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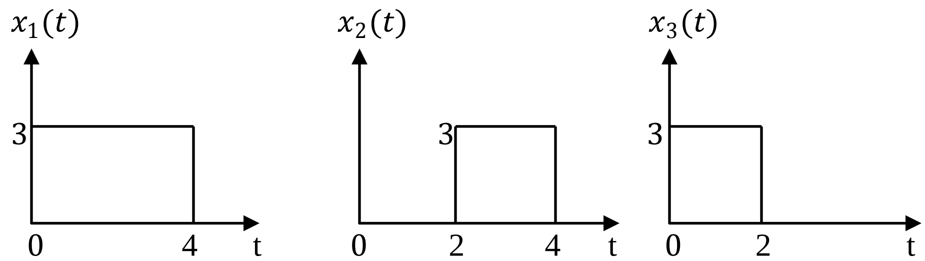
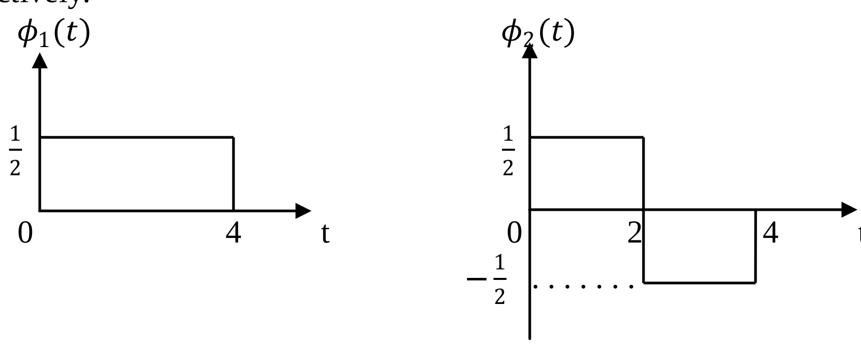
INTERNAL ASSESSMENT TEST – II

Sub:	DIGITAL COMMUNICATION							Code:	15EC61
Date:	16/ 04 / 2018	Duration:	90 mins	Max Marks:	50	Sem:	VI	Branch:	ECE,TCE

