SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

IV SEMESTER

EC3463 – ANALOG COMMUNICATION

Academic Year 2024 – 25 (*Even Semester*)

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SUBJECT : EC3463 – ANALOG COMMUNICATION

YEAR /SEM :II /IV

		UNIT I AMPLITUDE MODULATION			
		Amplitude Modulation- DSBSC, DSBFC, SSB, VSB - Modulation index, Spectra, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, DSBSC Generation – Balanced and Ring Modulator, SSB Generation – Filter, Phase Shift and Third Methods – Comparison of different AM techniques, Super heterodyne Receiver.			
		PART – A			
Q. No.	**Questions**		**CO**	**BT Level**	**Competence**
1.	Define amplitude modulation		CO1	BTL 1	Remembering
2.	Mention the need for the modulation in the communication system.		CO1	BTL 1	Remembering
3.	List the types of AM modulation.		CO1	BTL 1	Remembering
4.	What modulation scheme is used for television signal transmission?		CO1	BTL 1	Remembering
5.	List the differences between the DSB-SC AM signal and the SSB-SC AM signal		CO1	BTL 1	Remembering
6.	How do classify the AM signal based on the modulation index?		CO1	BTL 1	Remembering
7.	Draw the power spectrum of an amplitude modulated wave.		CO1	BTL 2	Understanding
8.	In a DSB-FC-AM signal the carrier power is Pc = 100 W with the modulation index of 0.67, compute the total power.		CO1	BTL 2	Understanding
9.	List the difference between high-level modulation and low-level modulation		CO1	BTL 2	Understanding
10.	Mention the techniques for generating an SSB modulated signal.		CO1	BTL 2	Understanding
11.	Interpret the filter method approach for SSB generation.		CO1	BTL 2	Understanding
12.	Why is a ring modulator called a double-balanced modulator?		CO1	BTL 2	Understanding
13.	Name the distortions observed in the diode detector output.		CO1	BTL 1	Remembering
14.	What is the output of a Weaver method modulator when a modulating signal and a carrier signal are applied?		CO1	BTL 1	Remembering

15.	Illustrate the advantages of the vestigial sideband modulation.	CO1	BTL 2	Understanding
16.	How is the transmission bandwidth of vestigial sideband modulation assessed?	CO1	BTL 2	Understanding
17.	How does SSB modulation save bandwidth compared to other AM techniques?	CO1	BTL 2	Understanding
18.	Why is SSB modulation preferred over DSB modulation in communication systems?	CO1	BTL 2	Understanding
19.	Write about coherent detection.	CO1	BTL 2	Understanding
20.	State the heterodyning principle.	CO1	BTL 1	Remembering
21.	What is the maximum modulating frequency if an AM radio channel has a bandwidth of 10 kHz?	CO1	BTL 1	Remembering
22.	What are sidebands in AM system?	CO1	BTL 2	Understanding
23.	What components are present in an AM wave?	CO1	BTL 2	Understanding
24.	What are the applications of SSB?	CO1	BTL 2	Understanding

PART – B

Q. No.		Questions			BT Level	Competence
1.		Describe the concepts of AM modulation and derive the equation of an AM wave. Draw the phasor diagram, spectrum and modulated AM wave for various degrees of modulation index.	(16)	CO1	BTL 3	Apply
2.	**(i)**	Derive the mathematical expression of AM signal using the square law method.	(8)	CO1	BTL 4	Analyse
	(ii)	Estimate the message signal from the amplitude modulated signal based on the envelope detector approach.	(8)	CO1		
3.	**(i)**	Draw the diagram of switching modulator and explain the generation of amplitude modulated signal.	(10)	CO1	BTL 3	Apply
	(ii)	List the limitations of an amplitude modulation.	(6)	CO1		
4.		For a DSB-FC amplitude modulated signal with peak unmodulated carrier voltage V_c= 10 V, a load resistance R_L = 10Ω and a modulation index m = 1, Evaluate the (a) Carrier power and the upper sideband power (b) Total sideband power (c) Total power of the modulated wave (d) Power spectrum diagram	(4) (4) (4) (4)	CO1	BTL 3	Apply
5.		Draw a balanced modulator circuit for generating DSB-SC-AM and describe its operation briefly.	(16)	CO1	BTL 3	Apply

