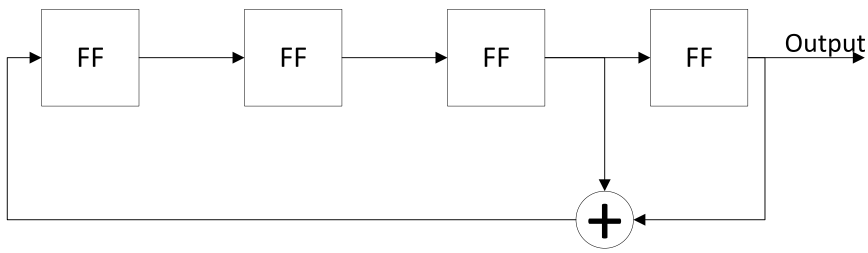
CMR
INSTITUTE OF
TECHNOLOGY

USN | | | | | | | | | |

Improvement Test

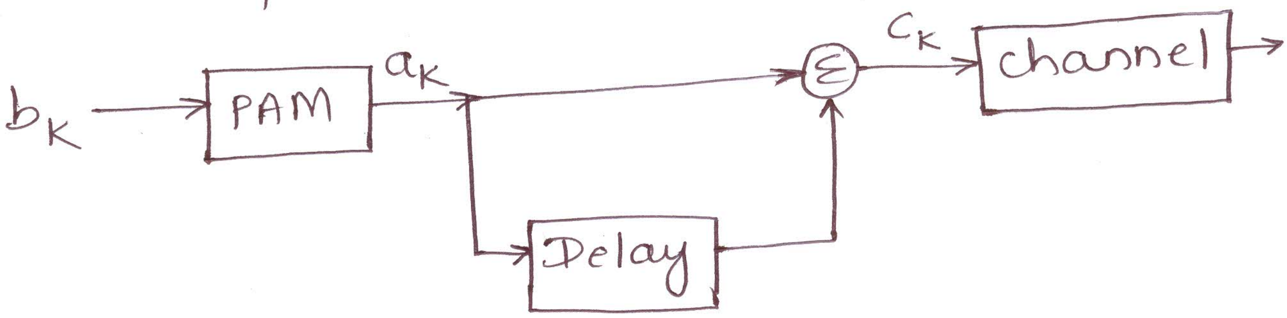
Sub:	DIGITAL COMMUNICATION							Code:	10EC/TE61
Date:	29 / 05 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	VI	Branch:	ECE(D)/TCE(B)

Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1	Explain duobinary coding with precoder and without precoder.	[10]	CO2	L2
2(a)	The binary data 01010101 is applied to a duo binary system. i. Construct the Duobinary coder output and the corresponding receiver output without precoder. ii. Construct the Duobinary coder output and the corresponding receiver output with precoder.	[05]	CO2	L2
2(b)	The binary data 10101010 is applied to a modified duobinary system. i. Construct the modified duobinary coder output and the corresponding receiver output without precoder. ii. Construct the modified duobinary coder output and the corresponding receiver output with precoder.	[05]	CO2	L2
3	With neat block diagrams, explain coherent binary ASK system. Derive an expression for probability of error.	[10]	CO3	L3
4	With neat block diagrams, explain coherent binary PSK system. Derive an expression for probability of error.	[10]	CO3	L3
5(a)	Plot the QPSK waveform for the binary data 01101000 clearly showing the waveforms for even indexed bits and odd indexed bits.	[05]	CO3	L2
5(b)	Obtain the differentially encoded sequence for the binary data 10010011. Plot the DPSK signal.	[05]	CO3	L2
6	Demonstrate the properties of maximum length PN sequence obtained from the shift register structure as shown in Fig 6. Consider the initial states of shift registers as 1000.  Figure 6. PN Sequence generator	[10]	CO4	L2
7	With neat block diagrams and necessary equations, explain direct sequence spread spectrum.	[10]	CO4	L2
8	With neat block diagrams and necessary equations, explain frequency hop spread spectrum.	[10]	CO4	L2

Solutions

1 Block diagram of duobinary coder without precoder.



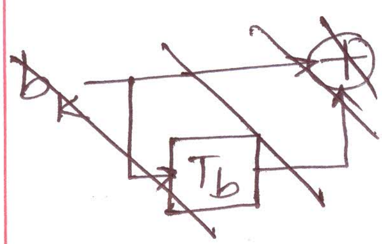
$$a_K = \begin{cases} 1V & \text{if } b_K = 1 \\ -1V & \text{if } b_K = 0 \end{cases}$$

