SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT

OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

V SEMESTER

1906004– Communication Engineering

Regulation – 2019

Academic Year :2022-2023 Odd Sem

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QUESTION BANK

SUBJECT : 1906004- COMMUNICATION ENGINEERING
YEAR /SEM : III / V

UNIT I
ANALOG MODULATION

Amplitude Modulation–AM, DSBSC, SSBSC, VSB–PSD, modulators and demodulators–Angle modulation–PM and FM–PSD, modulators and demodulators–Super heterodyne receivers.

PART – A

Q. No	Questions	BT Level	Competence
1.	Why do you need modulation in communication systems?	**BTL3**	Apply
2.	One input to a conventional AM modulator is a 500 kHz carrier with the amplitude of 20 V_p. The second input is 10 kHz modulating signal that is of sufficient amplitude to cause a change in the output wave of ± 7.5 V_p. Evaluate: (a) Upper and lower side frequency, (b) Modulation efficiency.	**BTL5**	Evaluate
3.	Define modulation index.	**BTL1**	Remember
4.	Consider an AM signal $x(t)=2\cos(2\pi fct) +0.5\cos(2\pi fct).\cos(2\pi fmt)$. Find the modulation index used to generate the signal.	**BTL5**	Evaluate
5.	The output voltage of a transmitter is given by $500(1+0.4 \sin 3140t)\sin 6.28\times10^7t$.Find the carrier frequency and modulating frequency.	**BTL3**	Apply
6.	What will be the power in each sideband in amplitude modulated signal if power of carrier wave is 176W and there is 60% modulation?	**BTL6**	Create
7.	Express the relationship between the modulating signal frequency and the bandwidth in a conventional AM system?	**BTL2**	Understand
8.	Summarize the methods for generating SSB-SC signal.	**BTL2**	Understand
9.	Define modulation coefficient and percent modulation.	**BTL1**	Remember
10.	In an amplitude modulation system, the carrier frequency is 100kz.The maximum frequency of the signal is 5 kHz. Calculate the lower & upper side bands and bandwidth of the AM signal.	**BTL3**	Apply
11.	The carrier amplitude of Am varies between 4V and 1V.Calculate the depth of modulation.	**BTL5**	Evaluate
12.	Compare AM with DSB-SC and SSB-SC.	**BTL4**	Analyze
13.	Write down the mathematical expression for angle modulated wave.	**BTL1**	Remember
14.	Draw the phasor diagram of narrow band FM.	**BTL1**	Remember
15.	Differentiate between narrow band and wide band FM signal.	**BTL4**	Analyze
16.	Infer about deviation sensitivity for FM.	**BTL4**	Analyze
17.	What is the relation between phase modulation and frequency modulation?	**BTL4**	Analyze
18.	Differentiate frequency and phase modulation.	**BTL1**	Remember
19.	What is the purpose of limiter in FM receiver?	**BTL1**	Remember
20.	Draw the Schematic of generating FM signal using Phase Modulator	**BTL2**	Understand

21.	What is Pre-emphasis and De-emphasis circuit? Where these circuits are used.		**BTL3**	Apply
22.	State Carson's rule.		**BTL2**	Understand
23.	The maximum frequency deviation in an FM is 10kHz and the signal frequency is 10kHz. Estimate the bandwidth using Carson's rule and the modulation index.		**BTL6**	Create
24.	Define heterodyning principle.		**BTL2**	Understand
	PART – B			
Q. No	**Questions**		**BT Level**	**Competence**
1.	With waveforms and circuit diagrams explain the amplitude modulation and demodulation. **(13)**		**BTL2**	Understand
2.	**(i)**	The output modulated wave of a standard AM transmitter is represented $S(t) = 500(1+0.4\sin 3140t)\sin(6.28\times10^{7})t$. This voltage is fed to a load of 600Ω. Analyse the following **(6)** **(a)** Modulating Frequency **(b)** Carrier Frequency **(c)** Mean power output	**BTL5**	Evaluate
	(ii)	Derive efficiency η of standard AM and show that for a single tone AM, η_{max} =33.3% at m=1. **(7)**		
3.	**(i)**	Derive an expression for the amplitude modulated wave and its power relation. **(8)**	**BTL3**	Apply
	(ii)	Explain any one AM demodulation method. **(5)**		
4.	Name the methods used for the suppression of unwanted side band in AM transmission. Describe about the working of any one of them. **(13)**		**BTL1**	Remember
5.	**(i)**	Discuss the generation of SSB using filtering and phasing method. **(8)**	**BTL4**	Analyze
	(ii)	Analyse about the SSB demodulation with necessary diagram and equations. **(5)**		
6.	**(i)**	Explain the operation of any one Amplitude Modulator. **(8)**	**BTL3**	Apply
	(ii)	With suitable sketch interpret about square law detector. **(5)**		
7.	An audio frequency signal $10\sin(2\pi\times 500)t$ is used to amplitude modulate a carrier of $50\sin(5\pi\times 10^{5})t$. Calculate and Analyse **(13)** **(i)** Modulation index **(ii)** Upper and lower side band frequencies **(iii)** Peak amplitude and power of side band **(iv)** Maximum and minimum amplitudes of envelope **(v)** Transmission efficiency		**BTL4**	Analyze
8.	Describe any one scheme for both amplitude modulation and amplitude demodulation. **(13)**		**BTL3**	Apply
9.	**(i)**	Derive the relation between the output power of an AM transmitter and the depth of modulation, and plot it as a graph for values of the modulation index from zero to maximum. **(8)**	**BTL5**	Evaluate
	(ii)	For a modulation coefficient m=0.2 and an unmodulated carrier power P_c=1000W, determine the total sideband power, upper and lower sideband power, modulated carrier power and total transmitted power. **(5)**		
10.	**(i)**	Obtain the mathematical expression for power and efficiency of an AM. **(6)**	**BTL1**	Remember
	(ii)	Derive the mathematical expression for FM system using Bessel function**.** **(7)**		
11.	**(i)**	Demonstrate an FM modulator operates at carrier signal frequency of 500 KHz with peak amplitude 10 Volts. A modulating frequency of 10 KHz	**BTL6**	Create

