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DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute Affiliated to VTU, Belagavi)
Shavige Malleshwara Hills, Kumaraswamy Layout, Bengaluru-560078

UG Semester End Examination, May-June 2019

Course: **Digital Communication** — Maximum marks: **100**
Course Code: **EC61** — Duration: **03 hours**
Semester: **VI**

Note: **i). Question ONE (a to t) has to be answered from pages 5 to 7 only.**
ii). Question 1 to 4 is compulsory.
iii). Any missing data should be suitably assumed.
iv). Complementary error function can be used.

Q. No.			Marks
1	a	Signal obtained when message signal is multiplied with Dirac comb is _____.	01
	b	For a step size of 0.2V, variance of the quantization noise produced by the uniform quantizer is_____	01
	c	Practical value of A in A-law companding is_____	01
	d	T1 carrier system can accommodate _____number of voice signals in first level.	01
	e	Name a binary format which is suitable for transmission over noisy channel, having error detection capability. _____	01
	f	ISI produced by transmitting binary pulses given by $p(t)=\text{sinc}(2B_0t)$ is_____	01
	g	Relationship between ACF and PSD is that they are_____	01
	h	If {1 0 1 0 0 1 1} is given as input to duo binary signaling scheme, the transmitted sequence is_____	01
	i	Given $S_1(t)=A\cos(2\pi ft)$, signal orthogonal to $S_1(t)$ is_____	01
	j	_____algorithm works on optimum decision rule given by $\hat{m}=m_i \quad if \quad P(m_i sent\|x) \geq P(m_k sent\|x)$	01
	k	In matched filter, impulse response of filter is matched to basis function and is given by_____	01
	l	_____form the perpendicular axes in signal space diagram.	01
	m	Each symbol is of length _____in 16-FSK.	01
	n	A pair of sinusoidal waves that differ only in a relative phase shift of 180^0 s are referred to as_____	01
	o	Non coherent version of BPSK is _____	01
	p	Probability of bit error is_____ for BPSK compared to BFSK for the same E_b/N_0 ratio.	01
	q	Multiple access technique derived out of spread spectrum concepts is _____	01
	r	The ML sequence generator which generates 31 bit sequence consists of _____ number of flip flops.	01
	s	Processing gain of DSSS communication system which uses 4 bit length shift register for generating ML sequence is_____	01

t In fast frequency hopping, hop rate is _____ symbol rate. 01

2 a Show that sinc() function plays the role of reconstructing the signal from ideally sampled signal by deriving interpolation formula. 06

b Compare DPCM and DM considering any 5 parameters. 05

c Calculate the bit rate at the output of Bell's T1 multiplexing system. 05

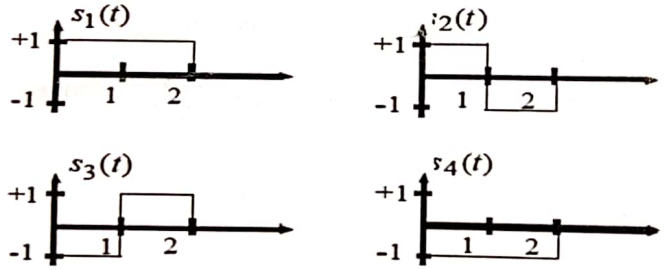
3 a Identify the formats which have self synchronization capability and inversion properties among the following with justification: **i)** Polar format **ii)** differential encoding **iii)** Bipolar format **iv)** Manchester format 04

b Show that the spectral content of NRZ bipolar format is relatively small around zero frequency by deriving the expression for power spectral density. 07

c A binary PAM wave is to be transmitted over a low pass channel with an absolute maximum BW of 75kHz. The bit duration is 10 μS. Find a raised cosine spectrum that satisfies these requirements. 05

4 a With neat diagram, explain two sub systems of correlation receiver. 08

b Given the signals shown below, find basis functions using GSO procedure. Draw signal space diagram and mark the signal points. 08



5 a Represent QPSK signals using basis functions. Draw signal space diagram and mark signal points in it. 08

b A binary FSK system transmits data at a rate of 3MBPs over an AWGN channel. The noise is zero mean with PSD, $N_0/2=10^{-12}$ W/Hz. The amplitude of the received signal in the absence of noise is 1micro volt. Calculate the average probability of error for coherent detection of FSK. 08

OR

6 a Show that in DPSK, data can be recovered without generating the carrier at the receiving end, with the help of its block diagram and an input sequence {10010011} 08

b Calculate E_b/N_0 required to achieve $P_e<10^{-5}$ for schemes: **i)** BPSK, **ii)** DPSK, **iii)** QPSK and explain the reason for variation in value. 08

7 a Define spread spectrum communication system. Justify FM is not spread spectrum system even though it require much higher transmission BW compared to message signal. 04

	b	Considering 4 stage feedback shift register with initial state=1001, generate the ML PN sequence. (Connection procedure => $x_3+x_4=x_0$) and show that it satisfy Run property.	08	
	c	Explain the working of DS/BPSK transmitter with the help of block diagram and waveforms.	04	

OR

8	a	Compare CDMA with FDMA and TDMA	06	
	b	Sketch time-frequency diagram for slow frequency hopping spread spectrum system considering ML sequence 100110101111000, and message sequence 100011101010. Consider 4FSK modulation and 2 symbols per hop. Represent each frequency with 4 bits of PN sequence	10	

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UG Makeup Examination, July 2019

Course: **Digital Communication**
Course Code: **EC61**
Semester: **VI**

Maximum marks: **100**
Duration: **03 hours**

Note: **i). Question ONE (a to t) has to be answered from pages 5 to 7 only.**
ii). Question 1 to 4 is compulsory.
iii). Any missing data should be suitably assumed.
iv). Complementary error function table to be used.

Q. No.			Marks
1	a)	What do you mean by aliasing effect in sampling?	01
	b)	What is the advantage of delta modulation over PCM?	01
	c)	Write NRZ unipolar format for the binary data 10101110	01
	d)	What is the sampling rate of human speech signal?	01
	e)	Define Pulse Amplitude Modulation (PAM)?	01
	f)	Define correlative coding?	01
	g)	What is the use of eye pattern?	01
	h)	State the main disadvantage of duo binary scheme?	01
	i)	Define antipodal signals?	01
	j)	Matched filter is used for _____detection.	01
	k)	The detector that minimizes the error probability is called as _____	01
	l)	Matched filter provides _____ signal to noise ratio.	01
	m)	The error probability of DPSK is _____ worse than PSK.	01
	n)	Which modulation scheme is also called as on-off keying method?	01
	o)	In which digital modulation technique, bit stream is portioned into even and odd stream?	01
	p)	Modulation process corresponds to _____ the amplitude, frequency or phase.	01
	q)	Pseudorandom signal _____ predicted.	01
	r)	Period of a maximal length sequence is given by _____	01
	s)	Define processing gain?	01
	t)	Which spread spectrum technique is better for avoiding jamming?	01

2 a) State and prove sampling theorem for lowpass signals. 08

b) Explain the working of DPCM transmitter and receiver. 08

3 a) Explain the need for a precoder in duo binary signaling. For input binary data 1011101, obtain the output of precoder, duo binary coder output and decoder output. 08

b) State and prove Nyquist criterion for distortion less baseband transmission. 08

4 a) Show that the impulse response of a matched filter is a time reversed and delayed version of the input signal. 08

b) What do you mean by an Optimum Receiver with reference to a digital modulation scheme? Write the scheme of correlation receiver and describe its features. 08

5 a) With neat diagram explain the operation of QPSK transmitter. Indicate the QPSK output phase for different Q and I binary input and phasor diagram. For an assumed input binary data write the QPSK output waveform. 08

b) Obtain the expression for probability of error of a BFSK system. 08

OR

6 a) Explain the working of DPSK system with neat block diagram 08

b) An FSK system transmits binary data at a rate of 2.5×10^6 bits per second. During the process transmission, white Gaussian noise of zero mean and power spectral density 10^{-20} W/Hz is added to the signal. In the absence of noise, the amplitude of the received sinusoidal wave for digit 1 or 0 is one microvolt. Determine the average probability of symbol error, assuming coherent detection. 08

7 a) Explain direct sequence spread spectrum with neat diagram 08

b) Discuss the application of spread spectrum techniques 05

c) A slow FH/MFSK has the following parameters 03
Number of bits/MFSK symbol = 4
Number of MFSK symbols/hop = 5
Find the processing gain of the system.