6.	Analyze the operation of a ring modulator with the help of a circuit diagram and graphical signal representation.	(16)	CO1	BTL 4	Analyse
7.	(i) Sketch the time domain representation of the SSB-SC-amplitude modulated signal and explain in detail.	(8)	CO1	BTL 3	Applying
	(ii) Outline the working principle of the phase shift method to generate the single sideband suppressed carrier AM signal.	(8)	CO1		
8.	Analyze how a message is reconstructed from an AM signal using a diode detector and discuss the distortions in its output	(16)	CO1	BTL 4	Analyse
9.	Describe the concept of Weaver's method and demonstrate how it is used to generate an SSB signal.	(16)	CO1	BTL 3	Applying
10.	Illustrate the generation and demodulation of VSB with the help of a block diagram.	(16)	CO1	BTL 3	Applying
11.	(i) Explain the concept of Hilbert Transform with an appropriate expressions.	(8)	CO1	BTL 3	Applying
	(ii) Describe the pre envelope and complex envelope of a signal with an illustrative diagram.	(8)	CO1		
12.	Compare the various parameters of different form of amplitude modulated signal.	(13)	CO1	BTL 4	Analyzing
13.	(i) Categorize the performance parameters of the AM receivers used in the communication system.	(10)	CO1	BTL 4	Analyzing
14.	(ii) In a superheterodyne receiver the input AM signal has a center frequency of 1425 kHz and bandwidth 10kHz. The input is down converted to 455 kHz. Evaluate the value of image frequency.	(6)	CO1		
15.	Draw and explain the block diagram of a superheterodyne receiver.	(13)	CO1	BTL 3	Applying
16.	Explain the significance of power saving by suppressing the carrier signal using DSB-FC and DSB-SC expressions.	(16)	CO1	BTL 3	Applying
17.	For an AM superheterodyne receiver with IF, RF and local oscillator frequencies of 455kHz, 600kHz and 1055 kHz respectively. Evaluate the image frequency and image frequency rejection ration for a pre-	(16)	CO1	BTL 4	Analyzing

UNIT II ANGLE MODULATION

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth - FM modulation – Direct and Indirect methods, FM Demodulation – Foster Seeley FM discriminator– FM receiver.

PART A

Q. No	Questions	CO	BT Level	Competence
1.	Define angle modulation.	CO2	BTL1	Remembering
2.	How do frequency modulation and phase modulation differ?	CO2	BTL 2	Understanding

3.	Why frequency modulation is more preferred for voice transmission?	CO2	BTL 1	Remembering
4.	Summarize the relationship between frequency modulation and phase modulation.	CO2	BTL 2	Understanding
5.	What is the condition for FM to be classified as narrowband FM?	CO2	BTL 1	Remembering
6.	What is the difference between narrowband FM and wideband FM?	CO2	BTL 2	Understanding
7.	What are the key features of wideband FM ?	CO2	BTL 2	Understanding
8.	How do you calculate the modulation index of an FM signal with a maximum frequency deviation of 75 kHz and an audio frequency limit of 15 kHz?	CO2	BTL 2	Understanding
9.	State the Carson's rule to determine the bandwidth of FM.	CO2	BTL 1	Remembering
10.	How is the bandwidth of an FM wave calculated for a 2 kHz modulating frequency and 12 kHz maximum frequency deviation?	CO2	BTL 2	Understanding
11.	How indirect method is used to generate the modulated signal	CO2	BTL 2	Understanding
12.	Mention the process of generating FM signal using indirect method.	CO2	BTL 1	Remembering
13.	Why is the Armstrong method of modulation better than the reactance modulator?	CO2	BTL 2	Understanding
14.	List the non linear effects in FM.	CO2	BTL 1	Remembering
15.	Name the different types of FM demodulator.	CO2	BTL 1	Remembering
16.	How does the Foster-Seeley discriminator convert frequency variations to voltage?	CO2	BTL 2	Understanding
17.	What is the principle of a frequency discriminator in FM demodulation?	CO2	BTL 1	Remembering
18.	What are the merits and demerits of a balanced slope detector?	CO2	BTL 1	Remembering
19.	Mention the limitations of slope detector?	CO2	BTL 2	Understanding
20.	Show how FM demodulation is performed using phase discriminator.	CO2	BTL 2	Understanding
21.	Mention the drawbacks of angle modulation?	CO2	BTL 2	Understanding
22.	Define carrier swing.	CO2	BTL 1	Remembering
23.	A 500HZ modulating voltage fed into a PM generator produces a frequency deviation of 2.25 KHZ. What is the modulation index?	CO2	BTL 2	Understanding

