USN | | | | | | | | | | |

INTERNAL ASSESSMENT TEST II

Sub:	DIGITAL COMMUNICATION							Code:	15EC61
Date:	15/ 04 / 2019	Duration:	90 mins	Max Marks:	50	Sem:	VI	Branch:	TCE, ECE (C)

Answer any 5 full questions

		Marks	CO	RBT
1	What is inter symbol interference (ISI)? Explain binary pulse amplitude modulation (PAM) system with a neat block diagram. Obtain the time domain and frequency domain condition for zero ISI.	10	4	3
2(a)	Starting from the frequency domain condition for zero ISI, derive the ideal solution to ISI. What are the practical difficulties in implementing the ideal solution?	5	4	3
2(b)	Explain raised cosine spectrum as a practical solution to ISI. Plot the raised cosine spectrum for $\alpha = 0.5$.	5	4	2
3	With a neat block diagram, explain duobinary coder. Derive and plot magnitude response, phase response and impulse response. Explain the decision rule at the receiver.	10	4	3

USN | | | | | | | | | | |

INTERNAL ASSESSMENT TEST II

Sub:	DIGITAL COMMUNICATION							Code:	15EC61
Date:	15/ 04 / 2019	Duration:	90 mins	Max Marks:	50	Sem:	VI	Branch:	TCE, ECE (C)

Answer any 5 full questions

		Marks	CO	RBT
1	What is inter symbol interference (ISI)? Explain binary pulse amplitude modulation (PAM) system with a neat block diagram. Obtain the time domain and frequency domain condition for zero ISI.	10	4	3
2(a)	Starting from the frequency domain condition for zero ISI, derive the ideal solution to ISI. What are the practical difficulties in implementing the ideal solution?	5	4	3
2(b)	Explain raised cosine spectrum as a practical solution to ISI. Plot the raised cosine spectrum for $\alpha = 0.5$.	5	4	2
3	With a neat block diagram, explain duobinary coder. Derive and plot magnitude response, phase response and impulse response. Explain the decision rule at the receiver.	10	4	3

4(a)	Binary data “10011101” is transmitted using a duobinary coder with precoder. Obtain the precoded bits, transmitted amplitudes and decoded bits assuming no transmission error.	5	4	2
4(b)	Binary data “10011101” is transmitted using a modified duobinary coder without precoder. Obtain the transmitted amplitudes. Decode the bits assuming that transmitted amplitude due to second bit reduces to zero.	5	4	2
5(a)	What is equalization? Explain zero forcing equalizer with a neat block diagram.	5	4	2
5(b)	Consider the signal $x(t) = a_1\phi_1(t) + a_2\phi_2(t) + a_3\phi_3(t), 0 \leq t \leq T$, where a_1, a_2, a_3 are the coordinates of $x(t)$ with respect to the basis functions $\phi_1(t), \phi_2(t), \phi_3(t)$. Obtain an expression for the energy of $x(t)$ in terms of its coordinates.	5	2	3
6	Using Gram Schmidt Orthogonalization procedure, obtain a set of orthonormal basis functions for the following set of signals. Express the signals as a linear combination of basis functions. Draw the signal-space diagram. $x_1(t) = 1,\ 0 \leq t \leq \frac{T}{3}$ $x_2(t) = 1,\ 0 \leq t \leq \frac{2T}{3}$ $x_3(t) = 1,\ \frac{T}{3} \leq t \leq T$	10	2	3

4(a)	Binary data “10011101” is transmitted using a duobinary coder with precoder. Obtain the precoded bits, transmitted amplitudes and decoded bits assuming no transmission error.	5	4	2
4(b)	Binary data “10011101” is transmitted using a modified duobinary coder without precoder. Obtain the transmitted amplitudes. Decode the bits assuming that transmitted amplitude due to second bit reduces to zero.	5	4	2
5(a)	What is equalization? Explain zero forcing equalizer with a neat block diagram.	5	4	2
5(b)	Consider the signal $x(t) = a_1\phi_1(t) + a_2\phi_2(t) + a_3\phi_3(t), 0 \leq t \leq T$, where a_1, a_2, a_3 are the coordinates of $x(t)$ with respect to the basis functions $\phi_1(t), \phi_2(t), \phi_3(t)$. Obtain an expression for the energy of $x(t)$ in terms of its coordinates.	5	2	3
6	Using Gram Schmidt Orthogonalization procedure, obtain a set of orthonormal basis functions for the following set of signals. Express the signals as a linear combination of basis functions. Draw the signal-space diagram. $x_1(t) = 1,\ 0 \leq t \leq \frac{T}{3}$ $x_2(t) = 1,\ 0 \leq t \leq \frac{2T}{3}$ $x_3(t) = 1,\ \frac{T}{3} \leq t \leq T$	10	2	3

