MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Estd. 2000

IQAC

MUST KNOW CONCEPTS | MKC

ECE | **2021-22**

Course Code & Course Name : 19ECC10- DIGITAL COMMUNICATION SYSTEMS

Year/Sem/Sec : III / V /A, B, C

S.No.	Term	Notation (Symbol)	Concept / Definition / Meaning / Units / Equation / Expression	Units
Unit-I : SAMPLING PROCESS & WAVE FORM CODING				
1.	Transmitter	Tx	It is a collection of electronic components and circuits that converts the electrical signal into a signal suitable for transmission over a given medium	-
2.	Communication Channel	-	It is the medium by which the electronic signal is sent from one place to another	-
3.	Types of media in transmitting signal	-	Electrical conductors: Optical media, Free space, System-specific media (e.g., water is the medium for sonar).	-
4.	Receivers	Rx	It is a collection of electronic components and circuits that accepts the transmitted message from the channel and converts it back into a form understandable by humans.	-
5.	Transceivers	TxR	It is an electronic unit that incorporates circuits that both send and receive signals.	-
6.	Attenuation	t	Signal **attenuation,** or degradation, exists in all media of wireless transmission. It is proportional to the square of the distance between the transmitter and receiver	-
7.	Noise	-	It is random, undesirable electronic energy that enters the communication system via the communicating medium and interferes with the transmitted message.	-
8.	Nyquist rate	W	Then Nyquist rate is given as, Nyquist rate = 2W samples/sec.	-
9.	Aliasing effect	-	Aliasing effect takes place when sampling frequency is less than Nyquist rate.	-
10.	Quantizing process	-	The conversion of analog sample of the signal into digital from	-
11.	Idle channel noise	-	Idle channel noise is the coding noise measured at the receiver output with zero transmitter input	-
12.	Prediction error	-	The different between the actual sample of the process at the time of interest and the prediction output is called prediction error	-

13.	Sampling	-	Converting continuous time signal to a digital signal.	-
14.	Source encoder	-	Represent the transmitted data more efficiently and remove redundant information	-
15.	Coding	-	Assigning a binary code to each finite amplitude in the analog signal	-
16.	Quantization	-	Converting the amplitude of the analog signal to a digital value	-
17.	Channel encoder	-	Control the noise and to detect and correct the errors that can occur in the transmitted data due the noise	-
18.	Channel decoder	-	Detects and corrects the errors in the signal gained from the channel	-
19.	Source decoder	-	Decompresses the data into its original format	-
20.	Delta modulation	DM	Transmits only one bit per symbol, Present sample value is compared with the previous sample value, to check the amplitude changes. Step size is fixed	-
21.	Adaptive Delta Modulation	ADM	Overcome the slope overload and granular noise	-
22.	Differential PCM	DPCM	Adjacent samples of the signal carry the same information with little difference, the encoded signal contains some redundant information.	-
23.	ADPCM Receiver	-	This DE quantized value is added to the value generated by the adaptive predictor to produce the reconstructed speech sample.	-
24.	LPC signal	-	The LP coefficients and error signal is multiplexed and transmitted. This signal is called LPC signal.	-
25.	Synthesizer	-	Reconstruct the speech signal from LPC is called synthesizer.	-
Unit-II : BASEBAND PULSE TRANSMISSION				
26.	Line code	-	It is the code used for data transmission of a digital signal over a transmission line. This process of coding is chosen so as to avoid overlap and distortion of signal such as inter-symbol interference.	-
27.	Properties of Line Coding	-	• For a given bandwidth, the power is efficiently used. • The probability of error is much reduced. • Error detection is done and the bipolar too has a correction capability. • Power density is much favorable.	-
28.	Types of Line Coding	-	• Unipolar • Polar • Bi-polar	-
29.	Unipolar Signaling	-	Unipolar signaling is also called as On-Off Keying or simply OOK. The presence of pulse represents a 1 and	-