		modulates it with the peak frequency deviation of 10 kHz. Calculate the following **(i)** Modulation index. **(ii)** Minimum BW. **(7)**		
	(ii)	If the signal v(t)=20 sin (6.28×10^6 t + 10 sin 6.283×10^3 t)represents a phase modulated signal ,determine the (i) The Carrier frequency (ii) The modulating frequency (iii)The modulation index (iv)The peak phase deviation **(6)**		
12.	With relevant diagrams explain the direct and indirect methods of generating frequency modulated waves. **(13)**		**BTL2**	Understand
13.	**(i)**	Compare wide band and narrow band FM system. **(6)**	**BTL2**	Understand
	(ii)	Explain the detection of FM using PLL detector. **(7)**		
14.	**(i)**	Draw the phasor diagram of wide band FM and explain about the bandwidth of FM Signal. **(6)**	**BTL1**	Remember
	(ii)	List the difference between phase modulation and frequency modulation. **(7)**		
15.	**(i)**	Summarize and prove the properties of power spectral density. **(7)**	**BTL1**	Remember
	(ii)	Describe about the PM modulator and demodulator. **(6)**		
16.	**(i)**	Discuss about the Armstrong method of FM generation. **(8)**	**BTL2**	Understand
	(ii)	Describe any one Angle demodulation method. **(5)**		
17.	**(i)**	Derive an expression for the FM wave. Compare it with phase modulated wave. **(7)**	**BTL4**	Analyze
	(ii)	Explain the operation of a super heterodyne receiver and list its advantages over Tuned radio frequency receiver. **(6)**		

PART – C

Q. No		Questions	BT Level	Competence
1.	**(i)**	A telephone transmitter using AM has unmodulated carrier output power of 20 kW and can be modulated to a maximum depth of 80% by a sinusoidal modulating voltage without causing overloading. Evaluate the value to which unmodulated carrier power may be increased without resulting in overloading if the maximum permitted modulation index is restricted to 60%. **(5)**	**BTL6**	Create
	(ii)	For an AM DSBFC wave with a peak unmodulated carrier voltage $V_c=10V_p$, a load resistance $R_L=10\Omega$ and a modulation coefficient m=1,determine (a) Powers of the carrier and the upper and lower sidebands. (b) The total side band power. (c) The total power of the modulated wave. (d) Draw the power spectrum. **(10)**		
2.	**(i)**	A complex modulating waveform consisting of as sine wave of amplitude 3V and frequency 1 kHz plus a cosine wave of amplitude 5 V and frequency 3 kHz amplitude modulates a 500 kHz and 10V peak carrier voltage. Develop the spectrum of modulated wave and determine the average power when the modulated wave is fed into 50-ohm load. **(9)**	**BTL5**	Evaluate
	(ii)	Find the power in each sideband of a DSBSC signal with the carrier signal at 1 MHZ and of a peak signal voltage of 100 V modulated simultaneously, and a peak modulating voltages are 10 V, 20 V and 30 V respectively. Assume a load resistance of 100 Ω. **(6)**		

3.		One input to a a conventional AM modulator is a 500 kHz carrier with an amplitude of 20 V_p .The second input is a 10 kHz modulating signal that is of sufficient amplitude to cause a change in the output wave of ±7.5 V_p. Determine (a) Upper and lower side frequencies. (b) Modulation coefficient and percent modulation. (c) Peak amplitude of the modulated carrier and the lower and upper side frequency voltages. (d) Maximum and minimum amplitude of the envelope. (e) Expression for the modulated wave. (f) Draw the output spectrum (g) Sketch the output envelope. **(15)**	**BTL5**	Evaluate
4.	**(i)**	What is the modulation index of an FM signal having a carrier swing of 100kHz, when the modulating signal has a frequency of 8kHz? **(5)**	**BTL6**	Create
	(ii)	A 107.6 MHz carrier signal is frequency modulated by a 7KHz signal sine wave. The resultant FM signal has frequency deviation of 5 KHz. Determine the following **(a)** The carrier swing of the FM signal **(b)** The highest and the lowest frequencies attained by the modulated signal, and **(c)** The modulation index of the FM wave. **(10)**		
5.	**(i)**	A FM radio link has a frequency deviation of 30kHz.The modulating frequency is 3kHz.Find the bandwidth needed for the link. **(3)**	**BTL5**	Evaluate
	(ii)	An angle modulated signal has the form $v(t)=100\cos[2\pi f_c t+4\sin 2000\pi t]$ where f_c=10MHz. Find: **(a)** The Average transmitted power. **(2)** **(b)** Peak phase deviation. **(3)** **(c)** Peak frequency deviation. **(3)** **(d)** Is this FM or a PM signal? Explain. **(4)**		