OR

8 a) Define spread spectrum. State the importance of PN Sequence. Explain the generation of PN sequence using maximum length sequence generator. 08

b) Explain the frequency hop spread M-ary FSK transmitter and receiver. 08

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UG Semester End Examination, May-June 2019

Course: **Digital Communication** Maximum marks: **100**
Course Code: **TE61** Duration: **03 hours**
Semester: **VI**

Note: i). **Question ONE (a to t) has to be answered from pages 5 to 7 only.**
ii). **Question 1 to 4 is compulsory.**
iii). **Any missing data should be suitably assumed.**

Q. No.			Marks
1	a	State sampling theorem for low pass signals.	01
	b	Define the term aliasing.	01
	c	Why is pre-filtering done before sampling?	01
	d	What is the Nyquist rate?	01
	e	If δ is the step size of a uniform Quantizer, the maximum Quantization error is _____	01
	f	Give the 6dB rule for uniform Quantizer.	01
	g	Why regenerative repeaters are used in Digital communication?	01
	h	Define Time Division Multiplexing.	01
	i	What is Adaptive delta modulation?	01
	j	Mention any two Companding Laws of non-uniform Quantizer.	01
	k	Define ISI.	01
	l	Mention any one of the modulation techniques used to convert analog to digital signal.	01
	m	Draw the polar NRZ wave form for the binary data 01101011.	01
	n	Name some of the modulation techniques used in transmission of Digital data.	01
	o	Expand the Acronym AWGN.	01
	p	Probability of symbol error of ASK is _____	01
	q	Mention any two advantages of Spread-spectrum technique.	01
	r	What are the two main types of Spread-Spectrum technique?	01
	s	Define Balance Property of Maximum Length Sequence.	01
	t	Give some of the application of spread spectrum technique.	01

	a	State Quadrature Sampling of Band Pass signal .Explain how signal is sampled and recovered back with appropriate diagram.	10
	b	Given $g(t)=A\cos(2\pi f0\ t)$.Plot the spectrum of discrete time signal $g_s(t)$ derived by sampling g(t) at time tn =n/fs where n=0, ±1, ±2, ±3,..... for **(i)** fs = f0 **(ii)** fs = 2f0 .	06
3	a	Obtain an expression for signal to Quantization noise ratio in the case of a uniform quantizer.	08
	b	A signal $m_1(t)$ is bandlimited to 3.6KHz and 3 other signals $m_2(t)$, $m_3(t)$, $m_4(t)$ are bandlimited to 1.2KHz each. These signals have to be transmitted by means of TDM.	08
		(i) Setup a scheme for realizing this multiplexing requirements with each signal sampled at its nyquist rate.	
		(ii) What must be the speed of the commutator in samples/sec.	
		(iii) Determine minimum BW of the channel.	
4	a	A speech signal with maximum frequency of 3.4 KHz and maximum amplitude of 1 V. this speech signal is applied to a delta modulator whose bit rate is set at 20 Kbps. Discuss the choice of an appropriate step size for the delta modulator.	08
	b	Derive the expression for power spectral density of unipolar NRZ line code. Hence discuss its characteristics.	08
5	a	Describe with diagrams the Transmitter and Receiver of DPSK.	10
	b	Derive the probability of error for PSK.	06
		OR	
6	a	Explain the generation and detection of binary QPSK with relevant diagram and waveforms.	08
	b	A binary FSK system transmits data at the rate of 2Mbps over a AWGN channel. The noise is zero mean with PSD $N_o/2=10^{-20}$ W/Hz. The amplitude of received signal in absence of noise is 1μv. Determine average probability of error for coherent detection of FSK.	08
7	a	Explain All the properties of Maximum Length Sequence.	06
	b	Construct 3-stage shift register with a maximum sequence length 01011100101110. Verify the three properties of PN sequence.	10
		OR	
8	a	Explain Direct sequence spread spectrum using block diagram.	08
	b	Give a short notes on Frequency spread-Spectrum Technique.	08

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UG Makeup Examination, July 2019

Course: **Digital Communication**
Course Code: **TE61**
Semester: **VI**

Maximum marks: **100**
Duration: **03 hours**

Note: i). Question ONE (a to t) has to be answered from pages 5 to 7 only.
ii). Question 1 to 4 is compulsory.
iii). Any missing data should be suitably assumed.

Q. No.			Marks
1	a)	Mention any two advantages of digital communication over analog communication.	01
	b)	State the sampling condition.	01
	c)	Name any two types of communication channels.	01
	d)	Define Aliasing.	01
	e)	Name any one of the modulation techniques used to convert analog signal into digital signal.	01
	f)	Give the sequence of operations of PCM.	01
	g)	Which of these modulation technique require minimum bandwidth ?Delta modulation PCM,DPCM ,PAM	01
	h)	When does the granular noise occur in Delta Modulation.	01
	i)	Draw the bipolar NRZ wave form for the binary data 11110101	01
	j)	The criterion used for pulse shaping to avoid ISI is_____	01
	k)	Define the Roll – off factor.	01
	l)	Define prediction error.	01
	m)	Which binary format waveform is used to generate ASK signal.	01
	n)	The probability of error of DPSK is _____ than that of BPSK.	01
	o)	Expand the Acronym AWGN.	01
	p)	In Binary Phase Shift Keying system, the binary symbols 1 and 0 are represented by carrier with phase shift of _____	01
	q)	Define FHSS	01
	r)	The period of a PN sequence produced by a linear n stage shift register cannot exceed _____ symbols.	01
	s)	Direct Sequence Spread Spectrum (DSSS) uses data rate of _____Mbps	01
	t)	In Frequency Hopping Spread Spectrum (FHSS), sender and receiver can have privacy if hopping period is (i) Short or (ii) Long	01

2	a)	Differentiate between Natural Sampling and Flat-top Sampling with relevant diagram and waveforms.	08
	b)	A signal $g(t)= 2\cos(400\pi t)+6\cos(640\pi t)$ is ideally sampled at $f_s = 500$Hz if sampled the signal is passed through an ideal LPF with a cut off frequency of 400Hz, what frequency components will appear at filter output?	08
3	a)	Obtain an expression for signal to Quantization error ratio in the case of a uniform quantizer.	08
	b)	A Voice signal $g(t)=6\sin(2\pi t)$ is transmitted using 4 bit PCM system. Quantizer of mid riser type with step size 1v is used. Sketch the PCMwave for one complete cycle. Assume sampling rate of 4 samples/sec with samples taken at t=±1/8, ±3/8, ±5/8 ,.....seconds	08
4	a)	Derive the power spectral density of polar NRZ code.	08
	b)	In a DM scheme, the voice signal is sampled at the rate of 64KHz. The maximum signal amplitude is 1v,voice signal BW is 3.5KHz.Determine **(i)**The minimum value of step size to avoid slope overload distortion. **(ii)**Determine granular noise. **(iii)**Assume signal to be sinusoidal, calculate signal power and SNR.	08
5	a)	Draw the necessary block diagram of coherent generation and detection of QPSK and explain. Also show the signal space diagram of it.	10
	b)	A binary data is transmitted using ASK over AWGN channel at the rate of 2.4Mbps. The carrier amplitude at receiver is 1mv. PSD of noise is 10-15 W/Hz. Find the average probability of error if the detection is **(i)** Coherent **(ii)** Non-Coherent.	06
		OR	
6	a)	Briefly discuss the working principle of DPSK system. Mention the advantage of DPSK over PSK.	08
	b)	Derive the probability of error for Phase Shift Keying.	08
7	a)	Construct 3-stage maximum length sequence generator and show the state diagram.	08
	b)	Explain the basic principle of direct sequence spread spectrum system.	08
		OR	
8	a)	Explain the FH/MFSK for transmitter and receiver.	10
	b)	Give a note on Fast-Frequency Hopping.	06