24.		A frequency modulated signal is given as $s(t) = 20\cos[2\pi f_c t+4\sin(200\pi t)]$. Determine the required transmission bandwidth.		CO2	BTL 2	Understanding
		PART B				
1.	(i)	Show the mathematical expression for Wideband Frequency Modulation. Also compare and contrast its characteristics with Narrowband Frequency modulation.	(8)	CO2	BTL 3	Apply
	(ii)	How do you obtain FM from PM and vice versa? Explain.	(8)		BTL 3	
2.	(i)	Compare the characteristics of amplitude modulation with Frequency modulation.	(8)	CO2	BTL 4	Analyzing
	(ii)	Obtain the expression for narrowband FM signal and explain with block diagram and phasor representation.	(8)		BTL 4	
3.	(i)	Illustrate the mathematical representation of FM and PM waves.	(8)	CO2	BTL 3	Applying
	(ii)	For an FM modulator with a modulation index m_f=1, $V_m(t)=V_m\sin(2pi*1000t)$ and an unmodulated carrier $V_c(t)=15\sin(2pi*500t)$,determine number of set of sideband frequencies, Amplitude, Draw the frequency spectrum showing their relative amplitude and explain	(8)		BTL 4	
4.		An FM wave is represented by the voltage equation $V_{FM}(t) = 10 \cos(8 \times 10^6\, t + 2 \sin (3 \times 10^4\, t))$ Evaluate (a) Modulating frequency (b) Carrier frequency (c) Modulation index (d) Frequency deviation	(4) (4) (4) (4)	CO2	BTL 3	Applying
5.		Obtain the expression for the single tone frequency modulated signal and hence prove that is the constant envelope modulation requiring infinite bandwidth.	(16)	CO2	BTL 4	Analyzing
6.	(i)	Assess the significance of transmission bandwidth of FM.	(6)	CO2	BTL 4	Analyzing
	(ii)	A carrier frequency of 80MHz is frequency modulated by a sine wave amplitude of 1volts and frequency of 10KHz and the frequency sensitivity of the modulator is 100Hz/V. Assess the appropriate bandwidth of the FM wave.	(10)		BTL 4	
7.		What are the methods of FM generation? Explain how an FM signal is generated using a direct method.	(16)	CO2	BTL 3	Applying
8.		With necessary block diagram explain the concept of FM generation using Armstrong method.	(16)	CO2	BTL 3	Applying
9.		Describe how FM generation is achieved using reactance modulators.	(16)	CO2	BTL 3	Applying
10.		Illustrate the process of FM demodulation with balanced slope detector with the circuit diagram and characteristic curve.	(16)	CO2	BTL 3	Applying

11.	(i)	Construct the ratio detector to suppress the amplitude variation caused by the communication media without using amplitude limited circuit.	(8)	CO2	BTL 3	Applying
	(ii)	Design the circuit diagram of stagger tuned discriminator and explain its working.	(8)		BTL 3	
12.		Analyze the working of the Foster-Seeley discriminator using phasor representations.	(16)	CO2	BTL 4	Analyzing
13.		Analyze the working principle of single slop detector circuit for detection of FM signal and mention its advantages and disadvantages,	(16)	CO2	BTL 4	Analyzing
14.	(i)	How the threshold effect is realized in the FM discriminator.	(8)	CO2	BTL 3	Applying
	(ii)	Summarize the need for pre-emphasis and de-emphasis circuits in the communication system.	(8)		BTL 3	
15.		Examine the building blocks of phase locked loop and explain how it can be used for FM demodulation.	(16)	CO2	BTL 4	Analyzing
16.		What are the characteristics of frequency and phase discriminators? Explain each with an example.	(16)	CO2	BTL 3	Applying
17.		Develop double frequency conversion FM super heterodyne receiver and explain.	(16)	CO2	BTL 3	Applying