UNIT -II
PULSE MODULATION

Low pass sampling theorem–Quantization–PAM–Line coding–PCM, PCM, DM, and ADPCM and ADM, Channel Vocoder-Time Division Multiplexing, Frequency Division Multiplexing

PART – A

Q. No	Questions	BT Level	Competence
1.	Define sampling theorem.	**BTL1**	Remember
2.	Differentiate natural and flat top sampling.	**BTL4**	Analyze
3.	What is sampling and quantization?	**BTL4**	Analyze
4.	Illustrate about quantization error.	**BTL3**	Apply
5.	What is meant by aliasing? How do you avoid aliasing?	**BTL1**	Remember
6.	State Nyquist rate and Nyquist interval.	**BTL4**	Analyze
7.	Determine the Nyquist rate and Nyquist interval for g(t)=sin c(200t)	**BTL6**	create
8.	What is meant by pulse modulation?	**BTL2**	Understand
9.	What are the four most common methods of pulse modulation?	**BTL1**	Remember
10.	Compare between PAM and PWM.	**BTL5**	Evaluate

11.	Why flat top PAM is preferred over natural PAM?	**BTL3**	Apply
12.	What is bit depth in PCM?	**BTL1**	Remember
13.	List out the few demerits of DPCM.	**BTL1**	Remember
14.	Illustrate the term slope overload noise.	**BTL3**	Apply
15.	Define Baud rate and Bit rate.	**BTL1**	Remember
16.	Summarize about Delta modulation.	**BTL5**	Evaluate
17.	Summarize the disadvantage of Delta modulation	**BTL2**	Understand
18.	Can you elaborate on ADPCM?	**BTL6**	Create
19.	What is companding?	**BTL2**	Understand
20.	How to apply the principle of ADM to generate ADM signal?	**BTL3**	Apply
21.	Assess the need channel vocoder?	**BTL5**	Evaluate
22.	List the types of vocoders.	**BTL2**	Understand
23.	Compare TDM and FDM.	**BTL4**	Analyze
24.	Write any four primary applications of FDM	**BTL2**	Understand

PART – B

Q. No		**Questions**	**BT Level**	**Competence**
1.		State and prove sampling theorem. Obtain the reconstructed Signal and Explain the low pass sampling theorem in detail**.** **(13)**	**BTL2**	Understand
2.	**(i)**	List the various sampling techniques. **(3)**		
	(ii)	Describe about the generation and detection of Flat top PAM. **(10)**	**BTL1**	Remember
3.	**(i)**	Describe the generation of PCM signal with a block diagram. **(7)**		
	(ii)	How does flat top sampling differ from natural sampling? Describe about the estimation of filtered output. **(6)**	**BTL1**	Remember
4.	**(i)**	Describe the pulse modulation schemes of PAM, PPM, and PWM. **(10)**		
	(ii)	Sketch the slope overload error and explain how that error could be minimized. **(3)**	**BTL3**	Apply
5.		Explain the quantization noise in PCM system .How it can be reduced? **(13)**	**BTL4**	Analyze
6.	**(i)**	Discuss DPCM technique with neat block diagram. **(7)**	**BTL6**	Create
	(ii)	For minimum line speed with an 8 bit PCM for speech signal ranging up to 1 volt. Calculate the resolution and quantization error. Calculate the coding efficiency for a resolution of 0.01 volt with the 8 bit PCM. **(6)**		
7.		Explain the pulse code modulation and demodulation process. **(13)**	**BTL2**	Understand
8.	**(i)**	Compare the various Pulse modulation techniques. **(9)**	**BTL5**	Evaluate
	(ii)	A PCM system uses a uniform quantizer followed by a 7-bit encoder. The system bit rate is 50 Mbits/sec. Calculate **(a)** Sampling frequency **(b)**Transmission bandwidth **(4)**		
9.		Demonstrate ADPCM with required diagram. How does it differ from PCM? **(13)**	**BTL5**	Evaluate
10.		Describe delta modulation in detail with neat block diagram. Also describe the quantization error in delta modulation. **(13)**	**BTL3**	Apply
11.	**(i)**	With neat sketch summarize the generation of DM signals. **(8)**		
	(ii)	State the drawbacks of DM and suggest a method to correct it. **(5)**	**BTL2**	Understand
12.		What is meant by quantization and develop the expression for Quantization noise in PCM and DM systems. **(13)**	**BTL3**	Apply
13.		With neat block diagram explain the Adaptive delta Modulation Scheme. Mention its disadvantages. **(13)**	**BTL1**	Remember
14.	**(i)**	Compare PCM and DPCM techniques. **(4)**	**BTL4**	Analyze
	(ii)	Discuss on the process, “Companding” and its characteristics. **(9)**		

