VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

SUBJECT : EC8491 – COMMUNICATION THEORY

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, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope –comparison of different AM techniques, Superheterodyne Receiver.		
	PART – A		
Q. No.	**Questions**	**BT Level**	**Competence**
1.	What is pre envelope and complex envelope?	BTL 1	Remembering
2.	Give the advantages of VSB-AM.	BTL 1	Remembering
3.	State heterodyning principle.	BTL 1	Remembering
4.	Mention the advantages of modulating low frequency signal into high frequency signal.	BTL 1	Remembering
5.	List the types of AM modulators.	BTL 1	Remembering
6.	Define Coherent Detection.	BTL 1	Remembering
7.	Why do you need modulation in communication systems?	BTL 3	Applying
8.	Identify the differences between single sideband and vestigial sideband systems.	BTL 2	Understanding
9.	Write about diagonal clipping and negative peak clipping.	BTL 2	Understanding
10.	Suggest a modulation scheme for broadcast video transmission.	BTL 6	Creating
11.	Apply the concepts of sensitivity and selectivity in AM receiver.	BTL 3	Applying
12.	Draw the AM modulated wave for over, under & 100% modulation.	BTL 2	Understanding
13.	If incoming frequency is f_1 and translated carrier frequency is f_2, apply and find the local oscillator frequency.	BTL 3	Applying
14.	Compare AM with DSB-SC and SSB-SC.	BTL 4	Analyzing
15.	Distinguish between high level and low level modulation.	BTL 4	Analyzing
16.	Differentiate between linear and non-linear modulation.	BTL 4	Analyzing
17.	A carrier of 20MHz is amplitude modulated with a signal frequency of 3 KHz and amplitude 5Volts. If modulation index is 0.5, determine the spectra of the waveform.	BTL 5	Evaluating
18.	If a 10KW amplitude modulated transmitter is modulated sinusoidally by 50%, evaluate the total RF power delivered.	BTL 5	Evaluating

19.	Summarize the methods for generating SSB-SC signal.		BTL 2	Understanding
20.	Formulate the theory of modulation index of an AM signal and write its classification.		BTL 6	Creating
	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.	**(13)**	**BTL 1**	**Remembering**
2.	(i) Find the phasor representation, current relation and efficiency of AM. (ii) In a superheterodyne receiver the input AM signal has a centre frequency of 1425 KHz and bandwidth 5 KHz. The input is down converted to 455 KHz. Identify the image frequency	**(7)** **(6)**	**BTL 1**	**Remembering**
3.	(i) Write the working of low level and high level AM Transmitters with the help of a neat block diagram. (ii) Obtain the types of AM modulators based on their placement in a transmitter circuit.	**(7)** **(6)**	**BTL 1**	**Remembering**
4.	(i) Outline the function of switching modulator in the generation of AM signal. (ii) Write the range of tuning of a local oscillator of a super heterodyne receiver when $f_{LO}>f_{C}$. The broadcast frequency range is 540 Hz to 1600 Hz. Assume f_{IF} =455 KHz	**(7)** **(6)**	**BTL 1**	**Remembering**
5.	(i) Demonstrate the concepts of envelope detection for demodulation of AM and explain its operation. (ii)Illustrate non coherent tuned radio frequency receiver.	**(7)** **(6)**	**BTL 2**	**Understanding**
6.	Give main idea about super heterodyne receiver with neat block diagram and explain the various parameters.	**(13)**	**BTL 2**	**Understanding**
7.	Identify the need for carrier suppression in AM system? Draw and explain the functioning of such system.	**(13)**	**BTL 3**	**Applying**
8.	Construct the balanced modulator circuit for the generation of DSB-SC-AM and explain its operation.	**(13)**	**BTL 3**	**Applying**
9.	How do you examine ring modulator for the generation of DSB-SC signal?	**(13)**	**BTL 4**	**Analyzing**
10.	Classify the methods and describe demodulation of DSBSC by Costas loop and Coherent detection.	**(13)**	**BTL 4**	**Analyzing**
11.	Analyse the significance of SSB-SC and elaborate in detail about filter method of suppression of unwanted sidebands.	**(13)**	**BTL 4**	**Analyzing**
12.	i) Assess the generation of SSBSC signal using phase shift method. ii) How would you generate SSB using Weavers method? Illustrate with a neat block diagram.	**(7)** **(6)**	**BTL 5**	**Evaluating**
13.	i) Conclude the generation and demodulation of VSB with the help of block diagrams. ii) How an amplitude modulated signal can be generated using nonlinear modulator circuit.	**(7)** **(6)**	**BTL 6**	**Creating**