	UNIT III RANDOM PROCESS			
	Random variables, Random Process, Stationary Processes, Mean, Correlation & Covariance functions, Power Spectral Density, Ergodic Processes, Gaussian Process, Transmission of a Random Process through a LTI filter.			
	PART A			
Q. No	**Questions**	**CO**	**BT Level**	**Competence**
1.	Define random variable. Specify the sample space and the random variable for a coin tossing experiment.	CO3	BTL 1	Remembering
2.	How do discrete random variables differ from uniform random variables?	CO3	BTL 2	Understanding
3.	State central limit theorem.	CO3	BTL 1	Remembering
4.	List the properties of the cumulative distributive function.	CO3	BTL 1	Remembering
5.	Classify random process? Give one example for each.	CO3	BTL 2	Understanding
6.	When is a random process considered stationary, deterministic, and ergodic?	CO3	BTL 2	Understanding
7.	when do we say random processes X(t) as white process?	CO3	BTL 2	Understanding
8.	Compare the random variable and random process.	CO3	BTL 2	Understanding
9.	Define the terms mean and variance.	CO3	BTL 2	Understanding

10.	What are the properties of an autocorrelation function?	CO3	BTL 1	Remembering
11.	Express the autocorrelation function and power spectral density of white noise.	CO3	BTL 2	Understanding
12.	Outline Ergodic processes and Gaussian processes.	CO3	BTL 1	Remembering
13.	Give the conditions to be satisfied for wide sense stationary.	CO3	BTL 2	Understanding
14.	What is the condition for a random process to be ergodic in mean?	CO3	BTL 1	Remembering
15.	What is the relationship between the autocorrelation function and power spectral density?	CO3	BTL 1	Remembering
16.	Show the input output relation for a power spectral density and cross spectral density.	CO3	BTL 3	Applying
17.	Mention the properties of Gaussian process.	CO3	BTL 3	Applying
18.	Analyze the cross ccorrelation of random processes of X(t) and Y(t).	CO3	BTL 4	Analyzing
19.	Summarize an expression for noise equivalent bandwidth.	CO3	BTL 5	Evaluating
20.	Formulate the mean of the output signal obtained from the linear time invariant filter.	CO3	BTL 6	Creating
21.	Give the probability density function for a Gaussian random variable.	CO3	BTL 2	Understanding
22.	What are the properties of covariance?	CO3	BTL 2	Understanding
23.	What is the difference between correlation and regression?	CO3	BTL 2	Understanding
24.	Write the mean of the output signal obtained from the linear time invariant filter.	CO3	BTL 2	Understanding

PART – B

1.	(i)	Classify the random variables and mention the mathematical representation of a random process.	CO3	(8)	BTL 4	Analyzing
	(ii)	Describe the concept of a probability distribution function (PDF) and cumulative distribution function (CDF) with suitable examples.	CO3	(8)		
2.		Probability Density Function is the more convenient representation of continuous random variable – Justify the statement with the explanation of the properties.	CO3	(16)	BTL 4	Analyzing
3.	(i)	List the different types of random process and give descriptions for each type.	CO3	(8)	BTL 3	Applying
	(ii)	Define the term mean, mean square value, variance and standard deviation.	CO3	(8)		
4.		Let X have the uniform distribution given by $$f_x(x) = \begin{cases} \frac{1}{2\pi}, & 0 \le \theta \le 2\pi \\ 0, & elsewhere \end{cases}$$	CO3	(16)	BTL 3	Applying