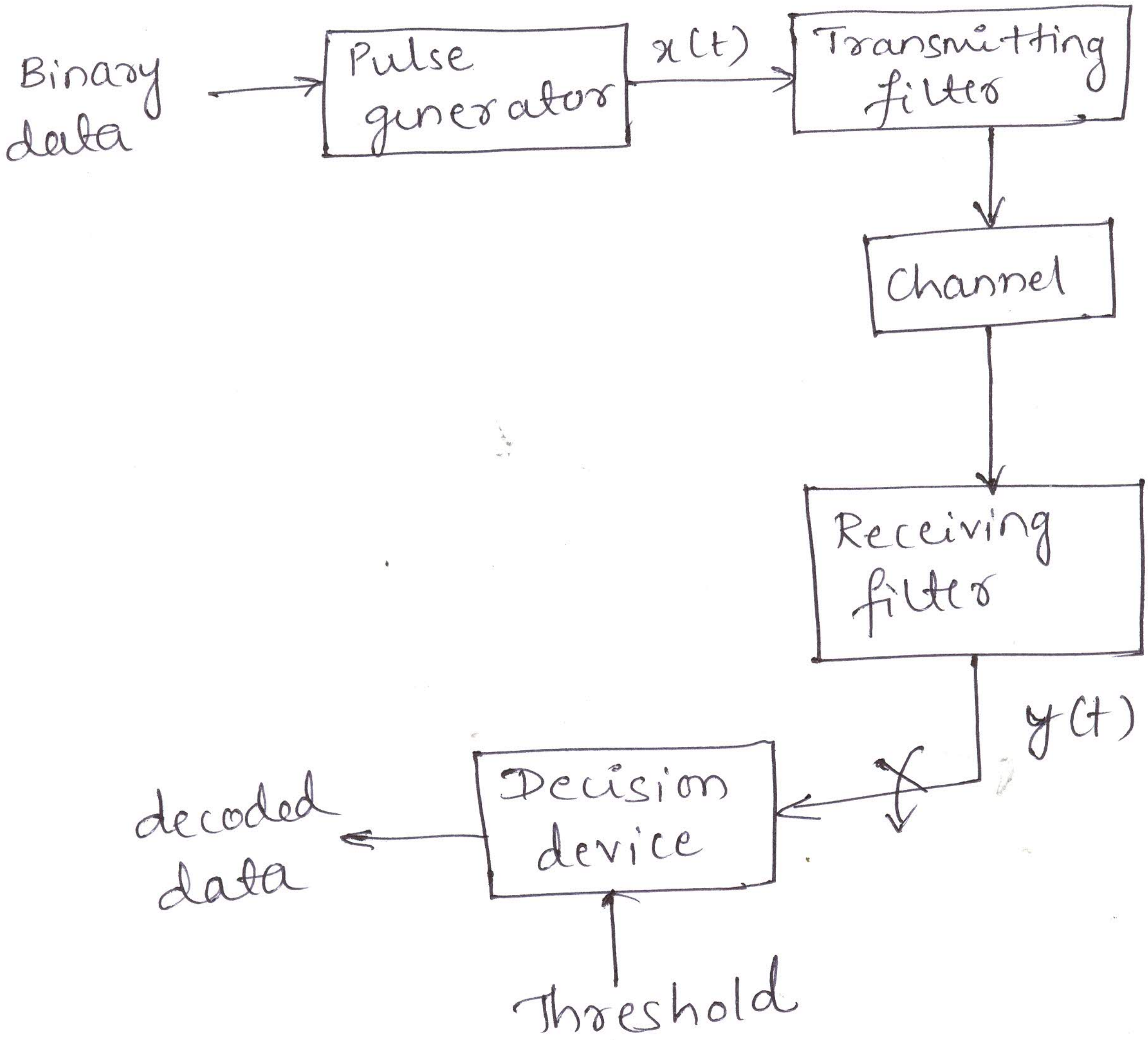
<u>Answer any 5 full questions</u>

		Marks	CO	RBT
1.	Explain binary PAM system with a neat block diagram. What is inter symbol interference (ISI). Derive time domain and frequency domain conditions for zero ISI.	[10]	CO4	L3
2(a).	Derive the ideal solution to inter symbol interference (ISI). What are its practical limitations?	[05]	CO4	L2
2(b).	Write a short note on raised cosine spectrum. Plot the raised cosine spectrum for $\alpha = 0$ and $\alpha = 1$, where α is the roll off factor.	[05]	CO4	L2
3.	With a neat block diagram, explain duobinary system without precoder. Plot the magnitude response and phase response of the duobinary system. Derive the impulse response of the duobinary system and plot the same.	[10]	CO4	L2
4(a).	Binary data 10100101 is applied to a duobinary coder with precoder. i. Obtain the output of duobinary coder with precoder. ii. Assuming that due to an error in transmission the level produced due to second bit becomes zero, obtain the decoded sequence.	[05]	CO4	L2
4(b).	Binary data 10100101 is applied to a modified duobinary coder without precoder. i. Obtain the output of modified duobinary coder without precoder. ii. Assuming that due to an error in transmission the level produced due to second bit becomes zero, obtain the decoded sequence.	[05]	CO4	L2
5(a).	What is an equalizer? Write a short note on zero forcing equalizer.	[05]	CO4	L2
5(b).	What is an adaptive equalizer? Write a short note on adaptive equalizer.	[05]	CO4	L2

6.	Applying Gram-Schmidt orthogonalization procedure find a set of orthonormal basis functions for the following set of signals.  Express the signals as a linear combination of basis functions. Draw the corresponding signal-space diagram (constellation diagram).	[10]	CO2	L3
7(a).	Consider the signal $x(t) = a\phi_1(t) + b\phi_2(t) + c\phi_3(t), 0 \leq t \leq T$ where $\phi_1(t), \phi_2(t), \phi_3(t)$ are the basis functions and (a, b, c) are the coordinates of $x(t)$ with respect to $\phi_1(t), \phi_2(t), \phi_3(t)$ respectively. Derive an expression for the energy of $x(t)$ in terms of its coordinates.	[05]	CO2	L2
7(b).	Given the basis functions $\phi_1(t)$ and $\phi_2(t)$, plot the signals $x_1(t)$ and $x_2(t)$ whose coordinates with respect to $\phi_1(t)$ and $\phi_2(t)$ are (2,3) and $(-2,4)$ respectively.  	[05]	CO2	L2