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DAYANANDA SAGAR COLLEGE OF ENGINEERING

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UG Semester End Examination, May2018

Course: Digital Communication **Code: TE61**

Maximum marks: 100 Duration: 3 hours

Answer five full Questions. All questions carry equal marks

			Marks
1	a	State the sampling theorem and Enumerate the sampling theorem with necessary equations.	10
	b	State basic components of a communication systems with block diagram, signal processing operation stages in digital communication.	10
		(OR)	
2	a	The signal g(t) = 10 cos(20πt) cos(200πt) is sampled at the rate of 250 samples per second. **(i)** Determine the spectrum of the resulting sampled signal. **(ii)** Specify the cut-off frequency of the ideal reconstruction filter so as to recover g(t) from its sampled version. **(iii)** What is the Nyquist rate for g(t). **(iv)** Explain the reconstruction process of a message from its samples.	10
	b	Bring out brief theory for natural sampling and flat-top sampling.	10
3	a	Formulate the process of quantization and obtain an expression for signal to quantization ratio in the case of a uniform quantizer.	10
	b	What is PAM? Explain TDM process with necessary diagrams.	10
		(OR)	
4	a	With neat diagrams, Pulse Code Modulation and demodulation system.	10
	b	Illustrate the Robust quantization with necessary diagrams.	10
5	a	What are the requirements of a line code? Draw following formats for digital data 10110001.**(i)** Manchester code **(ii)**NRZ **(iii)** NRZ Bipolar **(iv)** Polar RZ	10
	b	What is DM? Construct the transmitter and receiver of DM system.	10
		(OR)	
6	a	Illustrate the expression for power spectral density of unipolar NRZ line code. Hence discuss its characteristics.	10
	b	Formulate and explain ISI with necessary equations. And explain the block diagram of duo-binary signaling scheme for controlled ISI.	10
7	a	Describe with diagrams the generation and detection of coherent BFSK. Explain the probability of error for this scheme.	10
	b	Discuss about coherent detection of QPSK and derive its power spectral density.	10
		(OR)	

16/05/18

8	a	A set of binary data is sent at the rate of Rb = 100 Kbps over a channel with 60 dB transmission loss and power spectral density η = 10-12 W/Hz at the receiver. Determine the transmitted power for a bit error probability Pe=10-3 for the following modulation schemes. **(i)** FSK **(ii)** PSK **(iii)** DPSK **(iv)**16 QAM	10
	b	A BPSK system makes errors at the average rate of 100 errors per day. Data rate is 1 Kbps. The single-sided noise power spectral density is 10 W/Hz. Assume the system to be wide sense stationary, what is the average bit error probability?	05
	c	What are the advantages of QPSK over PSK?	05
9	a	What is the role of the PN sequence in spread spectrum communication? For the given PN sequence 0011101 verify the properties of it.	10
	b	Explain Direct sequence spread spectrum using block diagram.	10
		(OR)	
10	a	Explain the FH/MFSK for transmitter and receiver.	10
	b	Explain the properties of maximum length sequences and highlight the applications of spread spectrum techniques.	10

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DAYANANDA SAGAR COLLEGE OF ENGINEERING

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UG Makeup Examination, June/July 2018

Course: **Digital communication** Code: **TE61**

Maximum marks: 100 Duration: 3 hours

Answer five full Questions. All questions carry equal marks

			Marks
1	a	State basic components of a communication systems with block diagram and explain signal processing operation stages in digital communication.	08
	b	What do you mean by analog to digital conversion and digital to analog conversion?	04
	c	State the sampling theorem and Enumerate the sampling theorem for low pass signals with necessary equations.	08
		(OR)	
2	a	Bring out the advantages and disadvantages of digital communication.	06
	b	The analog signal is expressed by the equation $x(t) = 3\cos(50\pi t) + 10\sin(300\pi t) - \cos(100\pi t)$ .Calculate the **(i)** Nyquist rate **(ii)** Nyquist interval **(iii)** Draw the sampled spectrum at Nyquist rate.	06
	c	What is aliasing? Mention how aliasing can be avoided? Carry out the quadrature sampling of band pass signal.	08
3	a	What is PAM? Explain TDM process with necessary diagrams and equations.	08
	b	Differentiate analog pulse amplitude modulation and digital pulse amplitude modulation.	04
	c	Construct the PCM system and briefly explain each component of the PCM system.	08
		(OR)	
4	a	Illustrate the different types of quantizer along with the quantization error.	06
	b	What is the need of non uniform quantization and explain different types of companding with the characterstics.	08
	c	Show that μ=A, μ-law and the A-law have the same companding gain .	06
5	a	What is DM? Construct the transmitter and receiver of DM system. State the main advantages of DM.	10
	b	Find the output signal-to-noise ratio in delta modulated system for a 1KHz sinusoid .Which is sampled at 32Khz without slope overload. The bandwidth of the reconstruction filter used is 4kHz.	05
	c	Briefly explain **i)** Slope overload distortion **ii)** Granular noise **iii)** Bit rate of DM	05
		(OR)	
6	a	Formulate a ADM with expressions and block diagram. Quote a reasons to choose the ADM.	10

	b	Illustrate the expression for power spectral density of Manchester line code. Hence discuss its characteristics.	10
7	a	Describe with diagrams the generation and detection of coherent FSK. Explain the probability of error for this scheme.	10
	b	Discuss about coherent detection of QPSK and derive its power spectral density.	10
		(OR)	
8	a	Illustrate the generation and detection of binary PSK. Also derive the probability of error for PSK.	10
	b	A BPSK system makes errors at the average rate of 100 errors per day. Data rate is 1 Kbps. The single-sided noise power spectral density is 10 W/Hz. Assume the system to be wide sense stationary, what is the average bit error probability?	05
	c	What are the requirements of a line code? Draw following formats for digital data 10110001. **i)** Manchester code **ii)**NRZ **iii)** NRZ Bipolar **iv)** Polar RZ.	05
9	a	Explain the FH/MFSK for transmitter and receiver.	10
	b	Construct 3-stage shift register (2,3) with a linear feedback generates the sequence 01011100101110. **i)** Determine the period of the given infinite sequence **ii)** Verify the three properties of PN sequence for the given sequence.	10
		(OR)	
10	a	Explain Direct sequence spread spectrum for BPSK using block diagram and performance parameters.	10
	b	Explain the properties of maximum length sequences and highlight the applications of spread spectrum techniques.	05
	c	A spread spectrum communication system is characterized by the following parameters. Information bit duration TB = 4.095ms,Chip duration of the PN sequence TC=1μs, (Eb/No)=10,where Eb =energy per bit and No/2= Spectral density of white noise. Average probability of error = 0.5×10^{-5}. Determine the processing gain and jamming margin.	05

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DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute Affiliated to VTU, Belagavi)