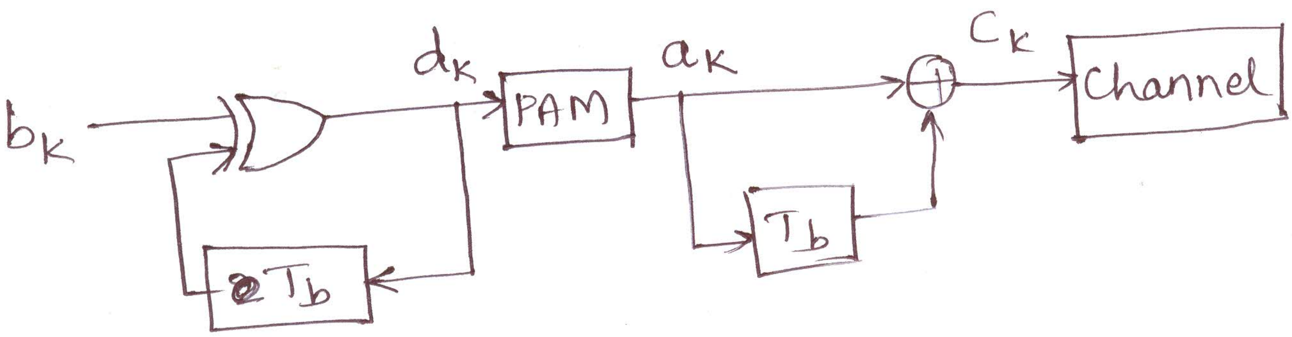
$$c_K = a_K + a_{K-1}$$

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

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

Duobinary coder with precoder.





3/8

$$d_K = b_K \oplus d_{K-1}$$

$$a_K = PAM(d_K)$$

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

$$c_K = \begin{cases} \pm 2V, & \text{if } b_K = 0 \\ 0V, & \text{if } b_K = 1 \end{cases}$$

2a

b_K: 0 1 0 1 0 1 0 1

a_K: 1 −1 1 −1 1 −1 1 −1 1

c_K: 1 0 0 0 0 0 0 0 0

$\hat{a}_K$: 1 −1 1 −1 1 −1 1 −1 1

$\hat{b}_K$: 0 1 0 1 0 1 0 1

2b

b_K: 1 0 1 0 1 0 1 0

a_K: 1 1 1 −1 1 −1 1 −1 1 −1

c_K: 0 −2 0 0 0 0 0 0

$\hat{a}_K$: 1 1 1 −1 1 −1 1 −1 1 −1

$\hat{b}_K$: 1 0 1 0 1 0 1 0

3 $s_1(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_c t), \quad 0 \le t \le T_b$