			the absence of pulse represents a 0.	
30.	Variations in Unipolar signaling	-	• Non Return to Zero NRZ • Return to Zero RZ	-
31.	Unipolar Non-Return to Zero NRZ	-	A High in data is represented by a positive pulse called as Mark, which has a duration T_0 equal to the symbol bit duration. A Low in data input has no pulse.	-
32.	Unipolar Return to Zero RZ	-	A High in data, though represented by a Mark pulse, its duration T_0 is less than the symbol bit duration.	-
33.	Methods of Polar Signaling	-	• Polar NRZ • Polar RZ	-
34.	Polar NRZ	-	In this type of Polar signaling, a High in data is represented by a positive pulse, while a Low in data is represented by a negative pulse.	-
35.	Polar RZ	-	In this type of Polar signaling, a High in data, though represented by a Mark pulse, its duration T_0 is less than the symbol bit duration.	-
36.	Bipolar Signaling	-	This is an encoding technique which has three voltage levels namely +, - and 0. Such a signal is called as duo-binary signal.	-
37.	Methods of Bipolar Signaling	-	• Bipolar NRZ • Bipolar RZ	-
38.	Power Spectral Density	PSD	The function which describes how the power of a signal got distributed at various frequencies, in the frequency domain is called as Power Spectral Density	-
39.	Error detection	-	Some codes such as duo binary provide the means of detecting data error without introducing additional error detection bits into the data sequence.	-
40.	Band width compression	-	Some codes such as multilevel codes increase the efficiency of the bandwidth utilization by allowing a reduction in required bandwidth for a given data rate, thus more information transmitted per unit band width.	-
41.	Noise Immunity	-	For same transmitted energy some codes produces lesser bit detection error than other in the presence of noise.	-
42.	Manchester encoding	-	Manchester encoding is therefore considered to be self-clocking, which means that accurate clock recovery from a data stream is possible.	-
43.	Nyquist Criterion for Zero–ISI	-	Nyquist proposed a condition for pulses $p(t)$ to have zero–ISI when transmitted through a channel with sufficient bandwidth to allow the spectrum of all the transmitted signal to pass.	-

44.	Roll–off factor	r	$r = \frac{\text{Excess Bandwidth}}{\text{Minimum Bandwidth}} = \frac{\omega_x}{\omega_b/2} = \frac{2\omega_x}{\omega_b}$	-
45.	Inter symbol Interference	-	Transmit digital data which demands more bandwidth which exceeds channel bandwidth, spreading will occur and cause signal pulses to overlap. This overlapping is called Inter Symbol Interference.	-
46.	Eye Pattern	-	The eye pattern is experimental method that contains all the information concerning the degradation of quality.	-
47.	Adaptive equalization	-	An equalizer is a filter that compensates for the dispersion effects of a channel. Adaptive equalizer can adjust its coefficients continuously during the transmission of data.	-
48.	Pre channel equalization	-	• Requires feedback channel • Causes burden on transmission.	-
49.	Post channel equalization	-	Achieved prior to data transmission by training the filter with the guidance of a training sequence transmitted through the channel so as to adjust the filter parameters to optimum values.	-
50.	Equalization	-	To make the signal free from ISI, and to ensure a maximum signal to noise ratio, we need to implement a method called Equalization.	-
Unit-III : PASS BAND TRANSMISSION				
51.	Power Spectrum of BPSK Modulated Signal	-	Continuing with our simplifying assumption of zero initial phase of the carrier and with no pulse shaping filtering	-
52.	power spectrum S(f) of BPSK	S(f)	$S(f) = \frac{1}{4}\left[U_B(f - f_c) + U_B(f + f_c)\right]$	-
53.	Quadrature Phase - Shift Keying	QPSK	QPSK is an expanded version from binary PSK where in a symbol consists of two bits and two orthonormal basis functions are used. A group of two bits is often called a "dibit".	-
54.	Product modulator	-	Product modulator, which is also supplied with a locally generated reference signal that is a replica of the carrier wave	-
55.	Low-pass filter	-	Low-pass filter, designed to remove the double-frequency components of the product modulator output and pass the zero-frequency components.	-
56.	Sampler	-	Sampler, which uniformly samples the output of the low-pass filter at where; the local clock governing the operation of the sampler is synchronized with the clock responsible for bit-timing in the transmitter.	-
57.	Decision-making device	-	Decision-making device, which compares the sampled value of the low-pass filters	-