14.	i) Illustrate the generation and demodulation of VSB with the help of a block diagram. ii) How would you describe Hilbert transform? And explain its properties and advantages.	(7) (6)	BTL 2	Understanding
	PART C			
1.	i) If a 10 KW amplitude modulated transmitter is modulated sinusoidally by 50%, predict the total RF power delivered? ii) Discuss on pre-envelope and complex envelope.	(8) (7)	BTL 5	Evaluating
2.	i) Devise the generation of SSB using balanced modulator. ii) For an AM DSBFC wave with a peak unmodulated carrier voltage of 10v, load resistance of 10 ohms and m=1. Summarize the carrier, total power of modulated wave, total sideband power, upper and lower sideband and draw the power spectrum.	(8) (7)	BTL 5	Evaluating
3.	An SSB signal is generated by modulating an 800 KHz carrier by the signal m(t) = cos(2000*pi*t)+2*sin(1200*pi*t).The amplitude of the carrier is A_C =10. Interpret the magnitude spectrum of the lower side band SSB signal	(15)	BTL 6	Creating
4.	A certain AM transmitter radiates 10 KW with a modulated carrier power as 11.8 KW when the carrier is sinusoidally modulated. Predict the modulation index if another sine wave corresponding to 30% modulation is transmitted simultaneously. Determine the total radiated power.	(15)	BTL 6	Creating

	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 – FM to AM conversion, FM Discriminator - PLL as FM Demodulator.		
	PART A		
Q. No	**Questions**	**BT Level**	**Competence**
1.	Define modulation index of frequency modulation and phase modulation.	BTL 1	Remembering
2.	Why frequency modulation is more preferred for voice transmission?	BTL 1	Remembering
3.	List the advantages of AM and FM.	BTL 1	Remembering
4.	What are the types of modulation?	BTL 1	Remembering
5.	State the Carson's rule to determine the bandwidth of FM.	BTL 1	Remembering
6.	Draw the block diagram of a method for generating a narrow band FM.	BTL 2	Understanding
7.	Give the mathematical expression for FM and PM.	BTL 2	Understanding
8.	Compare WBFM and NBFM.	BTL 4	Analyzing
9.	Analyze the bandwidth required for a FM wave in which the modulating frequency signal is 2KHz and the maximum frequency deviation is 12KHz.	BTL 4	Analyzing
10.	Differentiate between phase and frequency modulation.	BTL 4	Analyzing
11.	Assess the condition for wideband FM.	BTL 5	Evaluating