$$f_c = \frac{n}{T_b}$$

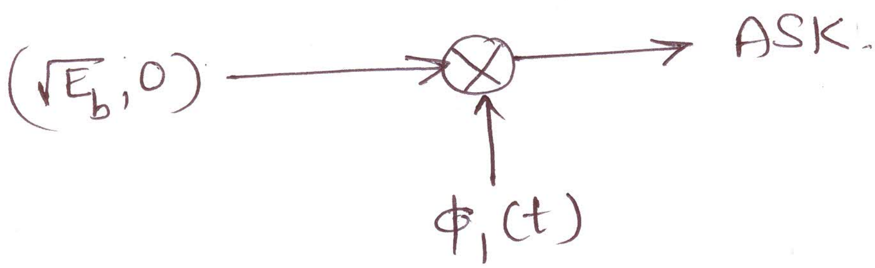
$$s_2(t) = 0, \quad 0 \le t \le T_b$$

$$\phi_1(t) = \sqrt{\frac{2}{T_b}} \cos(2\pi f_c t), \quad 0 \le t \le T_b$$

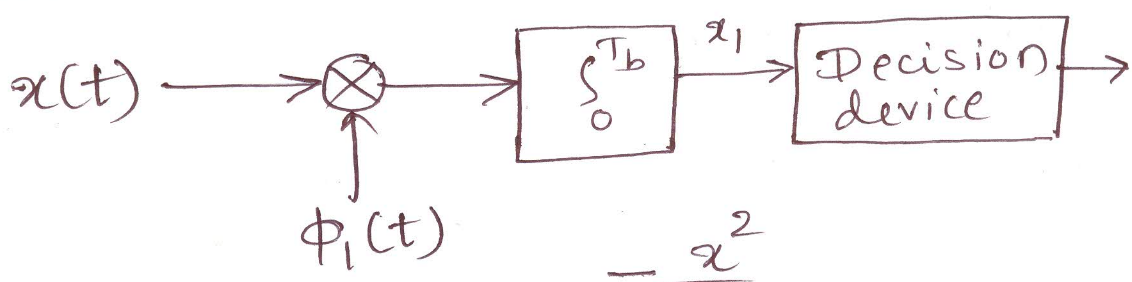
$$s_1(t) = \sqrt{E_b}\, \phi_1(t)$$

$$s_2(t) = 0\, \phi_1(t)$$

Transmitter



Receiver



$$f_{X_1}(x_1/0) = \frac{1}{\sqrt{\pi N_0}}\, e^{-\frac{x^2}{N_0}}$$

$$P_e(0) = \int_{\frac{\sqrt{E_b}}{2}}^{\infty} f_{X_1}(x_1/0)\, dx_1$$

$$= \int_{\frac{\sqrt{E_b}}{2}}^{\infty} \frac{1}{\sqrt{\pi N_0}} e^{-\frac{x_1^2}{N_0}} dx_1$$

$$= \frac{1}{2} \operatorname{erfc}\left(\frac{1}{2}\sqrt{\frac{E_b}{N_0}}\right)$$

$$P_e = \frac{1}{2} P_e(0) + \frac{1}{2} P_e(1)$$

$$= \frac{1}{2} \operatorname{erfc}\left(\frac{1}{2}\sqrt{\frac{E_b}{N_0}}\right)$$

4 $s_1(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_c t), \quad 0 \le t \le T_b$

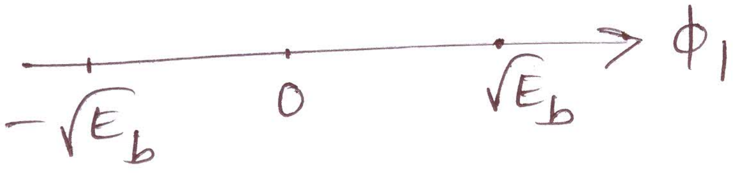
$f_c = \frac{n}{T_b}$

$s_2(t) = -\sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_c t), \quad 0 \le t \le T_b$