UG Semester End Examination, May2018

Course: Information Theory and Coding Code: **TE62**

Maximum marks: 100 Duration: 3 hours

Answer five full Questions. All questions carry equal marks

			Marks
1	a	Discuss some of the important properties of the codes.	04
	b	A source having an alphabet S = { s_1, s_2, s_3, s_4, s_5 } produces these symbols with respective probabilities $\frac{1}{2}, \frac{1}{6}, \frac{1}{6}, \frac{1}{9}, \frac{1}{18}$. (i) When these symbols are coded and has word lengths l_1 = 1 binits, l_2 = 2 binits, l_3 = 3 binits, l_4 and l_5 = 4 binits . Find the code efficiency and Redundancy.	06
	c	For the 4 messages X_1, X_2, X_3, X_4 with respective probabilities 0.1, 0.2, 0.3, 0.4 **(i)** Construct the Shannon-Fano code. **(ii)** Calculate the efficiency and redundancy of the code **(iii)** Calculate the probabilities of 0's and 1's in the code	10
		(OR)	
2	a	Apply Shannon's encoding algorithm to the following set of messages and obtain code efficiency and redundancy. m_1, m_2, m_3, m_4, m_5 with $\frac{1}{8}, \frac{1}{16}, \frac{3}{16}, \frac{1}{4}, \frac{3}{8}$ respective probabilities.	10
	b	Consider a zero-memory source with S {$S_1, S_2, S_3, S_4, S_5, S_6, S_7$}, P {0.4, 0.2, 0.1, 0.1, 0.1, 0.05, 0.05} (i) Construct a binary Huffman code by placing the composite symbol "**as low as**" you can. Compute the variance of the word-lengths.	10
3	a	Define **(i)** Linear block codes **(ii)** Systematic codes and non-systematic codes **(iii)** cyclic codes with relevant examples	06
	b	For the Systematic (6,3) code , the code vector C for a message input of (d_1 , d_2 ,d_3) is given by [C] = [d_1 ,d_2 ,d_3 , (d_1 +d_3), (d_2 +d_3), (d_1 +d_2)] construct the corresponding encoding circuit.	04
	c	Design an encoder for the (7,4) binary cyclic code generated by $g(x) = 1+x+x^3$ and verify its operation using message vectors(1001) and (1011)	10
		(OR)	
4	a	For a Systematic (6,3) linear code, the parity matrix is given by $\begin{pmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{pmatrix}$ **(i)**Find all possible code-Vectors, **(ii)** Show that it is a linear block code, **(iii)** For the received vector R=100100,find the syndrome and correct the code, **(iv)**Draw the encoding circuit.	10
	b	For a (7, 4) cyclic code, the received vector Z(x) is 1110101 and the generator polynomial is $g(x) = 1+x+x^3$. Draw the syndrome calculation circuit and correct the single error in the received vector.	10

5 a Define the following terms: Group, Sub Group, Field, vector space and Solve for x and y, from the following linear equations over GF (2^4). 10

$X+\alpha^7 y=\alpha^2$, $\alpha^{12}x+\alpha^8 y=\alpha^4$

b With an appropriate example, prove that any irreducible polynomial over GF(2) of degree m divides $X^{2^m-1}+1$ 10

(OR)

6 a Consider GF (2^4).If α^7 and its conjugates are roots of a polynomial f(x), and then determine the polynomial f(x). 10

b Construct a table for GF(2^4) based on the primitive polynomial $p(x)=1+x+x^4$. Display the power, polynomial, vector and decimal representation of each element. 10

7 a Determine the generator polynomials for t=1 and t = 2 for primitive BCH codes of length 15. Use Galois field GF(2^4) generated by $P(x) = 1+x+x^4$. 10

b Consider the double error correcting (15,7) BCH code and find the syndrome if the received vector r=(100000001000000) in GF(2^4) 10

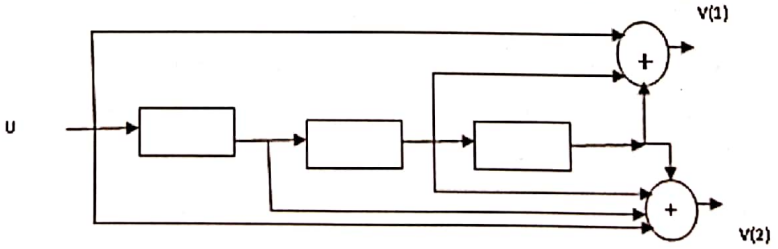
(OR)

8 a Construct g(x) for a triple error correcting Reed Solomon code with symbols from GF (2^4). 10

b Explain the Berlekamp algorithm for decoding Reed solomaon code. 10

9 a In a (3,2,1) convolution encoder $g_1^{(0)}$ = [11] , $g_1^{(1)}$ = [01] , $g_1^{(2)}$ = [11], $g_2^{(0)}$ = [01], $g_2^{(1)}$ = [10], $g_2^{(2)}$ = [10]. For the message $u^{(1)}$ = [110] and $u^{(2)}$ = [101] ,Find the code word using time domain and transform domain approach. 10

b For a (2,1,3) convolution encoder as shown in the figure , **(i)** draw the state transition diagram **(ii)** draw the code tree **(iii)** Find the encoder output produced by the message sequence (11101), travelling through the code tree. 10



(OR)

10 a A convolutional encoder with the connection matrix is given by $g=\begin{bmatrix}1 & 1 & 1\\ 1 & 0 & 1\end{bmatrix}$ is given an input d=10011. Using time-domain and transform domain approaches, compute the output sequences. 10

b Explain the distance properties and structural properties of convolution codes. 10

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DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute Affiliated to VTU, Belagavi)

UG Makeup Examination, June/July 2018

Course: Information Theory and Coding — **Code: TE62**

Maximum marks: 100 — Duration: 3 hours

Answer five full Questions. All questions carry equal marks

			Marks
1	a	Define Code Efficiency and Redundancy.	04
	b	Apply Shannon's encoding algorithm to the following set of messages and obtain code efficiency and redundancy. m_1, m_2, m_3, m_4, m_5 with $\frac{1}{8}, \frac{1}{16}, \frac{3}{16}, \frac{1}{4}, \frac{3}{8}$ respective probabilities.	06
	c	Construct an instantaneous binary code for a source producing 5 symbols S_1 to S_5.	10
		(OR)	
2	a	A discrete memory less source has an alphabet of seven symbols S $\{S_0, S_1, S_2, S_3, S_4, S_5, S_6,\}$ with probabilities P{ 0.25, 0.25, 0.125, 0.125, 0.125, 0.0625, 0.0625} Compute Shannon- Fano code for this source. Find coding efficiency.	10
	b	Consider a zero-memory source with S $\{S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8\}$, P {0.22, 0.20, 0.18, 0.15, 0.10, 0.08, 0.05, 0.02} (i) Construct a binary Huffman code and determine the code efficiency.	10
3	a	If code vector is [C] = [D] [G], then prove that $CH^T = 0$. Where H^T is the transpose of the parity check matrix H.	06
	b	Construct the standard array look up(syndrome decoding) table for a (6, 3) linear block code.	04
	c	Construct the generator matrix [G] and parity check matrix [H] of (7,4) cyclic codes using generator polynomial $g(x) = 1+x+x^3$	10
		(OR)	
4	a	Design an encoder for the (7,4) binary cyclic code generated by $g(x) = 1+x+x^3$ and verify its operation using message vectors(1001) and (1011).	10
	b	For a (7, 4) cyclic code, the received vector Z(x) is 1110101 and the generator polynomial is $g(x) = 1+x+x^3$. Draw the syndrome calculation circuit and correct the single error in the received vector.	10
5	a	Write modulo 5 addition and multiplication table and check if it satisfies all the properties.	10
	b	Check if the following polynomials are irreducible and primitive .	10
		(i) X^4+X+1	
		(ii) $X^4+X^3+X^2+X+1$	
		(OR)	

6 a Construct a table for GF(2^4) based on the primitive polynomial $p(x)=1+x+x^4$. Display the power, polynomial, vector and decimal representation of each element. 10

b Consider GF (2^4).If α^7 and its conjugates are roots of a polynomial f(x), and then determine the polynomial f(x). 10