			output to an externally supplied threshold, every seconds. If the threshold is exceeded, the device decides in favor of symbol 1; otherwise, it decides in favor of symbol 0.	
58.	Quadrature Amplitude Modulation	QAM	QAM is a combination of ASK and PSK	-
59.	Drawbacks of binary PSK system	-	It is difficult to detect +b(t) and –b(t) because of squaring in the receiver Problem, of ISI and inter channel interference are present.	-
60.	DPSK	-	The input sequence is modified. Let input sequence be d(t) and output Sequence be b(t). Sequence b(t) changes level at the beginning of each interval in which d(t)=1 and it does not changes level when d(t)=0.	-
61.	Bit error rate for coherent binary FSK	-	Pe = 1/2erfc√0.6(E/No)	-
62.	Noise spectral density	-	N0/2	-
63.	Signal energy per bit	-	√E/2	-
64.	QPSK Receiver	-	It consists of a pair of correlators with a common input and supplied with a locally generated pair of coherent reference signals ϕ1(t) & ϕ2(t)	-
65.	Applications of FSK Bandwidth	-	• On voice-grade lines, used up to 1200bps • Used for high-frequency (3 to 30 MHz) radio transmission • Used at higher frequencies on LANs that use coaxial cable.	-
66.	Synchronization	-	It is known till now that for the coherent reception of any signal, it is necessary to synchronize the receiver to the transmitter	-
67.	Modes of Synchronization	-	• Carrier Synchronization • Symbol Synchronization	-
68.	Carrier Synchronization	-	The estimation of carrier frequency and phase at the receiver is called carrier synchronization	-
69.	Symbol Synchronization	-	In order to perform the demodulation, the receiver is supposed to know the time instants at which the modulation changes its state.	-
70.	Advantage of BPSK	-	• Bandwidth which is lower than of a BFSK signal • Minimum Possibility of error • Very good noise immunity	-
71.	Advantage of BFSK	-	• Easy to implement • Has better noise immunity than ASK.	-
72.	Disadvantage of BFSK	-	High bandwidth requirement FSK is extensively used in low speed	-

			modems having bit rates below 1200 b/s	
73.	Types of Coherent Quadrature Modulation Techniques	-	• Quadrature Phase Shift Keying (QPSK) • Minimum Shift Keying (MSK)	-
74.	Aims of Digital Communication syatems	-	• To provide a reliable performance • To reduce the probability of error • Efficient utilization of channel bandwidth	-
75.	Disadvantage of DPSK	-	• Error rate in DPSK is higher than that in BPSK • Effect of noise is higher in DPSK than that in BPSK	-
Unit-IV : ERROR CONTROL CODING				
76.	Block Codes	-	It operate on a block of bits. Block codes are referred to as (n, k) codes. A block of k information bits are coded to become a block of n bits.	-
77.	Creating block codes	-	The block codes are specified by (n.k). The code takes k information bits and computes (n-k) parity bits from the code generator matrix.	-
78.	Convolutional codes	-	It is widely used as channel codes in practical communication systems for error correction	-
79.	Operation of a convolutional encoder	-	a) State diagram representation. b) Tree diagram representation. c) Trellis diagram representation.	-
80.	Trellis Diagram Representation	-	The trellis diagram of a convolutional code is obtained from its state diagram. All state transitions at each time step are explicitly to retain the time dimension, as is present in the corresponding tree diagram.	-
81.	Vitterbi Decoding Algorithm	-	• An efficient search algorithm • Performing ML decoding rule. • Reducing the computational complexity.	-
82.	Linearity property	-	The sum of any two code word is also a valid code word	-
83.	Cyclic property	-	Every cyclic shift of a valid code vector produces another valid code vector.	-
84.	Transparency with respect to line codes	-	The line code is said to be transparent if the synchronization between the transmitter and receiver is maintained for any type of input data sequence.	-
85.	Syndrome of linear block code	S=YHT	The non zero output of the produce YHT is called syndrome & it is used to detect errors in y. Syndrome is denoted by S &	-
86.	Code efficiency	-	The code efficiency is the ratio of message bits in a block to the transmitted bits for that block by the encoder	-
87.	Linear code	-	A code is linear if modulo-2 sum of any two code vectors produces another code vector.	-