		Solve for mean, mean square value and variance.				
5.		What is autocorrelation function of a two random variables $X(t_1)$ and $X(t_2)$? Explain the properties in detail.	CO3	(16)	BTL 3	Applying
6.	(i)	Illustrate the terms mean, correlation, covariance and ergodicity.	CO3	(8)	BTL 3	Applying
	(ii)	Interpret the process of autocorrelation and explain the properties of autocorrelation function.	CO3	(8)		
7.	(i)	Express the random process with mathematical equations.	CO3	(8)	BTL 4	Analyzing
	(ii)	Compare the wide sense stationary process and the strict sense stationary process.	CO3	(8)		
8.	(i)	When is a random process said to be Strict Sense Stationary (SSS), Wide Sense Stationary (WSS) and Ergodic process.	CO3	(8)	BTL 4	Analyzing
	(ii)	Let $X(t) = A \cos(\omega t + \phi)$ and $Y(t) = A \sin(\omega t + \phi)$, where A and ω are constants and ϕ is a uniform random variables [0, 2π]. Solve the cross correlation of x(t) and y(t).	CO3	(8)		
9.	(i)	For ergodic process show that mean of the time average is equal to ensemble mean.	CO3	(8)	BTL 4	Analyzing
	(ii)	Given a random process $X(t) = A \cos(\omega t + \theta)$ where A and ω are constants and θ is a uniform random variable. Interpret that X(t) is ergodic in both mean and auto correlation.	CO3	(8)		
10.	(i)	Outline the advantages of Gaussian Modelling of a random process.	CO3	(8)	BTL 3	Applying
	(ii)	Describe about stationary processes and its classifications.	CO3	(8)		
11.		Summarize and prove the properties of power spectral density.	CO3	(16)	BTL 4	Analyzing
12.		The random variable y is the function of another random variable 'X' such that y=cos(X) and 'X' is uniformly distributed in the interval (-π, π) such as $f_X(x) = \frac{1}{2\pi}, -\pi < x < \pi$ Calculate the mean value and variance of y.	CO3	(16)	BTL 4	Analyzing
13.		State and prove the properties of Gaussian process.	CO3	(16)	BTL 4	Analyzing
14.	(i)	Derive the input and output relation of the signal transmitted through the Linear Time Invariant (LTI) filter.	CO3	(8)	BTL 4	Analyzing
	(ii)	Consider two linear filters connected in cascade. Let X(t) be a stationary process with an auto correlation function $R_{xx}(\tau)$, the random process appearing at the input of the first filter is V(t) and the second filter output is Y(t).	CO3	(4)		

	(a) Find the auto correlation function of Y(t) (b) Compute the cross correlation function $R_{xy}(\tau)$ of V(t) and Y(t)		(4)		
15.	Probability Density Function of a continuous random variable said to be $F_x(x) = e^{-x}$ for $x \geq 0$. Estimate mean, variance and SD of random variable.	CO3	(16)	BTL 4	Analyzing
16.	A sinusoid generator output voltage is $A\cos\omega t$. This output is sampled randomly. The sampled output is a random variable X, which can take on any value in the range (-A,A). Determine mean and variance of the sampled output X.	CO3	(16)	BTL 3	Applying
17.	The amplitude modulated signal $X_{AM}(t) = A\, m(t)\cos(\omega t + \theta)$ where m(t) is the baseband signal and $A\cos(\omega t + \theta)$ is the carrier signal. The signal m(t) is modeled as a zero mean stationary random process with the autocorrelation function $R_{XX}(\tau)$ and the PSD $G_x(f)$. The carrier amplitude A and the frequency ω are assumed to be constant and the initial carrier phase θ is assumed to be a random uniformly distributed in the interval $(-\pi,\pi)$. Assume m(t) and θ are assumed to be independent. (a) Evaluate that $X_{AM}(t)$ is Wide Sense Stationary (b) Find PSD of $X_{AM}(t)$	CO3	 (10) (6)	BTL 4	Analyzing

UNIT IV NOISE CHARACTERIZATION

Noise sources – Noise figure, Noise temperature and Noise bandwidth – Noise in cascaded systems. Representation of Narrow band noise – In-phase and quadrature, Envelope and Phase – Noise performance analysis in FM systems – Threshold effect, Capture effect, Pre-emphasis and de-emphasis for FM.