15.	Briefly discuss about Vocoders and also demonstrate about channel Vocoder with necessary diagrams. **(13)**		**BTL2**	Understand
16.	Draw and explain the Time division multiplexing with its applications. **(13)**		**BTL1**	Remember
17.	**(i)**	Describe frequency division multiplexing with neat sketch. **(8)**	**BTL4**	Analyze
	(ii)	Compare and contrast the features of TDM and FDM system. **(5)**		

PART – C

Q.No		Questions	BT Level	Competence
1.	**(i)**	An analog signal is represented by the equation x(t)=5 cos150πt+20 sin 500πt-cos700πt. Calculate the Nyquist rate. **(6)**	**BTL5**	Evaluate
	(ii)	For a PAM transmission of voice signal having maximum frequency f_m=4kHz, calculate the transmission bandwidth. It is given that the sampling frequency f_s=8kHz and the pulse duration $\tau=0.1T_s$ **(4)**		
	(iii)	The bandwidth of a video signal is 4.5MHz.This signal is to be transmitted using PCM with the number of quantization levels Q=1024.The sampling rate should be 20% higher than the Nyquist rate .Calculate the system bit rate and minimum transmission bandwidth. **(5)**		
2.	A PCM system has the following parameters: a maximum analog input frequency of 4 KHz a maximum decoded voltage at the receiver of ±2.55 V, and a minimum dynamic range of 46dB. Evaluate the following: **(i)** Minimum sample rate. **(4)** **(ii)** Minimum number of bits used in the PCM code. **(4)** **(iii)** Resolution. **(4)** **(iv)** Quantization error. **(3)**		**BTL5**	Evaluate
3.	How would you compare the various digital communication systems? **(15)**		**BTL6**	create
4.	**(i)**	A telephone signal band limited to 4KHz is to be transmitted by PCM and the output signal to quantization noise ratio is to be held to a minimum of 40dB. (a) Calculate the number of binary digits per word (b) Find the bandwidth required for transmission. **(6)**	**BTL5**	Evaluate
	(ii)	A PCM system uses a uniform quantizer followed by a 7 bit encoder. The system bit rate is 50 M bits/sec. Calculate (a) Sampling frequency. (b) Transmission bandwidth , and (c) SNR_q for sinusoidal signal **(9)**		
5.	For minimum line speed with an 8 bit PCM for speech signal ranging upto 1 volt. Calculate the resolution and quantization error. Also analyze about the coding efficiency for a resolution of 0.01 volt with the 8 bit PCM. **(15)**		**BTL6**	create

Unit-III

DIGITAL MODULATION AND TRANSMISSION

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signalling M-ary PSK & QAM –Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

PART A

Q. N0	Questions	BT Level	Competence
1.	Define Digital Modulation and list out the types of Digital modulation.	**BTL1**	Remember

2.	Give the advantages and disadvantages of digital modulation.	**BTL2**	Understand
3.	Draw the BPSK signal for the given message signal 101101.	**BTL5**	Evaluate
4.	Draw the modulated waveform representing PSK and FSK.	**BTL2**	Understand
5.	For 16 PSK and a transmission system with a 10kHZ bandwidth. Find the maximum bit rate.	**BTL6**	Create
6.	Define DPSK, How it is different from PSK	**BTL1**	Remember
7.	Illustrate the expression for probability of error of BPSK and BFSK	**BTL3**	Apply
8.	Sketch the QPSK signal for the binary sequence 11001100	**BTL6**	Create
9.	Differentiate between BPSK from QPSK.	**BTL4**	Analyse
10.	Draw the constellation diagram of QPSK signal.	**BTL3**	Apply
11.	Differentiate coherent and Non coherent detection	**BTL1**	Remember
12.	What is M-ary encoding?	**BTL2**	Understand
13.	What is QAM? Assess the significance of QAM?	**BTL2**	Understand
14.	Compare M –ary PSK and QAM	**BTL4**	Analyse
15.	Demonstrate about pulse shaping in digital modulation.	**BTL3**	Apply
16.	How does pulse shaping reduce inter symbol interference?	**BTL4**	Analyse
17.	Explain the term ISI? How do you alleviate ISI?	**BTL2**	Understand
18.	What is meant by Inter Symbol Interference? List out the causes for that.	**BTL1**	Remember
19.	What is Duobinary encoding? Why precoding is used.	**BTL4**	Analyse
20.	Define bandwidth efficiency.	**BTL1**	Remember
21.	Illustrate the benefits of cosine filter.	**BTL3**	Apply
22.	Assess the significance of eye pattern. What are the information that can be obtained from eye pattern regarding the signal quality?	**BTL5**	Evaluate
23.	Summarize about Eye-pattern used in pulse shaping	**BTL5**	Evaluate
24.	What is an equalizer? List the applications of it.	**BTL1**	Remember