Scheme Of Evaluation

Internal Assessment Test II – April 2019

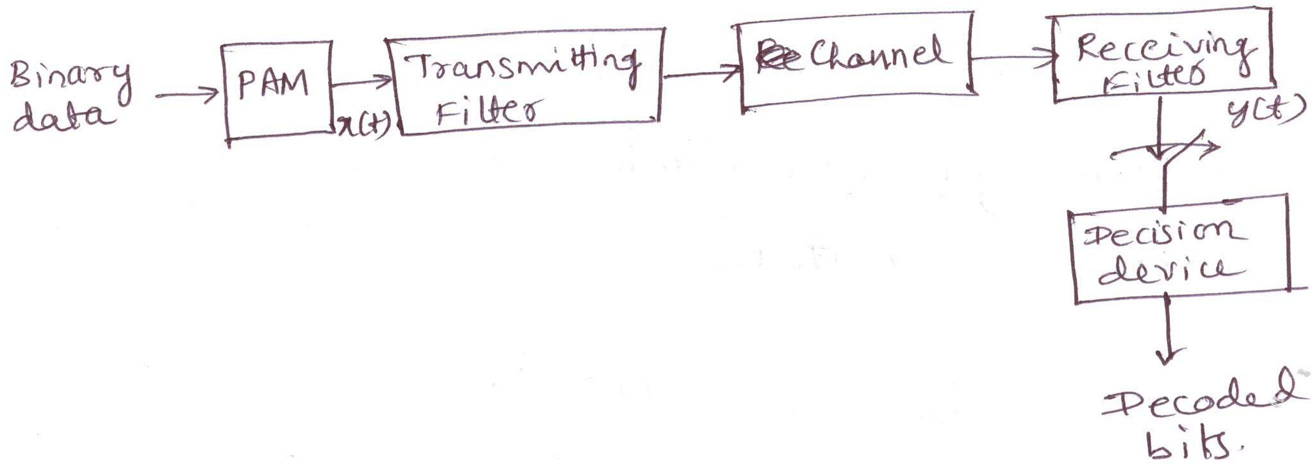
Sub:	DIGITAL COMMUNICATION					Code:	15EC61
Date:	15/ 04 / 2019	Duration:	90 mins	Max Marks:	50	Sem: VI	Branch: TCE

Note: Answer Any Five Questions

Question #		Description	Marks Distribution		Max Marks
1		What is inter symbol interference (ISI)? Explain binary pulse amplitude modulation (PAM) system with a neat block diagram. Obtain the time domain and frequency domain condition for zero ISI.		10	10
		• Definition of ISI • Block diagram of binary PAM system • Time domain condition for zero ISI • Frequency domain condition for zero ISI	2 2 3 3		
2	a	Starting from the frequency domain condition for zero ISI, derive the ideal solution to ISI. What are the practical difficulties in implementing the ideal solution?		5	10
		• Ideal Solution to ISI • Practical difficulties	3 2		
	b	Explain raised cosine spectrum as a practical solution to ISI. Plot the raised cosine spectrum for α=0.5.		5	
		• Formula for $P(f)$ • Plot of $P(f)$	3 2		
3		With a neat block diagram, explain duobinary coder. Derive and plot magnitude response, phase response and impulse response. Explain the decision rule at the receiver.		10	10
		• Block diagram • Magnitude Response • Phase response • Impulse response • Decision rule	2 2 2 2 2		
4	a	Binary data "10011101" is transmitted using a duobinary coder with precoder. Obtain the precoded bits, transmitted amplitudes and decoded bits assuming no transmission error.		5	10
		• Precoded bits • Transmitted amplitudes • Decoded bits	2 2 1		
	b	Binary data "10011101" is transmitted using a modified duobinary coder without precoder. Obtain the transmitted amplitudes. Decode the bits assuming that transmitted amplitude due to second bit reduces to zero.		5	
		• Transmitted amplitudes • decoded bits	2 3		
5	a	What is equalization? Explain zero forcing equalizer with a neat block diagram.		5	10