			This means any code vector can be expressed as linear combination of other code vectors.	
88.	Cyclic codes	-	Cyclic codes are the subclasses of linear block codes. They have the property that a cyclic shift of one code word produces another code word.	-
89.	Properties of cyclic codes	-	• Linearity property • Cyclic property	-
90.	Properties of line code	-	• The PAM signal should have adequate timing content, • The PAM signal should immune to channel noise and interference • The PAM signal should allow error detection and error correction • The PAM signal should be transparent to digital data being transmitted	-
91.	Code Word	-	It is n bit encoded block of bits. It contains message bits and parity or redundant bits	-
92.	Code Rate	-	It is defined as the ration of the number of message bits (k) to the total number of bits (n) in a code word	-
93.	Types of channels	-	Bandlimited channel Power limited channel	-
94.	Bandlimted Channel	-	These channels have a fixed finite bandwidth. Therefore signal which require larger bandwidth cannot be transmitted over such channels without distorting them	-
95.	Power limited channel	-	It have a limited power associated with them but they have a large bandwidth.	-
96.	Interleaving	-	It is a technique used as an alternative technique used for correcting the burst errors.	-
97.	Weight of a codeword	-	The weight of a binary word is the number of 1s in the word. Alternatively, we could add the bits	-
98.	Distance between codewords	-	The distance between two binary words is the number of positions in which they differ	-
99.	Syndrome decoding	-	It is a highly efficient method of decoding a linear code over a noisy channel, i.e. one on which errors are made	-
100.	Viterbi decoder	-	It uses the Viterbi algorithm for decoding a bitstream that has been encoded using forward error correction based on a convolutional code	-
Unit – V WIRELESS CHANNELS MODELS				
101.	Base station	-	A Fixed station in a mobile radio system used for radio communication with mobile station.	-
102.	Handoff	-	The process of transferring a mobile station form one channel or base station to another	-

103.	Mobile Station	-	It is the cellular radio service intended for use while in motion at unspecified locations. Mobile stations may be hand held personal units	-
104.	Frequency Reuse	-	The design process of selecting and allocating channel groups for all of the cellular base station within a system.	-
105.	Cluster	-	The N cells which collectively use the complete set of available frequencies.	-
106.	Channel assignment	-	• Fixed channel assignment • Dynamic channel assignment	-
107.	Interference	-	Another mobile in the same cell, a call in progress in a neighboring cell, other base station operating in the same frequency band	-
108.	Free Space Propagation Model	-	It is used to predict received signal strength when the transmitter and receiver have a clear, unobstructed line-of-sight path between them.	-
109.	Path loss for the free space	-	$PL\,(\mathrm{dB}) = 10\log\frac{P_t}{P_r} = -10\log\left[\frac{G_t G_r \lambda^2}{(4\pi)^2 d^2}\right]$	-
110.	Brewster Angle	-	The Brewster angle is the angle at which no reflection occurs in the medium of origin. $\sin(\theta_B) = \sqrt{\frac{\varepsilon_1}{\varepsilon_1 + \varepsilon_2}}$	-
111.	Parameters of Mobile Multipath Channels	-	• Time Dispersion Parameters • Coherence Bandwidth • Doppler Spread and Coherence Time	-
112.	Fast Fading	-	• High Doppler spread • Coherence time c Symbol period • Channel variations faster than base-band signal variations	-
113.	Slow fading channel	-	If the baseband signal bandwidth is much greater than BD, the effects of Doppler spread are negligible at the receiver	-
114.	Doppler Shift	-	It is to the mobile velocity and the spatial angle between the direction of motion of the mobile and the direction of arrival of the wave.	-
115.	Small-Scale Multipath Measurements	-	• Direct RF Pulse System • Spread Spectrum Sliding Correlator Channel Sounding • Frequency Domain Channel Sounding	-
116.	Spread spectrum channel sounder	-	A carrier signal is spread over large bandwidth by mixing it with a binary pseudo –noise (PN)	-
117.	Advantage of a spread spectrum system	-	• Cross-talk elimination • Better output with data integrity • Reduced effect of multipath fading • Better security	-