PART B

Q.NO		Questions	BT Level	Competence
1.	**(i)**	Demonstrate about ASK and FSK in detail. **(9)**	**BTL3**	Apply
	(ii)	Illustrate the various digital communication systems. **(4)**		
2.	**(i)**	Draw the BPSK wave forms for the bit stream 10110001. **(3)**	**BTL5**	Evaluate
	(ii)	For a BPSK modulator with a Carrier frequency of 70 MHz and an input bit rate of 10 Mbps, determine the maximum and minimum upper and lower side frequencies, draw the output spectrum, determine the minimum Nyquist bandwidth, and calculate the baud rate. **(10)**		
3.		Describe the generation and detection of BPSK with necessary diagram and equation. **(13)**	**BTL3**	Apply
4.		Discuss the working of DPSK transmitter and receiver with neat block diagram and state the reasons over BPSK. **(13)**	**BTL2**	Understand
5.	**(i)**	Demonstrate about the generation and detection of DPSK with neat diagram and necessary equation. **(10)**	**BTL2**	Understand
	(ii)	Distinguish between BPSK and DPSK. **(3)**		
6.	**(i)**	Explain in detail about the operation of QPSK transmitter with necessary diagrams. **(9)**	**BTL2**	Understand
	(ii)	Compare QPSK and BPSK. **(4)**		

7.		With relevant expression and figure, describe QPSK receiver with its signal space representation **(13)**	**BTL1**	Remember
8.		Explain about the M-ary Phase shift keying, by giving its transmitter and receiver with neat diagram. **(13)**	**BTL5**	Evaluate
9.	**(i)**	Draw the constellation diagram of QPSK modulation. **(3)**	**BTL6**	Create
	(ii)	For QPSK modulator with an input data rate equal to 10 Mbps and a carrier frequency of 70 MHz. Determine the following **(a)** Minimum double sided Nyquist bandwidth **(b)** Baud Rate and **(c)** Sketch the output spectrum. **(10)**		
10.	**(i)**	Define QAM. **(3)**		
	(ii)	Describe the operation of 8 QAM transmitter and receiver using a block diagram and truth table. **(10)**	**BTL1**	Remember
11.	**(i)**	Compare and contrast QPSK and QAM. **(8)**	**BTL4**	Analyze
	(ii)	Discuss in detail on signal design for ISI elimination. **(5)**		
12.		Explain M-ary PSK system and also demonstrate about its transmitter and receiver with neat diagrams. **(13)**	**BTL3**	Apply
13.	**(i)**	State Nyquist's pulse shape criterion for zero ISI and explain. **(3)**	**BTL4**	Analyze
	(ii)	Draw the block diagram and explain about the duo -binary signaling scheme for controlled ISI. **(10)**		
14.		Draw and describe the block diagram of the duo binary signaling scheme with and without precoding. **(13)**	**BTL1**	Remember
15.	**(i)**	What is meant by pulse Shaping? How it reduces ISI? **(4)**	**BTL4**	Analyze
	(ii)	Discuss raised cosine pulse shaping. **(9)**		
16.	**(i)**	Explain how eye diagram is obtained. **(5)**	**BTL2**	Understand
	(ii)	Draw a typical eye diagram and discuss various timing features interpreted from that. **(8)**		
17.	**(i)**	Summarize about the delay equalizer and the classifications of equalizers. **(8)**	**BTL1**	Remember
	(ii)	Describe about zero-forcing equalizer with neat diagram. **(5)**		

		PART – C		
Q. NO		**Questions**	**BT Level**	**Competence**
1.		Present a case study on the features and error performance of various Digital modulation systems. **(15)**	**BTL6**	Create
2.	**(i)**	For a BPSK modulator with a carrier frequency of 70 MHz and an input bit rate of 10 Mbps, determine the maximum and minimum upper and lower side frequencies, draw the output spectrum, determine the minimum Nyquist bandwidth, and calculate the baud. **(8)**	**BTL5**	Evaluate

	(ii)	For an 8 PSK system, operating with an information rate of 24 kbps, determine (a) Baud rate (b) Minimum bandwidth **(c)** Bandwidth efficiency. **(7)**		
3.	In a digital communication system, the bit rate of a bipolar NRZ data sequence is 1Mbps and carrier frequency is 100 MHz. Design by determining the symbol rate of transmission and the bandwidth requirement of the communication channel for M-ary PSK system. **(15)**		**BLT6**	Create
4.	**(i)**	Draw the QPSK and 8-QAM wave forms for the bit stream 1001110001010101.If needed discard the bits to a minimum extend. **(8)**	**BLT6**	Create
	(ii)	For a QPSK modulator with an input data rate (f_b) equal to 10 Mbps and a carrier frequency of 70 MHz, determine the minimum double sided Nyquist bandwidth (f_N) and the baud rate. **(7)**		
5.	The binary data stream 001101001 is applied to the input of a duobinary system. Construct the duobinary coder output and corresponding receiver output also comment on the merits of duobinary coding. **(15)**		**BTL5**	Evaluate