7 a Determine the generator polynomials for t=1 and t = 2 for primitive BCH codes of length 7. Use Galois field GF(2^3) generated by $P(x) = 1+x+x^3$. 10

b Consider the double error correcting (15,7) BCH code and find the syndrome if the received vector r=(100000001000000) in GF(2^4) 10

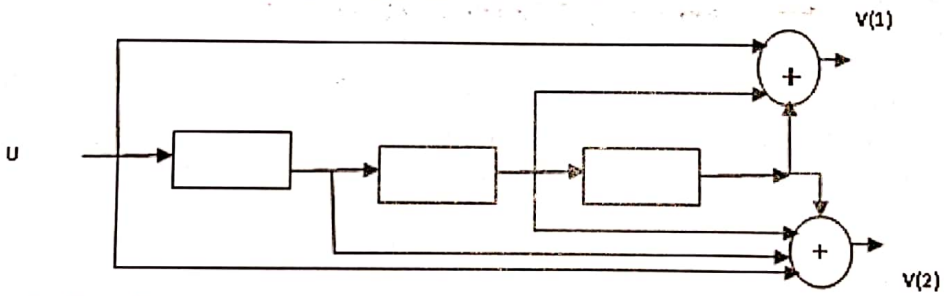
(OR)

8 a Give the important parameters and features of RS code. Give the encoding circuit for q-ary S code and explain the symbols used in the circuit. 10

b Construct the generator polynomial for a (7,5) Reed Solomon code. 10

9 a Consider the (3,1,2) convolutional encoder with g(0)={110}, g(1)={101}, g(2)={111}. **i)**Draw the encoder block diagram. **ii)**Find the time domain and transform domain code word for the information sequence u=(11101). 10

b For a convolution encoder as shown in the figure , **i)** draw the state transition diagram **ii)** draw the code tree **iii)** Find the encoder output produced by the message sequence (11101), travelling through the code tree. 10



(OR)

10 a In a (3,2,1) convolution encoder, the impulse response is given by, 10

$g_1^{(1)} = [01]$, $g_1^{(2)} = [10]$, $g_1^{(3)} = [10]$,

$g_2^{(0)} = [01]$, $g_2^{(1)} = [10]$, $g_2^{(2)} = [01]$.

(i) Draw the encoding circuit.

Find the code word for the message U = [110110]

b Explain the distance properties and structural properties of convolution codes. 10

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DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute Affiliated to VTU, Belagavi)

UG Semester End Examination, May2018

Course: **Digital Communication** Code: **EC61**

Maximum marks: 100 Duration: 3 hours

Answer five full Questions. All questions carry equal marks

			Marks
1	a	State sampling theorem. Explain quadrature sampling of band pass signals.	06
	b	What is robust quantization? Clarify the necessity of non-uniform quantization and explain how it is achieved using A law and μ law.	08
	c	Name the basic elements of PCM system. Elaborate all the elements in brief.	06
		(OR)	
2	a	Derive the expression for signal to quantization noise ratio for a PCM system which employs uniform quantization technique. If the input to the PCM system is a sinusoidal signal.	08
	b	What are slope overload distortion and granular distortion in delta modulation and how can it be improved.	08
	c	Illustrate encoding and decoding process in DPCM.	04
3	a	What is ISI? Arrive at Mathematical expression which indicates signal component and ISI.	07
	b	Arrive at the expression for power spectral density (PSD) of unipolar NRZ line codes.	08
	c	List the parameters based on which line codes selected for particular application.	05
		(OR)	
4	a	A computer O/P's binary data at the rate of 50 kilobits/sec that is transmitted using a baseband binary PAM system. Which is designed to have a raised cosine pulse spectrum. Find the transmission bandwidth required for each of the following factors **(i)** $\alpha = 0.2$ **(ii)** $\alpha = 0.4$ **(iii)** $\alpha = 0.8$.	07
	b	A binary sequence "001101001" is applied to a duo-binary system. Construct the duo binary coder output and corresponding receiver output without a precoder .suppose that due to error during transmission. The level at the receiver input produced by the second digit is reduced to zero. Construct the new receiver output.	07
	c	Analyse the need for Adaptive equalizer in Digital communication? List the parameters considered while designing a adaptive equalizer .Draw the block diagram of an adaptive equalizing filter.	06
5	a	Draw a typical digital communication system and discuss about gram-schmitt orthogonalization Procedure to determine a finite set of N orthonormal functions.	10

b Arrive at the equation for output signal to noise ratio of matched filter and prove that impulse response of optimum filter is a time reversed and delayed version of input signal. 10

(OR)

6 a Three message signals m1, m2 and m3 are to be transmitted over AWGN channel with noise power spectral density $\frac{N_0}{2}$. The messages are 10

$$S_1(t) = \begin{cases} 1 & for\ 0 \le t \le T \\ 0 & otherwise \end{cases}$$

$$S_2(t) = -S_3(t) = \begin{cases} 1 & for\ 0 \le t \le 0.5T \\ -1 & for\ 0.5T \le t \le T \\ 0 & otherwise \end{cases}$$

i. What is the dimensionality of the signal space?
ii. Find a set of orthonormal basis functions for the signal space.
iii. Draw the signal constellation for this problem.

b Differentiate between two optimum receivers. 06

c Illustrate the geometric representation of signals N=2 and M=5. 04

7 a Arrive at the expression for probability of error for PSK receiver. 10

b Elaborate on the generation and detection of QPSK. 06

c Discuss the advantages and disadvantages of DPSK. 04

(OR)

8 a Arrive at the generation of binary FSK wave and reconstruction of Binary wave from Coherent binary FSK receiver. 10

b Differentiate between Coherent and Non-Coherent PSK Techniques. 04

c Two quadrature carriers $\cos(2\pi ft)$ *and* $\sin(2\pi ft)$ are used to transmit digital information through an AWGN channel at two different data rates, 10Kbps and 100Kbps. Determine the relative amplitudes of the signals for the two carriers so that the $\frac{E_b}{N_0}$ for the two channels is identical. Here, E_b is the energy per bit. 06

9 a Arrive at the circuit diagram to generate 3 bit PN sequence .List any three Properties of PN Sequence. 10

b Discuss the Principle and operation of digital sequence spread spectrum system with coherent PSK. 10

(OR)

10 a In a direct Sequence spread –spectrum modulation a 14 stage linear feedback shift register is used to generate the PN code sequence. Find the Period of code sequence and Processing gain. 06

b List the properties of maximum length sequence and prove that the following sequence of binary digits 100110101111000 satisfies these properties. 10

c List the applications of Spread spectrum. 04

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DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute Affiliated to VTU, Belagavi)

UG Makeup Examination, June/July 2018

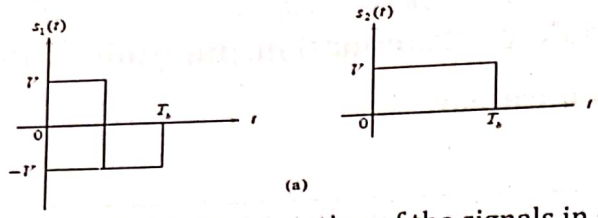
Course: Digital communication **Code: EC61**