			• Reduction in noise • Co-existence with other systems • Longer operative distances • Hard to detect • Not easy to demodulate/decode • Difficult to jam the signals	
118.	Doppler Spread	-	The range of frequency over which the received Doppler spectrum is essentially non zero.	-
119.	Coherence Time	-	It is the time duration over which the channel impulse response is considered to be not varying.	-
120.	Diversity	-	It is used to compensate the fading channel impairments and is usually implemented by using two or more receiving antennas	-
121.	Types of Diversity	-	• Frequency Diversity • Time Diversity • Polarization diversity • Angle Diversity • Space Diversity	-
122.	Frequency Diversity	-	The same information signal is transmitted on different carriers, the frequency separation between them being at least the coherence bandwidth	-
123.	Polarization diversity	-	The electric and magnetic fields of the signal carrying the information are modified and many such signals are used to send the same information.	-
124.	Angle Diversity	-	Directional antennas are used to create independent copies of the transmitted signal over multiple paths.	-
125.	Space Diversity	-	It is also known as antenna diversity. It consists of an elevated base station antenna and a mobile antenna closed to the ground.	-
Placement Questions				
126.	Communication Channel	-	It is the medium by which the electronic signal is sent from one place to another	-
127.	Types of media in transmitting signal	-	Electrical conductors: Optical media, Free space, System-specific media.	-
128.	Transceivers	TxR	It is an electronic unit that incorporates circuits that both send and receive signals.	-
129.	Noise	-	It is random, undesirable electronic energy that enters the communication system via the communicating medium and interferes with the transmitted message.	-
130.	Nyquist rate	W	Then Nyquist rate is given as, Nyquist rate = 2W samples/sec.	-
131.	Sampling	-	Converting continuous time signal to a digital signal.	-
132.	Delta modulation	DM	Transmits only one bit per symbol, Present sample value is compared with the previous sample value, to check the amplitude	-

			changes. Step size is fixed	
133.	Power Spectral Density	PSD	The function which describes how the power of a signal got distributed at various frequencies, in the frequency domain	-
134.	Inter symbol Interference	-	Transmit digital data which demands more bandwidth which exceeds channel bandwidth, spreading will occur and cause signal pulses to overlap	-
135.	Eye Pattern	-	The eye pattern is experimental method that contains all the information concerning the degradation of quality.	-
136.	Low-pass filter	-	Low-pass filter, designed to remove the double-frequency components of the product modulator output and pass the zero-frequency components.	-
137.	Quadrature Amplitude Modulation	QAM	QAM is a combination of ASK and PSK	-
138.	Synchronization	-	It is known till now that for the coherent reception of any signal, it is necessary to synchronize the receiver to the transmitter	-
139.	Cyclic property	-	Every cyclic shift of a valid code vector produces another valid code vector.	-
140.	Linear code	-	A code is linear if modulo-2 sum of any two code vectors produces another code vector. This means any code vector can be expressed as linear combination of other code vectors.	-
141.	Simplification	-	1899.981 ÷ √1444.12 – 119.910 % of 34.975 + 4.932 * 104.292 = **?** **Ans:** 528	-
142.	Profit and Percentage	-	A box contains six pink balls and four orange balls and three balls drawn one after other. Find the probability of all three balls being Pink balls if the balls drawn are not replaced? **Ans:** 1/6	-
143.	Number Series	-	Find the wrong term in the following number series? **90, 86, 95, 79, 103, 68, 117** **Ans:** 103	-
144.	Number Series	-	What value should come in the place of question mark in the given series? **19, 23, 32, 48, 73, 109, ?** **Ans:** 158	-
145.	Relation ship	-	Eight persons B, E, J, K, M, S, T and V are in a family with three different generations. J is the son of B. E is the daughter of K and	-

			sister of S. M is the mother of E. V is the sister-in-law of S, who has only two siblings. S is the aunt of J. T is the niece of B. E does not has any child. **If J is married to X, then how is X related to E?** **Ans:** Cannot be determined	
146.	Computer Awareness	-	The address of input/output device or memory is carried by the _____ and the data to be transferred is carried by the ___ **Ans:** Address bus, Data bus	-
147.	Directions	-	A man started walking from his place. He goes 5m south. He turns 90 degree anticlockwise and walks for 7m. Now he turns left and goes 3m. After turning right, he walks for 4m, again he walks for 3m after turning left. Now he turns towards west and walks for 5m. He again walks for 5m before he stops. **What is the shortest distance between his starting point and ending point?** **Ans:** 1m	-
148.	Speed and Time	-	A bag contains 4 red marbles, 5 green marbles and 6 pink marbles. If 3 marbles are taken at randomly, then find the probability that 2 marbles are Pink? **Ans: 27/91**	-
149.	Time and Work	-	A can do a work in 15 days, B can do it in 12 days but C can do (3/4)th of the work in 18 days. Find the time taken by all together to complete the work? **Ans:** 5 5/23 days	-
150.	Time and Work	-	A contractor hired 40 men to complete a project in 15 days. 40 men started working, after 9 days the contractor notices that only three-fifth of the work gets completed. Then how many extra men can be employed to complete the remaining work on time? **Ans: 0**	-

Faculty Team Prepared **Signatures**

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