UNIT-IV
INFORMATION THEORY AND CODING

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

PART –A

Q. No	Questions	BT Level	Competence
1.	Define information rate?	**BTL1**	Remember
2.	An analog signal is band limited to B Hz, sampled at the Nyquist rate, and the samples are quantized into 4 levels. The quantization levels Q1, Q2, Q3 and Q4 are assumed to be independent and occur with probabilities $P_1 = P_4 = 1/8$ and $P_2 = P_3 = 3/8$. Calculate the information rate of the source.	**BTL5**	Evaluate
3.	A source transmits messages Q_1 to Q_5 having probabilities 1/2,1/4, 1/8, 1/16, 1/16 respectively. Estimate the average information of the source.	**BTL6**	Create
4.	Define Entropy.	**BTL1**	Remember
5.	An event has six possible outcomes with probabilities {1/2, 1/4, 1/8, 1/16, 1/32, 1/32}. Calculate the entropy of the system.	**BTL6**	Create
6.	Define source coding and state the significance of source coding.	**BTL1**	Remember
7.	Why the Huffman code called as minimum redundancy coding?	**BTL4**	Analyze
8.	Define LZ coding and state the merits.	**BTL4**	Analyze
9.	State channel capacity theorem.	**BTL2**	Understand
10.	What is the need of channel coding?	**BTL4**	Analyze
11.	Illustrate Shannon's fundamental theorem of information theory.	**BTL3**	Apply

12.	State Shannon-Hartley law and its application.	**BTL1**	Remember
13.	What is the aim of error control coding? List the different error control mechanism.	**BTL1**	Remember
14.	Give the different error control methods.	**BTL2**	Understand
15.	Differentiate error detection from error correction.	**BTL2**	Understand
16.	Evaluate the Hamming distance between the following code words C_1= {1,0,0,0,1,1,1} and C_2= {0,0,0,1,0,1,1}. List the properties of Hamming distance.	**BTL5**	Evaluate
17.	For 12-bit data string of 1011 0001 0010, determine the number of hamming bits required.	**BTL5**	Evaluate
18.	State the difference between source coding and error control coding.	**BTL4**	Analyze
19.	What is prefix code? Give examples.	**BTL1**	Remember
20.	List the properties of cyclic codes.	**BTL2**	Understand
21.	Discover, when a binary code is said to be cyclic code?	**BTL3**	Apply
22.	Define syndrome in error control codes.	**BTL2**	Understand
23.	Compare block and convolution codes.	**BTL3**	Apply
24.	Illustrate the principle advantages of sequential decoding of convolution code?	**BTL3**	Apply

PART – B

Q.No		Questions	BT Level	Competence
1.	**(i)**	Brief the properties of entropy. **(6)**	**BTL1**	Remember
	(ii)	Describe the concept of Source coding theorem and state its significance. **(7)**		
2.		Explain about the discrete Memoryless Channels with its channel diagram and transition matrix and also summarize about BSC. **(13)**	**BTL4**	Analyze
3.	**(i)**	Develop Shannon's Fano algorithm and Huffman coding with a suitable example. **(10)**	**BTL6**	Create
	(ii)	What is a convolutional code? When is it used? **(3)**		
4.		Summarize the procedure of Shannon Fano algorithm and calculate the entropy for the following probabilities using the algorithm. **(13)** m1 m2 m3 m4 m5 m6 m7 m8 4/32 2/32 16/32 2/32 2/82 1/32 1/32 4/82	**BTL5**	Evaluate
5.		Given states S={S_0,S_1,S_2,S_3,S_4} and their probabilities P={0.4,0.2,0.2,0.1,0.1}. Find coding efficiency and entropy for shanon Fano coding. **(13)**	**BTL4**	Analyze
6.	**(i)**	Five symbols of the alphabet of discrete memory less source and their probabilities are given below. S = { S_0, S_1, S_2, S_3, S_4} P(S) = {0.4, 0.2, 0.2, 0.1, 0.1} Obtain code symbols using Huffman coding. **(10)**	**BTL5**	Evaluate
	(ii)	Discuss the drawbacks of Huffman coding. **(3)**		
7.	**(i)**	Demonstrate about LZ coding with a suitable example. **(10)**	**BTL3**	Apply
	(ii)	Consider that a source is transmitting equiprobable 1/0 at the rate of 10^3 b/s and the probability error of P_e = 1/16. Determine the rate of transmission. **(3)**		