Maximum marks: 100 Duration: 3 hours

Answer five full Questions. All questions carry equal marks

			Marks
1	a	Derive the expression for flat top sampling with the relevant waveforms	08
	b	Analyse the differential pulse coding and encoding technique with the help of block diagrams and equations.	08
	c	Determine the Nyquist rate & Nyquist sampling interval for the following signals **i)** $x_1 = \text{sinc}^2(350\pi t)$ **ii)** $x_2 = \text{sinc}^2(400\pi t) + \text{sinc}(300\pi t)$	04
		(OR)	
2	a	Apply the principles of digital communication on how to transmit and receive band pass signals.	07
	b	Analyse the errors encountered in a DM systems. Compare DM with other waveform coding techniques.	07
	c	A signal $g(t) = 10\cos(20\pi t)\cos(200\pi t)$ is ideally sampled at fs = 250 samples/sec. **i)** Sketch the spectrum of the sampled signal. **ii)** Specify the cut-off ideal reconstruction filter so as to recover g(t) from $g_\delta(t)$. **iii)** Specify the Nyquist rate for the signal g(t).	06
3	a	Generate the power spectral density of Manchester format.	08
	b	Arrive at the practical solution for zero ISI.	06
	c	For the binary data 001101011 applied to the input of a duobinary system, construct .The Duobinary coder output and receiver output without a precoder.	06
		(OR)	
4	a	Generate the digital data format for 1010110101 for Bipolar RZ, NRZ Bipolar and Manchester.	08
	b	Arrive at the ideal solution for zero ISI.	06
	c	Illustrate with the help of a diagram the modes of operating an Adaptive Equalizer.	06
5	a	Set up a scheme for generating a signal Si(t) and for generating the coefficients {Si} using Gram Schmidt Orthogonalization procedure.	08
	b	Illustrate the geometric representation of signals N=2, M= 3	04
	c	What are the two parts of an optimum receiver? Show the implementation using block diagrams.	08
		(OR)	

6	a	Conceptualize and explain the model of a digital communication system for detection of signals.	08	
	b	Given the signals shown below, find basis functions using GSO procedure. Draw signal space diagram and mark the signal points.	08	



(a)

	c	Illustrate the geometric representation of the signals in signal space, S1(t) =5ø1 (t) + ø2(t) S2(t) = 10ø1 (t) + 0.5 ø2(t), S3(t) = 3ø1 (t) – 7 ø2(t). What is the value of N and M.	04	
7	a	Write the Mathematical equations representing ASK, FSK and PSK Modulation techniques and the respective waveforms.	06	
	b	Conceptualize and explain the digital transmitter and reciever block diagrams for the non coherrent version of PSK.	06	
	c	Arrive at the transmitter block diagram and signal space diagram for FSK.	08	

(OR)

8	a	Derive the probability of error for Coherent Binary PSK with the help of signal space diagram.	10	
	b	For the sequence 01101000, generate the waveforms for in phase and quadrature components, and the final QPSK waveform.	06	
	c	Distinguish between coherent and non-coherent detection.	04	
9	a	Prove the properties of Maximum length sequence For the PN Sequence 0011101.	06	
	b	Analyze the model of DS/BPSK and write the associated equations.	06	
	c	Show the frequency hopping for a FH/MFSK if number of bits /MFSK symbol K=2, length of PN Segment per hop is three.	08	

(OR)

10	a	List the properties of maximum length sequence.	08	
	b	Design an ML sequence generator of length 3, write all the states of flip flops, and the output sequence.	06	
	c	Illustrate and explain the transmitter and receiver of an FH/FMFSK system.	06	

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DAYANANDA SAGAR COLLEGE OF ENGINEERING

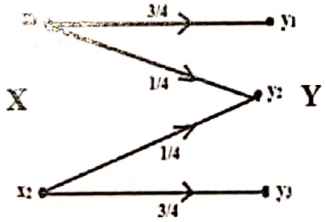
(An Autonomous Institute Affiliated to VTU, Belagavi)

UG Semester End Examination, May2018

Course: Information Theory and Coding Code: **EC64**

Maximum marks: 100 Duration: 3 hours

Answer five full Questions. All questions carry equal marks

			Marks
1	a	Define the following with respect to information theory **i)** Entropy **ii)** Rate of Information **iii)** Self information for a composite message.	06
	b	Derive an expression for average information content (entropy) of long independent messages.	06
	c	A binary source emitting an independent sequence of 0's and 1's with probabilities p and (1-p) respectively. Plot the entropy of the source.	08
		(OR)	
2	a	Derive the relation between Hartley, Nat and Bits.	06
	b	Design a trinary source code for the source shown using Huffman's coding procedure $S = \{s_1, s_2, s_3, s_4, s_5, s_6\}$, $P=\left\{\frac{1}{3}\frac{1}{4}\frac{1}{8}\frac{1}{8}\frac{1}{12}\frac{1}{12}\right\}$, $X= \{0\ 1\ 2\}$. Also determine efficiency and redundancy.	06
	c	Given the messages S_1, S_2, S_3, and S_4 with respective probabilities of 0.4,0.3,0.2 and 0.1 construct a binary code by applying Huffman encoding procedure. Determine the efficiency and redundancy of the code so formed.	08
3	a	Apply Shannon's binary Encoding procedure to the following set of messages and obtain the code efficiency and redundancy for 1/8,1/16,3/16, 1/4, 3/8	10
	b	Evaluate the rate of transmission of information through a channel whose noise characteristics is as shown. Given $p(x_1) = p(x_2) = 1/2$, rs=10,000 symbols/sec.	10
			
		(OR)	
4	a	A binary symmetric channel has the following noise matrix with source probabilities $P(x_1) = 2/3$, $P(x_2) = 1/3$. Evaluate H(x), H(y), I(x, y), C & η_{ch}. $$P\left(\frac{y}{x}\right) = \begin{bmatrix} 3/4 & 1/4 \\ 1/4 & 3/4 \end{bmatrix}$$	10
	b	What is Shannon's limit? Derive expression for Shannon's limit for (E_b/n_0) parameter illustrating with Bandwidth – efficiency diagram.	10

5 a Considering GF(7), construct Modulo-7 addition and multiplication tables. Referring to the tables perform the following operations: 10

Addition: 4 + 5,
Multiplication: 4. 5,
Subtraction: 4-5 and
Division 4 / 5.

b In a linear block code (7,4) the syndrome is given by S1=r1+r2+r3+r5, S2=r1+r2+r4+r6 and S3=r1+r3+r4+r7 10

i. Construct G and H Matrices.
ii. Design the corresponding encoding circuit.
iii. A single error has occurred in the received vector R=[1011100]. Detect and correct error.

(OR)

6 a What are the different methods of controlling errors? Explain. 06

b Prove that $\mathbf{C.H^T=0}$. 04

c In a linear block code (6,3) the syndrome is given by 10

S1=r1+r3+r4 ; S2=r2+r3+r5 and S3=r1+r2+r6

i. If the received code vector is R = [110010], Detect and correct the single error that has occurred due to noise.
ii. Construct G and H Matrices.
iii. Construct the corresponding encoding circuit.

7 a Consider a (15,11) Cyclic code generated using $\mathbf{g(x) = 1 + x + x^4}$ 10

i. Device a feedback registers Encoder for the same.
ii. Illustrate the encoding procedure with the message vector **[10010110111]** by listing the status of shift registers.

b A (15,5) binary cyclic code has a generator polynomial $g(x)=1+x+x^2+x^4+x^5+x^8+x^{10}$. 10

i. Construct the block diagram of encoder and Syndrome Calculator for this code.
ii. Estimate the code polynomial for message polynomial $D(x) =1+x^2+x^4$ in systematic form.
iii. Is $V(x) =1+x^4+x^6+x^8+x^{14}$ a code polynomial?