Solution and Scheme of Evaluation

1



(2)

(1)

$$x(t) = \sum_{k=-\infty}^{\infty} a_k \, x(t - kT_b)$$

(2)

$$y(t) = \mu \sum_{k=-\infty}^{\infty} a_k \, p(t - kT_b)$$

(1)

$$y(iT_b) = \mu \sum_{k=-\infty}^{\infty} a_k \, p(iT_b - kT_b)$$

(2)

For zero ISI,

$$p(iT - kT) = \begin{cases} 1, & i = k \\ 0, & i \neq k \end{cases}$$

$$\sum_{k=-\infty}^{\infty} P(f-kR_b) = T_b \quad (2)$$

2a $P(f) = T_b, \quad -\frac{R_b}{2} \le f \le \frac{R_b}{2}$ (2)

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

$$= T_b \left. \frac{e^{j2\pi f t}}{j2\pi t} \right|_{-\frac{R_b}{2}}^{\frac{R_b}{2}}$$

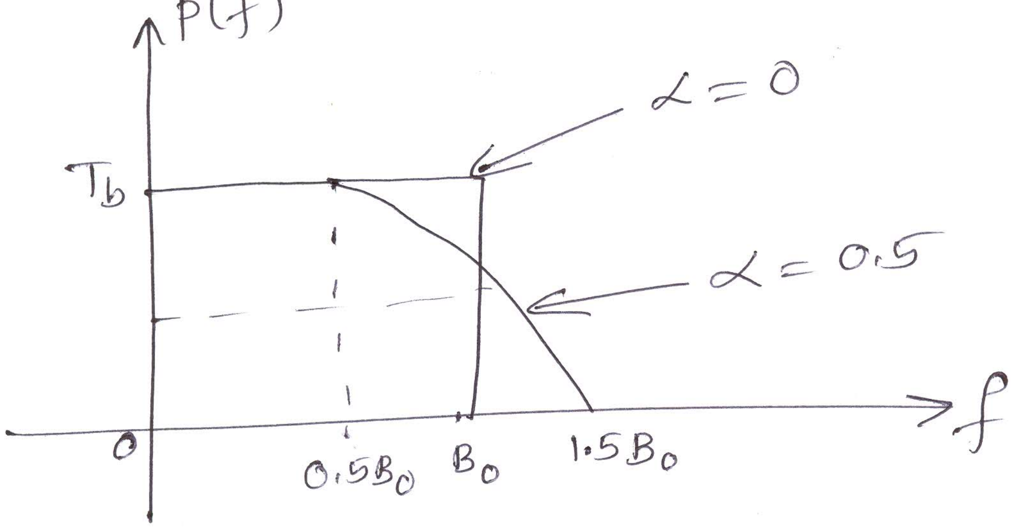
$$= \operatorname{sinc}(R_b t) \quad (3)$$

Practical limitations.