8.	State the relationship between the mutual information and channel capacity and also derive the expression for mutual information. **(13)**		**BTL3**	Apply
9.	Summarize the concept of coding and decoding methods of block codes with its mathematical framework and diagram. **(13)**		**BTL2**	Understand
10.	Explain in detail about error control codes and their applications. **(13)**		**BTL1**	Remember
11.	**(i)**	Describe about Shanon's theorem and channel capacity and also discuss about capacity of Gaussian Channel. **(7)**	**BTL1**	Remember
	(ii)	Explain Bandwidth-SNR trade off in source coding. **(6)**		
12.	Summarize about Cyclic codes with necessary diagram and equation. **(13)**		**BTL2**	Understand
13.	**(i)**	Demonstrate the Concept of block codes and coding efficiency. **(6)**	**BTL3**	Apply
	(ii)	Determine the Block check sequence (BCS) for the following data and cyclic redundancy check (CRC) generating polynomials: Data $G(x) = x^7+ x^5+ x^4+ x^2+ x^1+ x^0$, CRC $P(x) = x^5+ x^4+ x^1+ x^0$. **(7)**		
14.	**(i)**	Design a convolutional coder of constraint length 6 and rate efficiency ½. **(7)**	**BTL4**	Analyze
	(ii)	Analyse the concept of source coding theorem. **(6)**		
15.	Describe any one of the decoding methods of convolutional coding precisely with suitable example. **(13)**		**BTL1**	Remember
16.	Describe about the Viterbi algorithm by showing the possible path through the trellis of a coder. Assume the state diagram of any coder. **(13)**		**BTL2**	Understand
17.	Explain Viterbi decoding algorithm .Make suitable assumptions. **(13)**		**BTL2**	Understand

PART – C

Q.No		Questions	BT Level	Competence
1.	Consider a discrete memoryless source with source alphabet={x_1, x_2, x_3} and source statistics {0.7, 0.15, 0.15}. (a) Calculate the Entropy of a source X. (b) Calculate the Entropy of the second order extension of the source and also verify that $H(s^2)=2H(s)$ **(15)**		**BTL5**	Evaluate
2.	**(i)**	Give the procedure for Shannon Fano coding and use the procedure to obtain the code for the source symbols S_0, S_1, S_2, S_3, S_4, S_5 with their respective probabilities ½, 1/3, 1/12, 1/15, 1/120, 1/120. **(10)**	**BTL5**	Evaluate
	(ii)	Compare the merits and demerits of Shannon fano coding with other coding. **(5)**		

3.	The parity check matrix of a particular (7,4) linear block code is given by, [*H*]= 1110100 1101010 1011001 **(i)** Find the generator matrix (G). **(4)** **(ii)** List all the code vectors. **(4)** **(iii)** What is the minimum distance between code vectors? **(4)** **(iii)**How many errors can be detected and corrected **(3)**	**BTL6**	Create
4.	A discrete memoryless source has 6 symbols S_1, S_2, S_3, S_4, S_5, S_6 with probabilities 0.4, 0.1, 0.2, 0.1, 0.1 and 0.1 respectively. Construct a Huffman Code and calculate its efficiency. **(15)**	**BTL6**	Create
5.	A rate 1/3 convolution encoder has generating vectors as g1=(1 0 0) , g2=(1 1 1) and g3 = (1 0 1) **(i)** Sketch the encoder configuration. **(8)** **(ii)** Draw the code tree, state diagram and trellis diagram. **(7)**	**BTL6**	Create

UNIT-V
SPREAD SPECTRUM AND MULTIPLE ACCESS

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronization and tracking – Multiple Access – FDMA, TDMA, CDMA

PART – A

Q. No	Questions	BT Level	Competence
1.	List any four primary applications of FDMA.	**BTL1**	Remember
2.	Define Pseudo-Noise (PN) sequence. List its application	**BTL1**	Remember
3.	Illustrate the balance property of M sequences.	**BTL3**	Apply
4.	Point out the properties of M sequences.	**BTL4**	Analyze
5.	List out the benefits of spread spectrum.	**BTL3**	Apply
6.	Write the classification of direct sequences spread spectrum.	**BTL2**	Understand
7.	Give the applications of DS-SS system.	**BTL2**	Understand
8.	Summarize the advantages of frequency hopped spread spectrum (FHSS)	**BTL5**	Evaluate
9.	What is called processing gain?	**BTL1**	Remember
10.	State the Purpose of synchronization and tracking.	**BTL2**	Understand
11.	What are the benefits of multiple access techniques in communication engineering?	**BTL1**	Remember
12.	Point out the most critical requirement of TDMA technique.	**BTL4**	Analyze
13.	Evaluate the number of channels available if the system bandwidth is 10 MHz ,channel spacing is 20 KHz and the edge guard spacing is 5 KHz.	**BTL5**	Evaluate
14.	List out the merits of TDMA system.	**BTL1**	Remember
15.	Define FDMA.	**BTL1**	Remember
16.	Point out the advantages of FDMA	**BTL4**	Analyze
17.	Generalize time division multiplexing and frequency division multiplexing.	**BTL6**	Create
18.	Illustrate the popular coding sequences of CDMA system.	**BTL3**	Apply