12.	Why FM is said to be nonlinear modulation method? List the nonlinear effects in FM System.		**BTL 5**	**Evaluating**
13.	Discuss the difference between the direct method and indirect method of FM.		**BTL 6**	**Creating**
14.	Point out the advantages and disadvantages of foster-seely discrimination method?		**BTL 6**	**Creating**
15.	Describe the limitations of slope detector		**BTL 2**	**Understanding**
16.	Outline the concepts of lock in range and dynamic range of PLL.		**BTL 2**	**Understanding**
17.	Prove that Armstrong method is superior to reactance modulator		**BTL 3**	**Applying**
18.	Summarize the merits and demerits of balanced slope detector.		**BTL 3**	**Applying**
19.	Apply the concepts for detecting FM signals.		**BTL 3**	**Applying**
20.	Outline the applications of phase locked loop.		**BTL 1**	**Remembering**
	PART – B			
1.	Obtain the expression for the single tone frequency modulated signal and hence prove that is the constant envelope modulation requiring infinite bandwidth.	**(13)**	**BTL 1**	**Remembering**
2.	(i)Show the mathematical expression for Wideband Frequency Modulation. Also compare and contrast its characteristics with Narrowband Frequency modulation. (ii)How do you obtain FM from PM and vice versa? Explain.	**(7)** **(6)**	**BTL 1**	**Remembering**
3.	What are the methods of FM generation and explain an indirect method to generate an FM signal.	**(13)**	**BTL 1**	**Remembering**
4.	With a neat diagram, describe the concepts of FM transmitters with direct method of generation.	**(13)**	**BTL 1**	**Remembering**
5.	Describe how FM generation is achieved using Varactor and reactance modulators.	**(13)**	**BTL 2**	**Understanding**
6.	Explain the principle of indirect method of generating a wideband FM signal.	**(13)**	**BTL 2**	**Understanding**
7.	(i) Illustrate the mathematical representation of FM and PM waves. (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	**(7)** **(6)**	**BTL 3**	**Applying**
8.	With the phasor representations, demonstrate and explain the working of Foster Seeley discriminator.	**(13)**	**BTL 3**	**Applying**
9.	(i) Demonstrate the comparison of AM and FM. (ii)Examine the carrier, modulating frequency modulation index and maximum deviation of the FM wave represented by the equation $V_{FM}(t)=6\sin(3*10^8t+9\sin1000t)$ what will the FM wave dissipate in a 10 ohm resistance?	**(7)** **(6)**	**BTL 4**	**Analyzing**
10.	(i)Analyse the significance of transmission bandwidth of FM. (ii) Classify FM detection methods and Explain any one methods with neat sketches.	**(7)** **(6)**	**BTL 4**	**Analyzing**

11.	(i)When the modulating frequency in an FM system is 400Hz and the modulating voltage is 2.4V and the modulation index is 60. Analyse on the maximum deviation. Apply the concepts of modulation index and calculate the modulating index when the modulating frequency is reduced to 250Hz and the modulating voltage is simultaneously raised to 3.2V. (ii) Explain pre-emphasis and de-emphasis circuits and explain its characteristics.	**(7)** **(6)**	**BTL 4**	**Analyzing**
12.	Explain in detail any two methods of FM Discriminator.	**(13)**	**BTL 5**	**Evaluating**
13.	(i) Construct the ratio detector to suppress the amplitude variation caused by the communication media without using amplitude limited circuit. (ii) Design the circuit diagram of stagger tuned discriminator and explain its working.	**(7)** **(6)**	**BTL 6**	**Creating**
14.	(i) Interpret the operation of round Travis detector. (ii) Summarize the operation of PLL as a FM demodulator.	**(7)** **(6)**	**BTL 2**	**Understanding**
	PART-C			
1.	A 20 MHZ is frequency modulated by a sinusoidal signal such that the maximum frequency deviation is 100 KHZ. Determine the modulation index and appropriate bandwidth of the FM signal for the following modulating signal frequencies: 1 KHZ, 100 KHZ, 500 KHZ.	**(15)**	**BTL 5**	**Evaluating**
2.	(i) An angle modulated wave is described by the equation $V(t)=10\cos(2*10^6*pi*t+10\cos2000*pi*t)$. Determine power of the modulation signal, maximum frequency deviation, bandwidth. (ii)How will you classify FM based on modulation index value and explain?	**(8)** **(7)**	**BTL 5**	**Evaluating**
3.	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.	**(15)**	**BTL 6**	**Creating**
4.	(i) Construct a double tuned discriminator with detailed diagram and explain. (ii) Develop double frequency conversion FM super heterodyne receiver and explain.	**(8)** **(7)**	**BTL 6**	**Creating**

	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**	**BT Level**	**Domain**
1.	State central limit theorem.	**BTL 1**	**Remembering**
2.	Define random variable. Specify the sample space and the random variable for a coin tossing experiment.	**BTL 1**	**Remembering**
3.	List the properties of the cumulative distributive function.	**BTL 1**	**Remembering**
4.	Describe mean, autocorrelation and covariance of a random process.	**BTL 1**	**Remembering**
5.	What are the properties of an autocorrelation function?	**BTL 1**	**Remembering**