(OR)

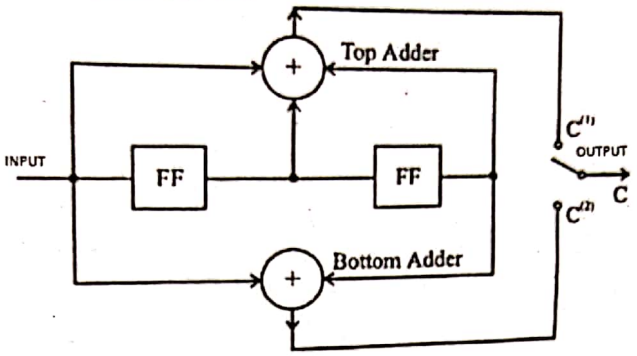
8 a Design an encoder for the (7,4) binary cyclic code generated by g(x) = 1 + x + x3 and check its operation using the message vectors 1001 and 1011 10

b Consider a (6, 3) linear block code whose generator matrix is given below. 10

Determine: **i)** all code words **ii)** Construct the encoder circuit
iii) Syndrome calculation circuit.

$$G=\begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 \end{bmatrix}$$

9 a For the convolution encoder shown in figure, construct the **i.** state table **ii.** state diagram **iii.** State transition table **iv.** the corresponding code tree **v.** Using the code tree, find the encoded sequence for the message (10111) using transform domain approach. 10



b Consider the (3,1,2) convolution code with $g^{(1)}$=(1 1 0),$g^{(2)}$=(1 0 1) and $g^{(3)}$=(1 1 1). 10

i. Determine the constraint length, rate efficiency.

ii. Construct the generator matrix.

iii. Build the encoder block diagram.

iv. Generate the code word for the message sequence (1 1 1 0 1) using time domain approach.

(OR)

0 Consider the (3,1,2) convolution code with $g^{(1)}$=(1 1 0),$g^{(2)}$=(1 0 1) and $g^{(3)}$=(1 1 1). 20

i. Build the encoder block diagram.

ii. Construct the generator matrix.

iii. Generate the code word for the message sequence (1 0111) using time domain and Transfer domain approach.

iv. verify using code tree

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DAYANANDA SAGAR COLLEGE OF ENGINEERING

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UG Makeup Examination, June/July 2018

Course: Information theory & Coding **Code: EC64**

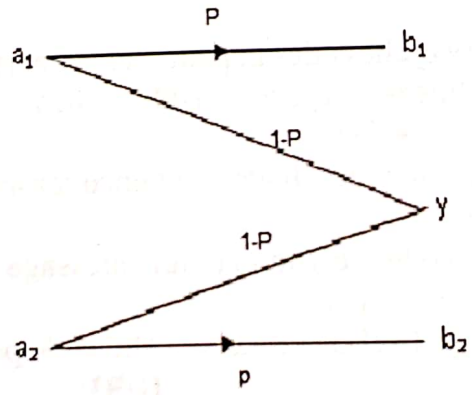
Maximum marks: 100 Duration: 3 hours

Answer five full Questions. All questions carry equal marks

			Marks
1	a	A source has 2 symbols alpha and beta. The duration of alpha is 0.2 sec, beta duration is 3 times of alpha duration. The probability of alpha is twice that of beta and time between each symbol is 0.2 sec. Calculate the information rate of the source.	06
	b	Explain the reasons for using logarithmic measure for measuring information.	04
	c	Given a five symbol source with probabilities P={0.55, 0.15, 0.15, 0.10, 0.05} Construct two different Huffman binary codes as directed below: **i)** Place the composite symbol as 'high' as possible **ii)** Move the composite symbol as 'low' as possible. In each case determine the variance of the word lengths and comment on the results.	10

(OR)

2	a	An analog signal is band limited to 500Hz and is sampled at Nyquist rate. The samples are quantized into 4 levels. The quantization levels are assumed to be independent and occur with probabilities $P_1=P_4=\frac{1}{8}$, $P_2=P_3=\frac{3}{8}$. Find the information rate of the source.	04
	b	Construct a binary code for the following source using Shannon's encoding algorithm. S = {s1, s2, s3, s4, s5} P = {0.4, 0.08, 0.12, 0.25, 0.15}	06
	c	Show that the entropy of a discrete memory less source will become maximum when all source symbols are equally probable. What is the maximum value of entropy ?	06
	d	Define the following terms with examples for each. **(i)** Self information **(ii)** Mutual information	04
3	a	For a binary erasure channel shown in fig below find the following. **(i)** Average mutual information. **(ii)** The channel capacity.	10



b A binary symmetric channel has the following noise matrix with source probabilities of P(x1) = 2/3 and P(x2) = 1/3. 10

$$P[Y/X] = \begin{bmatrix} \frac{3}{4} & \frac{1}{4} \\ \frac{1}{4} & \frac{3}{4} \end{bmatrix}$$

(i) Determine H(X),H(Y), H(X,Y), H(Y/X),H(X/Y) and I(X,Y)
(ii) Find the channel capacity .
(iii) Find channel efficiency and redundancy.

(OR)

4 a Define Binary Symmetric channel. Derive an expression for the channel capacity of a BSC. 10

b For the Joint probability matrix shown below, find H(x,y), H(x), H(y), H(x/y), H(y/x) and I(x;y). 10

$$P(x,y) = \begin{bmatrix} 0.2 & 0 & 0.2 & 0 \\ 0.1 & 0.01 & 0.01 & 0.01 \\ 0 & 0.02 & 0.02 & 0 \\ 0.04 & 0.04 & 0.01 & 0.06 \\ 0 & 0.06 & 0.02 & 0.2 \end{bmatrix}$$

5 a What is a primitive polynomial ? Construct a table for GF(2^4) based on the primitive polynomial P(X) = 1 + X + X^4. 08

b For a (6,3) linear block code, the parity matrix P is given by 12

$$[G] = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$$

(i) Find code word for all messages.
(ii) Write encoder circuit.
(iii) Find the Parity check matrix.
(iv) Write the syndrome circuite

(OR)

6 a Define Groups and Fields. 04

b Construct Modulo-7 addition and multiplication tables. 04

c State and prove the following theorems valid for a linear block code: 12

(i) Theorem on minimum distance of a linear block code.
(ii) Theorem on the number of errors which the code can correct and the number of errors which can be detected.

7 a What is a binary cyclic code? Explain the properties of cyclic code. 06

b A (15,5) linear cyclic code has a generator polynomial $g(x)=1+x+x^2+x^4+x^5+x^8+x^{10}$ 14

i) Draw the block diagram of encoder and syndrome calculator for this code.
ii) Find code polynomial for message polynomial .$D(x)=1+x^2+x^4$ in systematic form.
iii) Is $V(x)=1+x^4+x^6+x^8+x^{14}$ a valid code polynomial.

(OR)

8 a A linear cyclic code has a generator polynomial $g(x) = 1 + x + x^2 + x^4 + x^5 + x^8 + x^{10}$ 10

(i) Draw the block diagram of encoder and syndrome calculator for this code.

(ii) Find code polynomial for message polynomial $D(x) = 1 + x^2 + x^4$ in systematic form.

b Design (n,k) hamming code with $d_{min} = 3$ and a message length of 4 bits. Also find its error correcting capability. 05

c The generator polynomial for (15,7) cyclic code is $g(x)=1+x^4+x^6+x^7+x^8$. Find the code vector in systematic form of message $D(x) = x^2+x^3+x^4$ suffer transmission error. Find the syndrome of V(x). 05

9 a For a (3,1,2) convolution code with $g^{(1)}=110$, $g^{(2)}=110$ and $g^{(3)}=111$. 14

i) Draw encoder block diagram

ii) Find generator matrix

iii) Find code word corresponding to sequence (11101) using time domain and transfer domain approach.

b Explain Trellis diagram technique for convolution encoder. 06

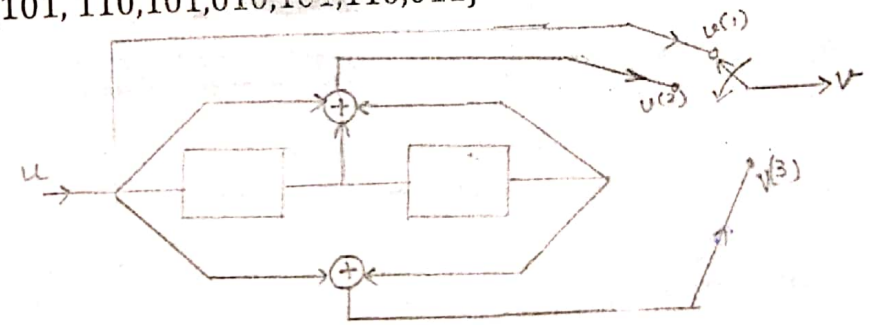
(OR)