PART A

Q. No	Questions	CO	BT Level	Competence
1.	What is white noise? Give its characteristics.	CO4	BTL 1	Remembering
2.	Define noise figure and noise equivalent temperature.	CO4	BTL 2	Understanding
3.	A Receiver is connected to an antenna with resistance 50Ω and an equivalent noise resistance of 30Ω. Calculate the receiver noise figure.	CO4	BTL 1	Remembering
4.	Identify the expression for the thermal noise voltage across a resistor. Also define thermal noise.	CO4	BTL 1	Remembering
5.	Compute the narrow-band noise m(t) at the IF filter output in terms of its in-phase and quadrature components.	CO4	BTL 2	Understanding
6.	Determine thermal noise voltage across the simple parallel RC circuit shown with R =1kΩ and C=1μF at T = 27°C.	CO4	BTL 2	Understanding
7.	Evaluate the equivalent noise temperature if the overall noise figure of the receiver is 24 dB	CO4	BTL 2	Understanding

8.	Calculate the noise voltages for the two resistors 20KΩ & 50KΩ in series at 300^0K for a bandwidth of 100KHz.	CO4	BTL 2	Understanding
9.	Express the formula to find the overall noise figure of the cascaded networks.	CO4	BTL 2	Understanding
10.	State threshold effect in AM receiver.	CO4	BTL 1	Remembering
11.	Analyze the impact of FM threshold effect.	CO4	BTL 2	Understanding
12.	Write the characteristics of narrow band noise.	CO4	BTL 1	Remembering
13.	Point out the characteristic of shot noise.	CO4	BTL 2	Understanding
14.	What do you understand by 'capture effect' in FM?	CO4	BTL 1	Remembering
15.	Mention the methods used to improve FM threshold reduction?	CO4	BTL 1	Remembering
16.	Outline the significance of noise equivalent bandwidth.	CO4	BTL 3	Applying
17.	Analyze the performance of synchronous detector with envelope detector.	CO4	BTL 3	Applying
18.	Compare the noise performance of FM receiver with AM.	CO4	BTL 4	Analyzing
19	Summarize an expression for noise equivalent bandwidth.	CO4	BTL 5	Evaluating
20	Formulate the mean of the output signal obtained from the linear time invariant filter.	CO4	BTL 6	Creating
21	Give the probability density function for a Gaussian random variable.	CO4	BTL 2	Understanding
22	What are the properties of covariance?	CO4	BTL 2	Understanding
23	What is the difference between correlation and regression?	CO4	BTL 2	Understanding
24	Write the mean of the output signal obtained from the linear time invariant filter.	CO4	BTL 2	Understanding

PART – B

1	(i)	Describe in detail various sources of noise.	CO4	(8)	BTL 4	Analyzing
	(ii)	Explain the role of noise figure in noise analysis at the receiver.	CO4	(8)		
2		Write a short note on (a) Shot noise with its power spectral density (b) Thermal noise with power spectral density	CO3	(16)	BTL 4	Analyzing
3		Explain the use of noise temperature in the noise characterization of the receiver. Derive the relationship between noise figure and noise temperature.	CO4	(16)	BTL 4	Analyzing
4		Analyze the features of coherent detector. Derive an expression for SNR at input (SNR_c) and output of (SNR_o) of a coherent detector.	CO4	(16)	BTL 4	Analyzing