6.	Outline Ergodic processes and Gaussian processes.		BTL 1	Remembering
7.	Express the autocorrelation function and power spectral density of white noise.		BTL 2	Understanding
8.	Point out the Rayleigh and Rician probability density functions.		BTL 2	Understanding
9.	Distinguish between random variable and random process.		BTL 2	Understanding
10.	Give the conditions to be satisfied for wide sense stationary.		BTL 2	Understanding
11.	Illustrate Einstein-Wiener –Khintchine relation.		BTL 3	Applying
12.	Show the input output relation for a power spectral density and cross spectral density.		BTL 3	Applying
13.	Demonstrate when random process is called as deterministic?		BTL 3	Applying
14.	Classify random process? Give one example for each.		BTL 4	Analyzing
15.	Examine the properties of Gaussian process.		BTL 4	Analyzing
16.	Infer the crosscorrelation of random processes of X(t) and Y(t)?		BTL 4	Analyzing
17.	Summarise an expression for noise equivalent bandwidth.		BTL 5	Evaluating
18.	Evaluate when a random process is called as stationary, deterministic and ergodic.		BTL 5	Evaluating
19.	Elaborate when do we say random processes X(t) as white process?		BTL 6	Creating
20.	Formulate the power spectral density of X(t).		BTL 6	Creating
	PART B			
1.	Explain the following terms: Random variable, Gaussian process and Central limit theorem	**(13)**	BTL 4	Analyzing
2.	(i) For ergodic process show that mean of the time average is equal to ensemble mean. (ii) Differentiate the strict-sense stationary with that of wide sense stationary process.	**(7)** **(6)**	BTL 2	Understanding
3.	(i) Analyze the following terms mean, correlation, covariance and ergodicity. (ii) Explain the properties of the auto correlation function.	**(7)** **(6)**	BTL 4	Analyzing
4.	(i) Demonstrate the advantages of Gaussian Modelling of a random process. (ii)Describe about stationary processes and its classifications.	**(7)** **(6)**	BTL 3	Applying
5.	Generalize the equation for finding the probability density function of a one to one differential function of a given random variable.	**(13)**	BTL 6	Creating
6.	(i) Write about Transmission of random process through a Linear Time Invariant (LTI) filter. (ii) Find the autocorrelation of a sequence x(t) =A cos(2πfc(t+θ)) where A and fc are constant and θ is a random variable that is uniformly distributed over the interval [-π π].	**(7)** **(6)**	BTL 1	Remembering
7.	(i) Define autocorrelation. Discuss the properties of autocorrelation function. (ii) Differentiate between random variable and random process.	**(7)** **(6)**	BTL 1	Remembering
8.	Discuss and prove the properties of power spectral density.	**(13)**	BTL 2	Understanding
9.	(i) When is a random process said to be Strict Sense Stationary (SSS), Wide Sense Stationary (WSS) and Ergodic process. (ii) Let X(t) = A cos (ωt+Φ) and Y(t) = A sin (ωt+Φ), 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).	**(7)** **(6)**	BTL 3	Applying
10.	(i) Give the mean and variance of a stationary process whose auto correlation function is given by $R_{XX}(\tau) = 18 + \frac{2}{16+\tau^2}$	**(7)**	BTL 5	Evaluating

	(ii) Evaluate the autocorrelation function of periodic time function x(t)=A sin ωt	**(6)**		
11.	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 $$f_X(x) = \frac{1}{2\pi}, 0 \le x \le 2\pi$$ Calculate the mean , mean square value and standard deviation.	**(13)**	**BTL 4**	**Analysing**
12.	State and prove the properties of Gaussian process.	**(13)**	**BTL 1**	**Remembering**
13.	(i)Identify the different types of random process and give the definitions. (ii) Define the term mean, mean square value, variance and standard deviation.	**(7)** **(6)**	**BTL 2**	**Understanding**
14.	Describe in detail about mean, moments and variance.	**(13)**	**BTL 1**	**Remembering**
	PART C			
1.	A random variable 'X' has pdf as $$f_X(x) = \begin{cases} \frac{\pi}{16}\cos\left(\frac{\pi x}{8}\right) for -4 \le x \le 4 \\ 0 \quad for \quad otherwise \end{cases}$$ Find mean, mean square, variance and standard deviation.	**(15)**	**BTL 5**	**Evaluating**
2.	(i)Let X(t) and Y(t) be both zero-mean and WSS random processes. Consider the random process z(t) = X(t) + Y(t). Determine the auto correlation and power spectrum of z(t) if X(t) and Y(t) are jointly WSS. (ii)PDF of a random variable 'X' is given by $f_X(x) = e^{-x}$ for $x \ge 0$. Then find E[X], E[X^2], E[$(X-1)^2$]& Variance.	**(8)** **(7)**	**BTL 6**	**Creating**
3.	PDF of a random variable 'X' is given by $f_X(x) = e^{-x}$ for $x \ge 0$. Then find E[X], E[X^2], E[$(X-1)^2$], Variance, standard deviation	**(15)**	**BTL 6**	**Creating**
4.	The pdf of a random variable is given as $$f_X(x) = \begin{cases} K \quad for\ a \le x \le b \\ 0 \quad for \quad otherwise \end{cases}$$ Where K is constant. (i) Sketch the pdf and determine value of K. (ii) if a=-1 and b=2, calculate P(|X|$\le c$) for c=0.5	**(7)** **(8)**	**BTL 5**	**Evaluating**