19.	Generalize the spectral efficiency calculation for FDMA.	**BTL6**	Create
20.	Discuss the applications of CDMA system.	**BTL2**	Understand
21.	Define near –far problem in CDMA.	**BTL2**	Understand
22.	Differentiate SDMA with CDMA**.**	**BTL4**	Analyze
23.	Demonstrate the working principle of SDMA.	**BTL3**	Apply
24.	Evaluate the total number of bits per frame, if the frame duration is 10 ms and Channel bit rate is 5000 bit per second.	**BTL5**	Evaluate

PART – B

Q.No		Questions	BT Level	Competence
1.		Draw the block diagram and explain in detail the model of spread spectrum digital communication system. **(13)**	**BTL2**	Understand
2.	**(i)**	What are PN sequences? What are the properties of PN sequences? **(4)**	**BTL1**	Remember
	(ii)	What are the differences between the FHSS and DSSS? **(4)**		
	(iii)	What are the advantages of spread spectrum? **(5)**		
3.	**(i)**	Describe in detail about generation of PN codes. **(7)**	**BTL2**	Understand
	(ii)	Discuss the properties of PN sequences**.** **(6)**		
4.	**(i)**	How Maximal-length sequence will be obtained from PN sequence? **(3)**	**BTL6**	Create
	(ii)	Develop and discuss about the Maximal –length sequence involving 3 flip flops and discuss about its properties. **(10)**		
5.	**(i)**	Explain the functioning of DS spread spectrum with coherent binary PSK processing. **(9)**	**BTL5**	Evaluate
	(ii)	Discuss the access techniques used for wireless communication. **(4)**		
6.	**(i)**	Explain the principle of operation of FHSS with necessary diagrams. **(9)**	**BTL2**	Understand
	(ii)	Also Compare fast frequency hopping and slow frequency hopping. **(4)**		
7.	**(i)**	Describe the various multiple access techniques with neat diagram. **(9)**	**BTL1**	Remember
	(ii)	List the advantages and disadvantages of various multiple access techniques. **(4)**		
8.		Discuss in detail the multiple access techniques that are used in wireless communications. What difference is taken into account here as the channel is now wireless? **(13)**	**BTL3**	Apply
9.		Explain the principle of FDMA with neat diagram. **(13)**	**BTL4**	Analyze
10.	**(i)**	With neat block diagram explain the Frequency Division Multiple Access technique. **(9)**	**BTL4**	Analyze
	(ii)	Discuss the application of FDMA in communication**.** **(4)**		
11.	**(i)**	Demonstrate the operation of a typical TDMA system with neat block diagram. **(7)**	**BTL2**	Understand
	(ii)	Distinguish TDMA with FDMA. **(6)**		
12.		Describe about the allocation of time slot in TDMA and time frequency characteristics of synchronous TDMA. **(13)**	**BTL1**	Remember

13.	Draw and explain the block diagram of transmitter and receiver of CDMA. **(13)**		**BTL1**	Remember
14.	Illustrate the concept of using CDMA scheme in FDD and TDD. **(13)**		**BTL3**	Apply
15.	**(i)**	What is CDMA? Explain in detail. **(7)**	**BTL5**	Evaluate
	(ii)	Assess the basic features of CDMA systems. Explain soft hand over. **(6)**		
16.	Illustrate how interference is avoided by using code division multiplexing. **(13)**		**BTL3**	Apply
17.	Explain with a neat block diagram the SDMA technique. **(13)**		**BTL4**	Analyze

PART – C

Q.No		Questions	BT Level	Competence
1.	**(i)**	A spread spectrum communication system is characterized by the following parameters. Duration of each information bit T_b=5.045ms Chip duration of a PN sequence T_c=1.5μs Calculate the processing gain and jamming margin if E_b/N_0 =20 and the average probability of error $P_e=0.5\times10^{-5}$ **(7)**	**BTL6**	Create
	(ii)	If a normal GSM slot consists of six trailing bits , 8.25 guard bits 26 training bits and two traffic bursts of 58 bits of data ,find the frame efficiency. **(8)**		
2.	500 users employ FDMA to transmit 1000-bit packets of data. The channel band width is 100MHz and QPSK is used at each of the 5000 carrier frequencies employed **(i)** What is the maximum bandwidth allocated to each user? **(5)** **(ii)** What is the bit rate employed by each user? **(5)** **(iii)** How long does it take to transmit a packet? **(5)**		**BTL6**	Create
3.	Summarize Spread Spectrum modulation technique based upon the operating concept and compare about DSSS and FHSS. **(15)**		**BTL5**	Evaluate
4.	**(i)**	In the AMPS system the system bandwidth is 12.5 MHz, the channel spacing is 30kHz, and the edge guard spacing is 10 kHz. The number of channel allocated for control signalling is 21. Estimate the number of channels available for message transmission and spectral efficiency of FDMA. **(9)**	**BTL6**	Create
	(ii)	A PN sequence generator using feedback shift register of length 4.If the chip rate is 10^8 chips/sec. Calculate the chip and PN sequence duration. **(6)**		
5.	Design a PN sequence generator and evaluate the sequence length for the following (a) 4 shift registers (b) 9 shift registers (c) 13 shift registers. **(15)**		**BTL5**	Evaluate


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