1. No margin for error in deciding sampling instants
2. $\operatorname{sinc}(R_b t)$ can not be physically realized

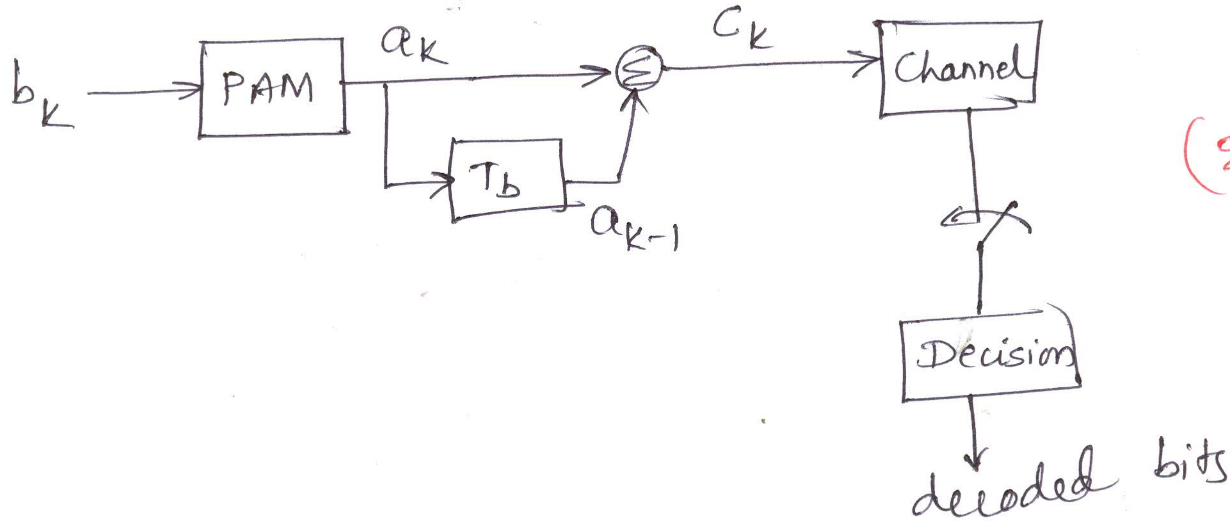
2b

$$P(f) = \begin{cases} T_b & \text{for } |f| < f_1 \\ \frac{T_b}{2}\left\{1 + \cos\left[\frac{\pi}{2} \frac{|f| - f_1}{B_0 - f_1}\right]\right\} & f_1 \le |f| < 2B_0 - f_1 \\ 0, & |f| \geqslant 2B_0 - f_1 \end{cases} \quad (3)$$



(2)

3



(2)

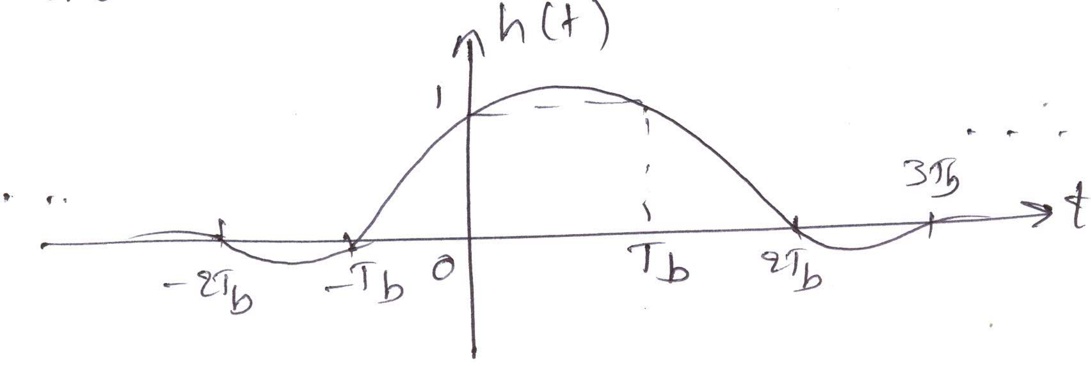
$$a_k = \begin{cases} 1\,V & \text{if } b_k = 1 \\ -1\,V & \text{if } b_k = 0 \end{cases}$$ (1)

(1)

$$c_k = a_k + a_{k-1}$$

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

$$h(t) = \operatorname{sinc}(R_b t) + \operatorname{sinc}(R_b(t - T_b))$$ (2)



(2)

4a

b_k 1 0 1 0 0 1 0 1

d_k 1 0 0 1 1 1 0 0 1

a_k 1 -1 -1 1 1 1 -1 -1 1

(2) c_k 0 -2 0 2 2 0 -2 0 $\qquad c_k = a_k + a_{k-1}$

$\hat{c}_k$ 0 0 0 2 2 0 -2 0

~~$\hat{a}_k$ 1 1 1 -1 3 -1 1 -3 3~~ $\qquad \cancel{\hat{a}_k = \hat{c}_k - \hat{a}_{k-1}}$