	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 AM & FM systems – Threshold effect, Pre-emphasis and deemphasis for FM.		
	PART A		
Q.No	**Questions**	**BT Level**	**Domain**
1.	Describe white noise? Give its characteristics.	**BTL 2**	**Understanding**
2.	Define noise figure and noise equivalent temperature.	**BTL 1**	**Remembering**
3.	A Receiver is connected to an antenna of resistance of 50Ω has an equivalent noise resistance of 30Ω. Formulate the receiver noise figure.	**BTL 6**	**Creating**
4.	Give the expression for the thermal noise voltage across a resistor. Also define thermal noise.	**BTL 1**	**Remembering**

5.	Formulate the narrow-band noise m(t) at the IF filter output in terms of its in-phase and quadrature components.	**BTL 6**	**Creating**
6.	Discuss the need for pre-emphasis and de-emphasis.	**BTL 2**	**Understanding**
7.	State threshold effect in AM receiver.	**BTL 1**	**Remembering**
8.	What is FM threshold effect?	**BTL 1**	**Remembering**
9.	Distinguish the noise performance of DSBSC receiver using coherent detection with AM receiver using envelope detection.	**BTL 2**	**Understanding**
10.	Illustrate the characteristics of white noise.	**BTL 3**	**Applying**
11.	Classify the methods are to improve FM threshold reduction?	**BTL 4**	**Analyzing**
12.	Obtain the equation for transfer function of de-emphasis circuit.	**BTL 3**	**Applying**
13.	Name what is capture effect? What do you understand by 'capture effect' in FM?	**BTL 1**	**Remembering**
14.	Discuss threshold effect with respect to noise?	**BTL 2**	**Understanding**
15.	Explain noise equivalent bandwidth.	**BTL 1**	**Remembering**
16.	Calculate the noise voltages for the two resistors 20KΩ & 50KΩ in series at 300^0K for a bandwidth of 100KHz.	**BTL 3**	**Applying**
17.	Point out the characteristic of shot noise.	**BTL 4**	**Analyzing**
18.	Evaluate the thermal noise voltage generated at 290^0 K for a bandwidth of 100KHz.	**BTL 5**	**Evaluating**
19.	DC current of 2 mA flows through the semiconductor junction. Consider the effective noise bandwidth of 1 kHz and Infer the shot noise component.	**BTL 4**	**Analyzing**
20.	Determine thermal noise voltage across the simple parallel RC circuit shown with R =1kΩ and C=1µF at T = 27°C.	**BTL 5**	**Evaluating**
	PART – B		
1.	Write a short note on (i) Shot noise with its power spectral density **(7)** (ii) Thermal noise with PSD **(6)**	**BTL 1**	**Remembering**
2.	Describe in detail various sources of noise. **(13)**	**BTL 2**	**Understanding**
3.	What is coherent detector? Derive an expression for SNR at input (SNR_c) and output of (SNR_o) of a coherent detector. **(13)**	**BTL 1**	**Remembering**
4.	Express and derive the output SNR for FM reception. Also obtain the figure of merit. **(13)**	**BTL 4**	**Analyzing**
5.	(i) Point out the significance of pre-emphasis and de-emphasis in communication system. **(7)** (ii) Write in detail about FM threshold effect. **(6)**	**BTL 1**	**Remembering**
6.	Formulate the figure of merit for AM system using envelope detector. **(13)**	**BTL 6**	**Creating**
7.	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 tando. Apply to find noise figure and equivalent noise temperature. **(13)**	**BTL 3**	**Applying**
8.	(i) Discuss in detail about the narrowband noise and analyse the properties of in-phase and quadrature components of narrow band noise. **(7)** (ii) Explain narrowband noise analyser and noise synthesizer. **(6)**	**BTL 3**	**Applying**
9.	Consider two amplifiers are connected in cascade. First stage amplifier has gain and noise figure as 15 dB and 9 dB. Second stage has noise figure of 20 dB. Estimate the total noise figure. **(13)**	**BTL 2**	**Understanding**