5	Express and derive the output SNR for FM reception. Also obtain the figure of merit.	CO4	(16)	BTL 4	Analyzing
6	Two resistors 20k ohm and 50k ohm are at room temperature. Evaluate; the thermal noise voltage for a bandwidth of 100kHz for (a) Each resistor. (b) Two resistors in series. (c) Two resistors in parallel.	CO4 CO4	(16)	BTL 3	Applying
7	Comment and explain on the role of pre-emphasis and de-emphasis circuit on SNR improvement.	CO4	(16)	BTL 3	Applying
8	Obtain the Friis formula for effective noise figure of cascaded stage and express it in terms of noise temperature.	CO4	(16)	BTL 3	Applying
9	The three amplifiers 1, 2 and 3 have the following characteristics: F_1 = 9dB, G_1 = 48dB, F_2 = 6dB, G_2 = 35dB, F_3 = 4dB, G_3 = 20dB. The amplifiers are connected in cascade. Apply to find noise figure and equivalent noise temperature.	CO4 CO4	(8) (8)	BTL 3	Applying
10	What is narrowband noise? Discuss the properties of the quadrature components of a narrowband noise.	CO4 CO4	(8) (8)	BTL 4	Analyzing
11	Consider two amplifiers are connected in cascade. First stage amplifier has gain and noise figure as 15 dB and 9dB. Second stage has noise figure of 20dB.Estimate the total noise figure.	CO4 CO4	(8) (8)	BTL 4	Analyzing
12	A receiver circuit has a noise figure of 12 dB and it is fed by a low noise amplifier that has a gain of 50dB and a noise temperature of 90^0K. Calculate the noise temperature of the receiver and the overall noise temperature of the receiving system.	CO4 CO4	(8) (8)	BTL 4	Analyzing
13	Write short notes on (a) FM threshold effect (b) FM capture effect	CO4 CO4	(8) (8)	BTL 3	Applying
14	Illustrate noise in FM receivers using Phasor diagram. Compare the noise performance of AM and FM systems.	CO4	(16)	BTL 4	Analyzing
15	(i) Classify the different noise sources and its effect in real scenario.	CO4	(16)	BTL 4	Analyzing
	(ii) Discuss the effects of noise in cascaded system.	CO4	(16)	BTL 4	Analyzing
16	Find the power spectral density of in-phase and quadrature phase noise of narrow band noise. Find the PDF of sine wave pulse noise.	CO4	(16)	BTL 4	Analyzing
17	Describe how pre emphasis and de-emphasis circuit can be used to overcome the threshold effects.	CO4	(16)	BTL 4	Analyzing

UNIT V SAMPLING & QUANTIZATION

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non- uniform quantization - Quantization noise - Companding –PAM, PPM, PWM– TDM, FDM.

PART A

Q. No.	Questions	CO	BT Level	Domain
1.	Mention the advantages and disadvantages of digital communication system.	CO5	BTL 1	Remembering
2.	Define Band pass sampling.	CO5	BTL 1	Remembering
3.	List out the different types of sampling.	CO5	BTL 1	Remembering
4.	Distinguish natural and flat top sampling.	CO5	BTL 2	Understanding
5.	Mention the use of pre-filtering before sampling a signal.	CO5	BTL 2	Understanding
6.	Outline the concept of aliasing.	CO5	BTL 1	Remembering
7.	Name the components and processes required for signal reconstruction.	CO5	BTL 1	Remembering
8.	Summarize the characteristics of non-uniform quantization in signal processing.	CO5	BTL 2	Understanding
9.	Illustrate the two fold effects of quantization process.	CO5	BTL 2	Understanding
10.	Compare uniform and non-uniform quantization based on their characteristics and applications.	CO5	BTL 2	Understanding
11.	State the Nyquist sampling Theorem.	CO5	BTL 1	Remembering
12.	What is the role of the Nyquist rate in signal reconstruction?	CO5	BTL 1	Remembering
13.	Determine the minimum number of representation levels and the minimum number of bits required for a PCM scheme to achieve an output SNR greater than 13 dB when transmitting a sinusoidal signal.	CO5	BTL 2	Understanding
14.	Calculate the message bandwidth for a PCM system with a uniform quantizer and a 6-bit encoder, operating at a bit rate of 50 Mbps	CO5	BTL 2	Understanding
15.	Outline the input-output characteristic of a compressor and expander.	CO5	BTL 2	Understanding
16.	What is the primary goal of companding in signal processing?	CO5	BTL 1	Remembering
17.	What is the purpose of μ-law compression in communication systems?	CO5	BTL 1	Remembering
18.	Compare Pulse Position Modulation (PPM) and Pulse Width Modulation (PWM) in terms of their characteristics and applications.	CO5	BTL 2	Understanding

19.	Define aperture effect.	CO5	BTL 2	Understanding
20.	What are the basic operations involved in PCM system?	CO5	BTL 2	Understanding
21.	What is Time Division Multiplexing (TDM)?	CO5	BTL 2	Understanding
22.	List the advantages and disadvantages of Frequency Division Multiplexing (FDM).	CO5	BTL 1	Remembering
23.	What is the advantage of Time Division Multiplexing (TDM) in communication systems?	CO5	BTL 1	Remembering
24.	How is information encoded in Pulse Position Modulation (PPM)	CO5	BTL 1	Remembering