(3) $\hat{b}_k$ 1 1 1 0 0 1 0 1

4b

b_k 1 0 1 0 0 1 0 1

a_k 1 1 1 -1 1 -1 -1 1 -1 1

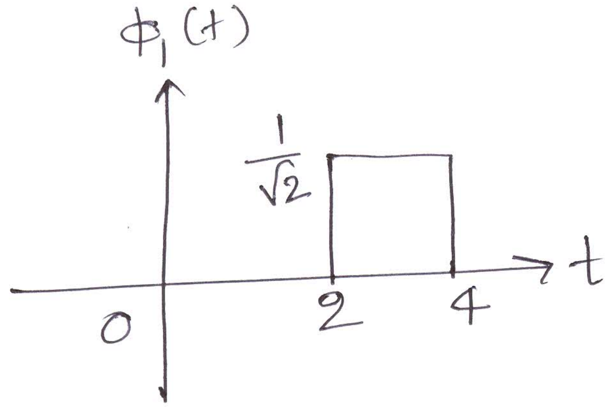
(2) c_k 0 -2 0 0 -2 2 0 0 $\qquad c_k = a_k - a_{k-2}$

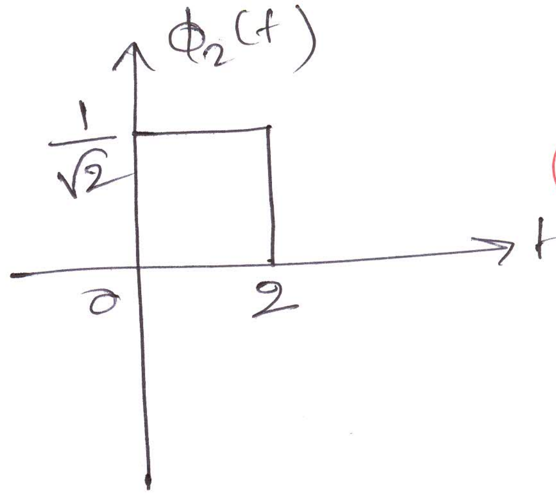
$\hat{c}_k$ 0 0 0 0 -2 2 0 0

$\hat{a}_k$ 1 1 1 1 1 1 -1 3 -1 3

(3) $\hat{b}_k$ 1 1 1 1 0 1 0 1

6 5



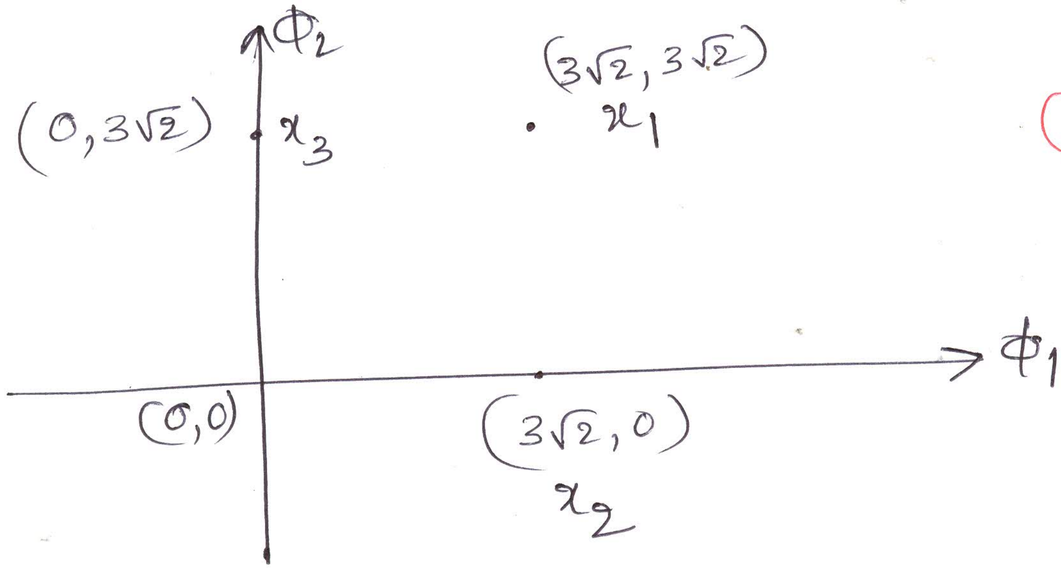


(5)

$x_1(t) = 3\sqrt{2}\,\phi_1(t) + 3\sqrt{2}\,\phi_2(t)$ (3)