10.	Evaluate the effective noise temperature of a cascade amplifier from Friss formula.	(13)	BTL 5	Evaluating
11.	Two resistors 20kohm and 50kohm are at room temperature. Derive for a bandwidth of 100kHZ; the thermal noise voltage for (i) Each resistor. (ii) Two resistors in series. (iii) Two resistors in parallel.	(5) (4) (4)	BTL 4	Analyzing
12.	Evaluate the figure of merit of FM, compare with AM and conclude on which has better figure of merit.	(13)	BTL 4	Analyzing
13.	Summarize with block diagram of a communication system, the noise performance with the figure of merit and SNR.	(13)	BTL 2	Understanding
14.	(i) Explain the terms noise figure, noise factor and noise temperature. (ii) How sine wave pulse noise is represented. Obtain the joint PDF of such noise component.	(7) (6)	BTL 1	Remembering
	PART C			
1.	Deduce the expression for figure of merit of DSB-SC receiver using coherent detection.	(15)	BTL 5	Evaluating
2.	Propose the Power Spectral Density of in-phase and quadrature phase noise of narrow band noise. Find the PDF of sine wave pulse noise.	(15)	BTL 6	Creating
3.	A mixer circuit has noise figure of 12dB. It is preceded by an amplifier that has an equivalent noise temperature of 200K and power gain of 30dB. Calculate the equivalent noise temperature referred to the input of the amplifier.	(15)	BTL 5	Evaluating
4.	Consider two amplifiers connected in cascade, one amplifier having power gain G_1 & noise factor F_1 and other amplifier with G_2 and F_2 respectively. Obtain Friss formula and calculate the total noise figure if G_1 = 10dB, F_1 = 2dB and F_2 = 3dB.	(15)	BTL 6	Creating

	UNIT V SAMPLING & QUANTIZATION		
	Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM.		
	PART A		
Q. No	**Questions**	**BT Level**	**Domain**
1.	List the advantages and disadvantage of digital communication system.	BTL 1	Remembering
2.	Define Band pass sampling.	BTL 1	Remembering
3.	Mention the definition of FDM.	BTL 1	Remembering
4.	Distinguish natural and flat top sampling.	BTL 2	Understanding
5.	Interpret the use of pre-filtering done before sampling.	BTL 3	Applying
6.	What is meant by aliasing?	BTL 1	Remembering