PART – B

1.		Discuss the implications of Aliasing, Signal Reconstruction, and Aperture Effect Distortion during the sampling process, providing detailed explanations and diagrams.	CO5	(16)	BTL 3	Applying
2.		Compare and analyze the sampling procedures of Natural Sampling and Flat-top Sampling, highlighting their characteristics and applications.	CO5	(16)	BTL 4	Analyzing
3.	(i)	Find the sampling rate for the following signal m(t)=2[cos(500*pi*t).cos(1000*pi*t)]	CO5	(8)	BTL 3	Applying
	(ii)	Determine the Nyquist Rate for m(t)=5*cos(5000*pi*t).cos²(8000*pi*t)	CO5	(8)		
4.		Let the maximum spectral frequency component (f_m) in an analog information signal be 3.3khz .Can you identify the frequency spectra of sampled signal under the following relationships between the sampled frequency (f_s) and maximum analog signal frequency (f_m) (a) $f_s=2f_m$ (b) $f_s>2f_m$ & $f_s<2f_m$	CO5	(8) (8)	BTL 4	Analyzing
5.		Compare the concept of uniform and non-uniform quantisation in digital communication system.	CO5	(16)	BTL 4	Analyzing
6.		Elaborate in detail about logarithmic companding of speech signals and comment also on A-law and μ-- law.	CO5	(16)	BTL 4	Analyzing
7.		Explain the process of generating and detecting Pulse Amplitude Modulation (PAM) using natural sampling, and assess its advantages over other sampling methods.	CO5	(16)	BTL 3	Applying
8.		List the types of Quantizer. Describe the mid tread and midrise type characteristics of uniform quantizer with suitable diagram.	CO5	(16)	BTL 3	Applying
9.	(i)	Distinguish various Pulse Modulation Techniques	CO5	(10)	BTL 4	Analyzing
	(ii)	Analyze the concept of Non Uniform Quantization and mention the Laws for implementing the same	CO5	(6)		
10.	(i)	Compare TDM and FDM	CO5	(10)	BTL 4	Analyzing

	(ii) Point out the sampling rate for the signal , given m(t)=(1/2*pi)[cos(4000*pi*t)cos(1000*pi*t)]	CO5	(6)		
11.	Discuss the process of multiplexing and demultiplexing in a Time Division Multiplexing (TDM) system for multiple channels, and explain how it efficiently manages bandwidth in communication systems.	CO5	(16)	BTL 3	Applying
12.	Describe about Frequency Division Multiplexing system for *N*- number of channels with neat diagrams.	CO5	(16)	BTL 3	Applying
13.	Examine the process of quantization in PCM systems and explain how the quantization error affects the signal. Derive the expression for the Signal to Quantization Noise Ratio (SQNR) and discuss its dependence on the number of quantization levels	CO5	(16)	BTL 4	Analyzing
14.	Given an analog signal with a maximum frequency of 3 kHz and 16 quantization levels, analyze and calculate the minimum number of bits per sample, the minimum sampling rate, and the resulting transmission data rate for the PCM system.	CO5	(16)	BTL 4	Analyzing
15.	The T1 carrier system used in digital Telephony multiplexes 24 voice channels based on 8 but PCM. Each voice signal is out through a LPF with cut off frequency of 3.4KHz.The LPF output is sampled at 8 KHz. Then a single bit is added at the end of the frame for the purpose of synchronization. Calculate (a) Bit duration (b) Transmission Rate (c) Nyquist Bandwidth	CO5	(5) (5) (5)	BTL 4	Analyzing
16.	Given the bandwidth of a TV signal (4.5 MHz) and 1024 quantization levels, calculate the number of bits per second generated by a PCM system when the signal is sampled at 20% above the Nyquist rate	CO5	(16)	BTL 3	Applying
17.	Illustrate the concept of PCM and provide a diagram showing the steps involved in its operation. Then, analyze the various pulse modulation schemes like PAM, PPM, and PWM, discussing their advantages and applications.	CO5	(16)	BTL 3	Applying