ (iii) $s(t) = \text{sinc}(800t)$

b) Compare Analog communication and Digital Communication. (4)

c) (8)

The spectrum of a band pass signal is shown in Fig.Q7(c). The signal is sampled using ideal sampling method. Draw the spectrum of the sampled signal if the sampling rate is (i) 100 samples/sec (ii) 40 samples/sec.

Specify whether the signal can be reconstructed or not in each case.

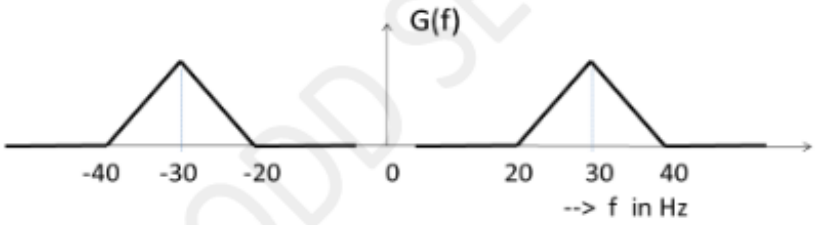

Fig.Q7(c)

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