7.	How would you show your understanding of the components required for signal reconstruction?	BTL 3	Applying
8.	Write about non uniform quantization.	BTL 1	Remembering
9.	Illustrate the two fold effects of quantization process.	BTL 2	Understanding
10.	Illustrate the difference between uniform and non-uniform quantization.	BTL 3	Applying
11.	Construct the Nyquist sampling Theorem with equation.	BTL6	Creating
12.	A Sinusoidal signal is transmitted using PCM scheme. The target output SNR should be greater than 13 dB. Can you identify the minimum number of representation levels and minimum number of bits required to represent each sample to achieve the above performance.	BTL 4	Analyzing
13.	A pulse code modulation system uses a uniform quantizer followed by a 6 bit encoder. The bit rate of the system is 50 Mbps. Determine the message bandwidth of the system.	BTL 5	Evaluating
14.	Outline the input-output characteristic of a compressor and expander.	BTL 1	Remembering
15.	Point out the µ-law of compression.	BTL 4	Analyzing
16.	State in your own words the definition for PPM and PWM.	BTL 2	Understanding
17.	Express the Quantization noise of a PCM system.	BTL 2	Understanding
18.	Formulate the concept of PAM and PCM.	BTL 6	Creating
19.	Examine the concept of TDM.	BTL 4	Analyzing
20.	Summarize the advantages and disadvantages of FDM.	BTL 5	Evaluating
	PART – B		
1.	(i) Explain the following terms with respect to sampling Aliasing, Signal Reconstruction and Aperture effect distortion **(7)** (ii) Outline Time Division Multiplexing system for N- number of channels. **(6)**	BTL 1	Remembering
2.	Illustrate the following sampling procedures with proper details for Natural Sampling and Flat top Sampling. **(13)**	BTL 2	Understanding
3.	(i)Find the sampling rate for the following signal m(t)=2[cos(500*pi*t).cos(1000*pi*t)]. **(7)** (ii)Determine the the Nyquist Rate for m(t)=5*cos(5000*pi*t).cos²(8000*pi*t) . **(6)**	BTL 3	Applying
4.	Deduce the concept of Low pass sampling, Aliasing and Signal Reconstruction. **(13)**	BTL 4	Analyzing
5.	Compare the concept of Uniform and Non Uniform Quantisation with necessary illustrations. **(13)**	BTL 4	Analyzing
6.	Propose the ideas about Uniform Quantization and its types **(13)**	BTL 5	Evaluating
7.	A signal m(t) band limited to 4 KHz is sampled at the rate of 50% higher than Nyquist rate, the maximum acceptable error in the **(13)**	BTL 2	Understanding

	sample amplitude is 1% of peak amplitude. The quantized samples are binary coded. Find minimum bandwidth of a channel required to transmit the encoded binary signal.			
8.	Illustrate and describe the types of Quantizer. Describe the mid tread and midrise type characteristics of uniform quantizer with suitable diagram.	**(13)**	**BTL 3**	**Applying**
9.	Distinguish various Pulse Modulation Techniques with necessary diagrams.	**(13)**	**BTL 4**	**Analyzing**
10.	Determine the purpose of Non Uniform Quantization and mention the Laws for implementing the same.	**(13)**	**BTL 6**	**Creating**
11.	(i) Describe PCM system with neat block diagram? (ii) What is TDM and mention its applications. Explain the difference between analog TDM and digital TDM.	**(7)** **(6)**	**BTL 1**	**Remembering**
12.	Write about Frequency Division Multiplexing system for N-number of channels with neat diagrams.	**(13)**	**BTL 1**	**Remembering**
13.	Elaborate the concept of PCM with diagram and discuss the various pulse modulation schemes.	**(13)**	**BTL 1**	**Remembering**
14.	(i) Illustrate the principle of quantization and obtain the expression for the signal to quantization noise ratio in PCM system. (ii) The information in an analog signal with maximum frequency of 3 KHz is required to be transmitted using 16 quantization levels in PCM systems. Interpret the maximum number of bits per sample that should be used, the minimum sampling rate required and the resulting transmission data rate.	**(7)** **(6)**	**BTL 2**	**Understanding**
	PART – C			
1.	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) (i) $f_s=2f_m$ (ii) $f_s>2f_m$ & $f_s<2f_m$	**(15)**	**BTL 5**	**Evaluating**
2.	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 (i) Bit duration (ii) Transmission Rate (iii) Nyquist bandwidth	 **(5)** **(5)** **(5)**	**BTL 6**	**Creating**
3.	(i) Elaborate in detail about logarithmic companding of speech signals. (ii) Estimate the sampling rate for the signal , given m(t)=(1/2*pi)[cos(4000*pi*t)cos(1000*pi*t)]	**(8)** **(7)**	**BTL 5**	**Evaluating**

4.	The bandwidth of TV, Video + audio signal is 4.5 MHz If the signal is converted to PCM bit stream with 1024 quantization levels. Determine the number of bits per second generated by the PCM system. Assume that signal is sampled at the rate of 20% above Nyquist rate.	**(15)**	**BTL 6**	**Creating**