10 a For the convolutional encoder shown in figure given below, 12

i) Draw the Tree diagram and determine the output produced by a message u=(1011...)

ii) Draw the Trellis diagram and extract the transmitted 'u' using Viterbi algorithm for the received sequence.

r = {101, 110,101,010,101,110,011}



b What is Viterbi algorithm? For an L – bit message sequence, and an encoder of memory M, how does the algorithm proceed? Comment on the advantage and disadvantage of the Viterbi algorithm. 08

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DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute Affiliated to VTU, Belagavi)
Shavige Malleshwara Hills, Kumaraswamy Layout, Bengaluru-560078

UG Semester End Examination, May-June 2019

Course: **Information Theory and Coding**
Course Code: **EC64** Maximum marks: **100**
Semester: **VI** Duration: **03 hours**

Note: **i). Question ONE (a to t) has to be answered from pages 5 to 7 only.**
ii). Question 1 to 4 is compulsory.
iii). Any missing data should be suitably assumed.

Q. No.			Marks
1	a)	Define Entropy.	01
	b)	When entropy achieves the maximum value.	01
	c)	What do you mean by Prefix property	01
	d)	what is the need for extension of Memory less Source	01
	e)	Define Posterior (Conditional) Entropy.	01
	f)	By adding the elements of JPM column wise we can obtain the probability of _____	01
	g)	Channel Capacity of Binary Symmetric Channel is C= _____	01
	h)	State Shannon Hartley Law	01
	i)	Define Block Codes.	01
	j)	Define Fields.	01
	k)	An irreducible polynomial P(X) of degree m is said to be Primitive if the smallest integer n for which P(X) divides _____	01
	l)	The order of Generator matrix G is _____	01
	m)	Single error correcting Hamming code for which the code length n must satisfy equation given by_____	01
	n)	Define (n,k) cyclic code.	01
	o)	Error Correction Capability of a Hamming Code_____	01
	p)	To generate systematic cyclic code , the remainder polynomial R(X) is obtained by _____.	01
	q)	Define Convolutional Code.	01
	r)	The Convolutional Encoder output using Transform domain approach C(X) is _____	01
	s)	Define Trellis diagram.	01
	t)	Constrain Length of (n,k,m) Convolutional encoder is_____	01
2	a)	Consider a source with 8 symbols S1 to S8 with the probabilities of {0.22,0.20,0.18,0.15,0.10,0.08,0.05,0.02} determine the code efficiency and Code Redundancy using Shannon's Encoding Algorithm.	08
	b)	Consider a source with 8 symbols S1 to S8 with the probabilities of {0.21,0.20,0.19,0.14,0.11,0.07,0.05,0.03} determine the code efficiency using binary Huffman code and ternary Huffman code.	08

3 a) Explain mutual information and prove that Mutual Information is always non-negative. 08

b) Determine the entropies H(X,Y),H(X),H(Y/X), H(X/Y), H(Y) and verify their relationships for a discrete memory less channel whose channel matrix is given below 08

$$P(Y/X) = \begin{pmatrix} 0.2 & 0 & 0.2 & 0 \\ 0.1 & 0.01 & 0.01 & 0.01 \\ 0 & 0.02 & 0.02 & 0 \\ 0.04 & 0.04 & 0.01 & 0.06 \\ 0 & 0.06 & 0.02 & 00.06 \\ 0 & 0.06 & 0.02 & 0.2 \end{pmatrix}$$

4 a) A Linear Block Code has the syndrome given by,$S_1 = r_1+r_2+r_3+r_5$, $S_2 = r_1+r_2+r_4+r_6$, $S_3 = r_1+r_3+r_4+r_7$. Construct G -Matrix , H- Matrix , Draw encoder ,Syndrome calculation circuit, find the code words and Find the syndrome for the received data 1011011. 12

b) Prove That $C H^T = 0$. 04

5 a) Design a single error correcting Hamming code with a message block of 11 bits and show by an example that the code can correct single error. 08

b) A (7,4) linear Binary cyclic code has a generator polynomial $g(x) = 1+x+x^3$ Draw block diagram of an encoder , List the shift register contents in a tabular form for the message 1110 and obtain the code word corresponding to the message given, Draw the syndrome calculator circuit. 08

OR

6 a) A (15,5) linear cyclic code has a generator polynomial $g(x) = 1+x+x^2+x^4+x^5+x^8+x^{10}$ Draw block diagrams of an encoder and syndrome calculator for this code, Find the code polynomial for the message polynomial $D(x) = 1 + x^2 + x^4$ in systematic form. 10

b) The generator polynomial for a (7,4) binary cyclic code is $g(x) = 1+x+x^3$, Determine the code vector in Systematic and Non Systematic form for the following messages, **(i)** 1010 **(ii)** 1111. 06

7 a) Explain with necessary equation Convolutional code and Viterbi algorithm. 06

b) For a (3, 1, 2) Convolutional encoder with generator sequences $g^{(1)} = 101$, $g^{(2)} = 111$, $g^{(3)} = 110$.

i) Find the encoder diagram 10

ii) Find Code word for 11001 using Time domain and Transform Domain Approach.

OR

8 a) For the convolutional encoder shown in the following fig 1, the information sSequence is d = 11101. Find the output sequence using the following two aApproaches. 08

i) Time domain approach. **ii)** Transform domain approach.

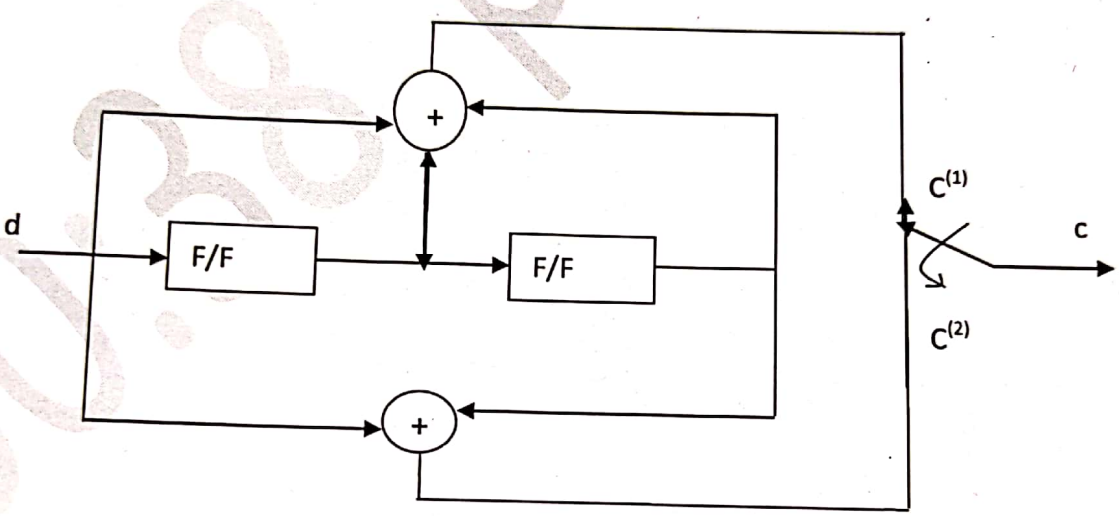

Fig 1

b) For The Convolutional encoder shown in Fig 1, Construct the state table, State transition Table, State diagram and Corresponding Code tree. Using the code tree detect the encoded sequence for the message d = 10101. 08