		• Definition • Block diagram and explaination	2 3		
	b	Consider the signal $x(t) = a_1\phi_1(t) + a_2\phi_2(t) + a_3\phi_3(t), 0 \leq t \leq T$, where a_1, a_2, a_3 are the coordinates of $x(t)$ with respect to the basis functions $\phi_1(t), \phi_2(t), \phi_3(t)$. Obtain an expression for the energy of $x(t)$ in terms of its coordinates.		5	10
		• Expression for energy	5		
6		Using Gram Schmidt Orthogonalization procedure, obtain a set of orthonormal basis functions for the following set of signals. Express the signals as a linear combination of basis functions. Draw the signal-space diagram. $x_1(t) = 1,\ \ 0 \leq t \leq \frac{T}{3}$ $x_2(t) = 1,\ \ 0 \leq t \leq \frac{2T}{3}$ $x_3(t) = 1,\ \ \frac{T}{3} \leq t \leq T$		10	
		• Basis function $\phi_1(t)$ • Basis function $\phi_2(t)$ • Basis function $\phi_3(t)$ • Signal-space diagram	2 2 2 4		

1



$$x(t) = \sum_{K=-\infty}^{\infty} v(t - KT_b)\, a_K$$

$$y(t) = \mu \sum_{K=-\infty}^{\infty} a_K\, p(t - KT_b)$$

$$y(iT_b) = \mu \sum_{K=-\infty}^{\infty} a_K\, p(iT_b - KT_b)$$

$$= \mu a_i + \underbrace{\mu \sum_{\substack{K=-\infty \\ K \neq i}}^{\infty} a_K\, p(iT_b - KT_b)}_{\text{ISI.}}$$

$$p(iT_b - KT_b) = \begin{cases} 0 & \text{for } k \neq i \\ 1 & \text{for } k = i \end{cases}$$

$$\sum_{K=-\infty}^{\infty} P(f - kR_b) = T_b$$

2a

$$\sum_{K=-\infty}^{\infty} P(f - KR_b) = T_b$$

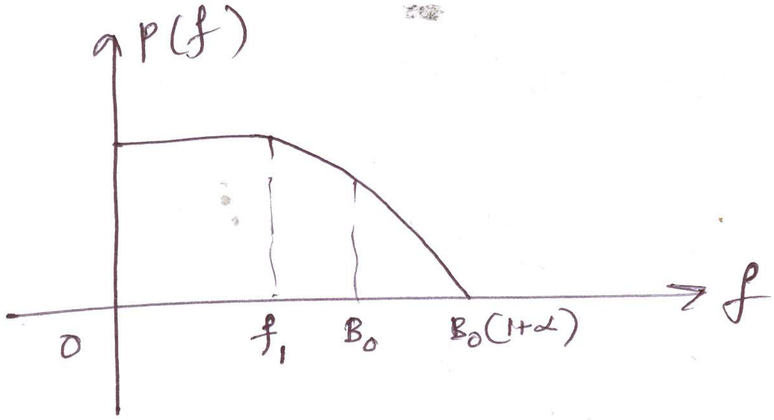
$$p(t) = \int_{-\frac{R_b}{2}}^{\frac{R_b}{2}} T_b\, e^{j2\pi ft}\, df$$