$x_2(t) = 3\sqrt{2}\,\phi_1(t) + 0\,\phi_2(t)$

$x_3(t) = 0\,\phi_1(t) + 3\sqrt{2}\,\phi_2(t)$



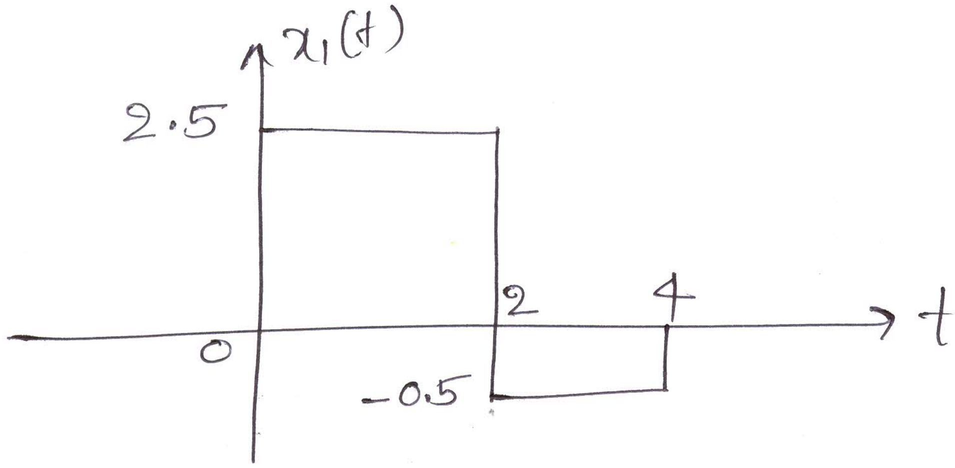
(2)

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

$= \int_0^T (a\phi_1(t) + b\phi_2(t) + c\phi_3(t))\,(a\phi_1(t) + b\phi_2(t) + c\phi_3(t))\, dt$

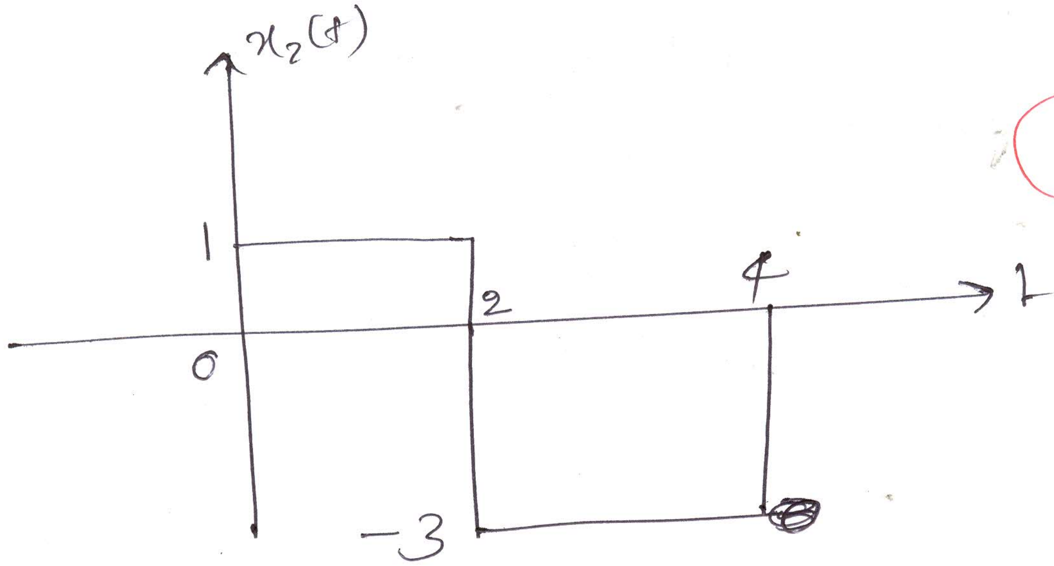
$= a^2 + b^2 + c^2$ (5)

7b $x_1(t) = 2\,\phi_1(t) + 3\,\phi_2(t)$



(2.5)

$x_2(t) = -2\,\phi_1(t) + 4\,\phi_2(t)$



(2.5)