$= \operatorname{sinc}(R_b t)$

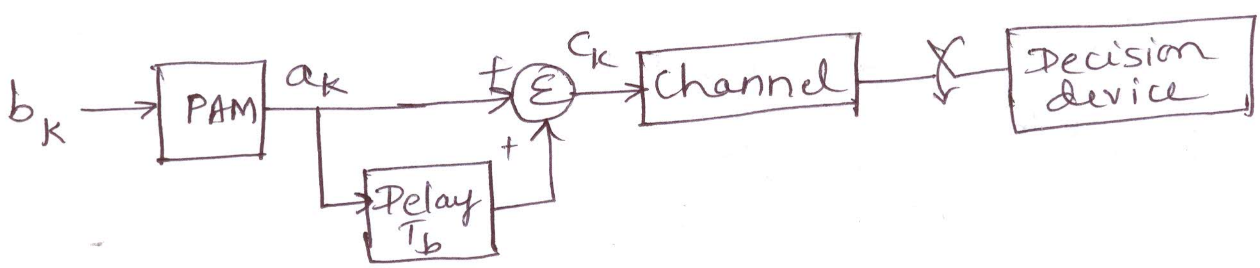
1) No margin for timing error
2) Abrupt transitions.

2b

$$P(f) = \begin{cases} T_b, & |f| < f_1 \\ \frac{T_b}{2}\left[1 + \cos\left(\frac{\pi}{2}\frac{|f|-f_1}{B_0 - f_1}\right)\right], & f_1 \le |f| \le 2B_0 - f_1 \\ 0, & |f| > 2B_0 - f_1 \end{cases}$$



3



$$a_K = \begin{cases} 1 & \text{if } b_K = 1 \\ -1 & \text{if } b_K = 0 \end{cases}$$

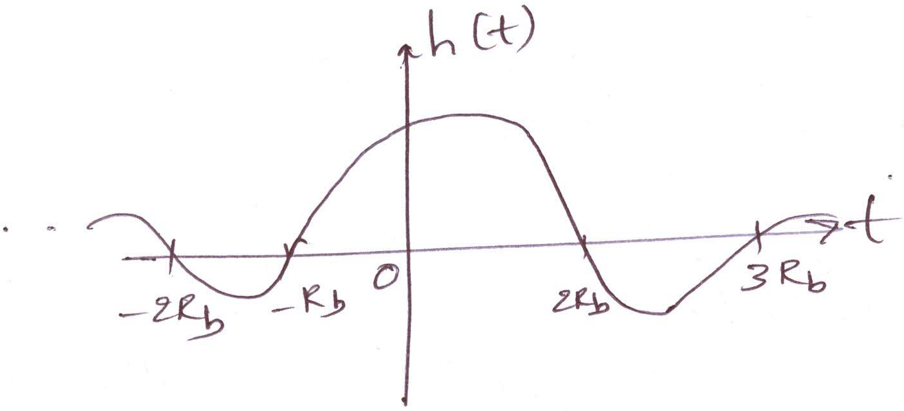
$$c_K = a_K + a_{K-1}$$

$$\hat{a}_K = \hat{c}_K - \hat{a}_{K-1}$$

$$\hat{b}_K = \begin{cases} 1 & \text{if } \hat{a}_K = 1 \\ 0 & \text{if } \hat{a}_K = -1 \end{cases}$$

$$H(f) = \left[1 + e^{-j2\pi f T_b}\right] T_b, \quad -\frac{R_b}{2} \le f \le \frac{R_b}{2}$$

$$h(t) = \text{sinc}(R_b t) + \text{sinc}(R_b(t - T_b))$$



4a

b_k		1	0	0	1	1	1	0	1
d_k	1	0	0	0	1	0	1	1	0
a_k	1	-1	-1	-1	1	-1	1	1	-1
c_k		0	-2	-2	0	0	0	2	0
$\hat{b}_k$		1	0	0	1	1	1	0	1

4b

b_k			1	0	0	1	1	1	0	1
a_k	1	1	1	-1	-1	1	1	1	-1	1
c_k			0	-2	-2	2	2	0	-2	0
$\hat{c}_k$			0	0	-2	2	2	0	-2	0
$\hat{a}_k$	1	1	+1	+1	-1	3	1	+3	-3	3
$\hat{b}_k$			1	1	0	1	1	1	0	1

5 $x(t) = a_1 \phi_1(t) + a_2 \phi_2(t) + a_3 \phi_3(t), \quad 0 \le t \le T$

$$E = \int_0^T |x(t)|^2 \, dt$$

$$= \int_0^T a_1^2 \phi_1^2(t) + a_2^2 \phi_2^2(t) + a_3^2 \phi_3^2(t) \, dt$$

$$= a_1^2 + a_2^2 + a_3^2$$

6