$\phi_1(t) = \sqrt{\frac{2}{T_b}} \cos(2\pi f_c t), \quad 0 \le t \le T_b$

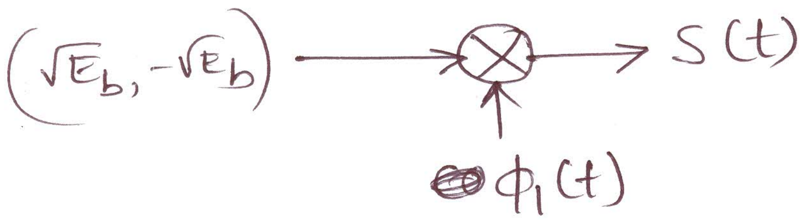
$s_1(t) = \sqrt{E_b}\, \phi_1(t)$

$s_2(t) = -\sqrt{E_b}\, \phi_1(t)$

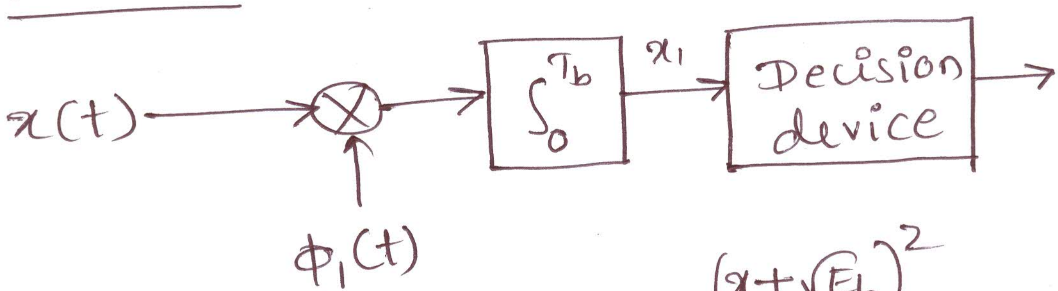


5|8

Transmitter



Receiver



$$f_{x_1}(x_1/0) = \frac{1}{\sqrt{\pi N_0}} e^{-\frac{(x+\sqrt{E_b})^2}{N_0}}$$

$$P_e(0) = \int_0^{\infty} f_{x_1}(x_1/0)\, dx_1$$

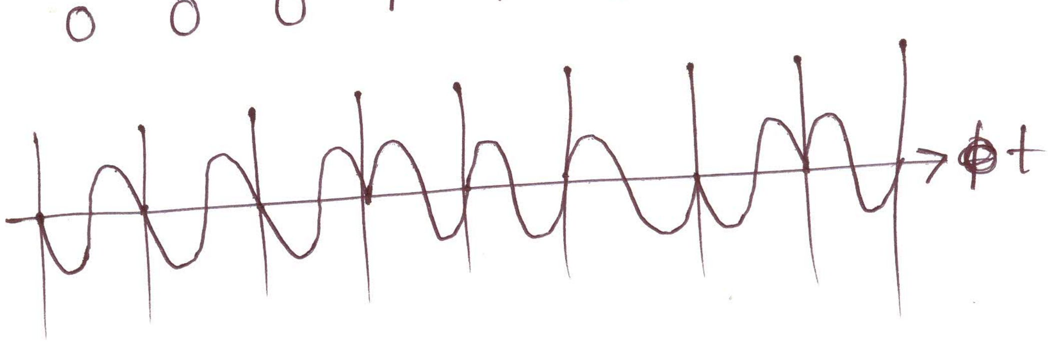
$$= \frac{1}{2} \operatorname{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right)$$

$$P_e = \frac{1}{2} P_e(0) + \frac{1}{2} P_e(1)$$

$$= \frac{1}{2} \operatorname{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right)$$

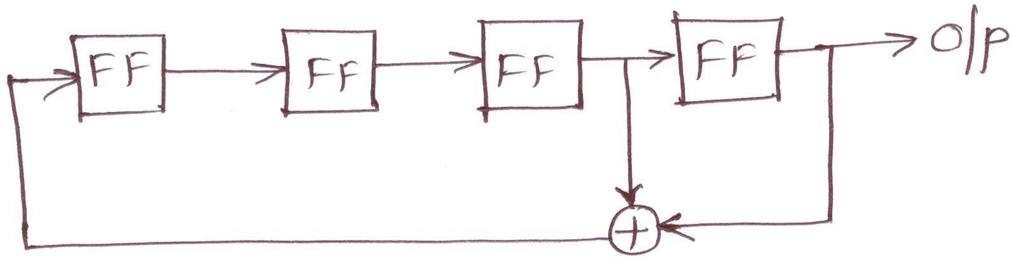
5

b_k		1	0	0	1	0	0	1	1
d_k	1	0	0	0	1	1	1	0	1



6|8

6



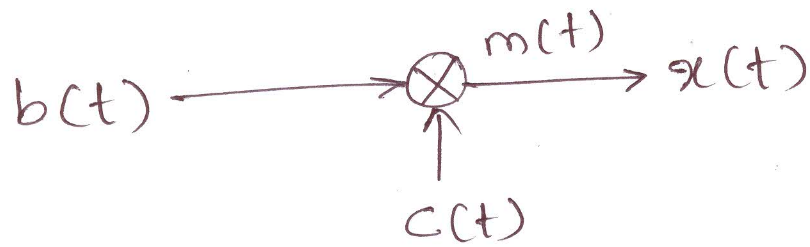
Clk	FF1	FF2	FF3	FF4
0	1	0	0	0
1	0	1	0	0
2	0	0	1	0
3	1	0	0	1
4	1	1	0	0
5	0	1	1	0
6	1	0	1	1
7	0	1	0	1
8	1	0	1	0
9	1	1	0	1
10	1	1	1	0
11	1	1	1	1
12	0	1	1	1
13	0	0	1	1
14	0	0	0	1
15	1	0	0	0

7/8

Properties:

1. Run property
2. Balance property
3. Autocorrelation property

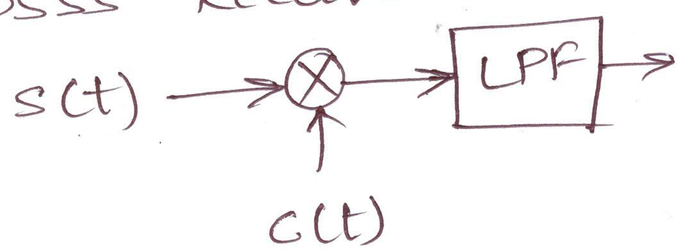
7 DSSS Transmitter



$$x(t) = b(t)\,c(t)$$

$$s(t) = x(t) + j(t)$$

DSSS Receiver.

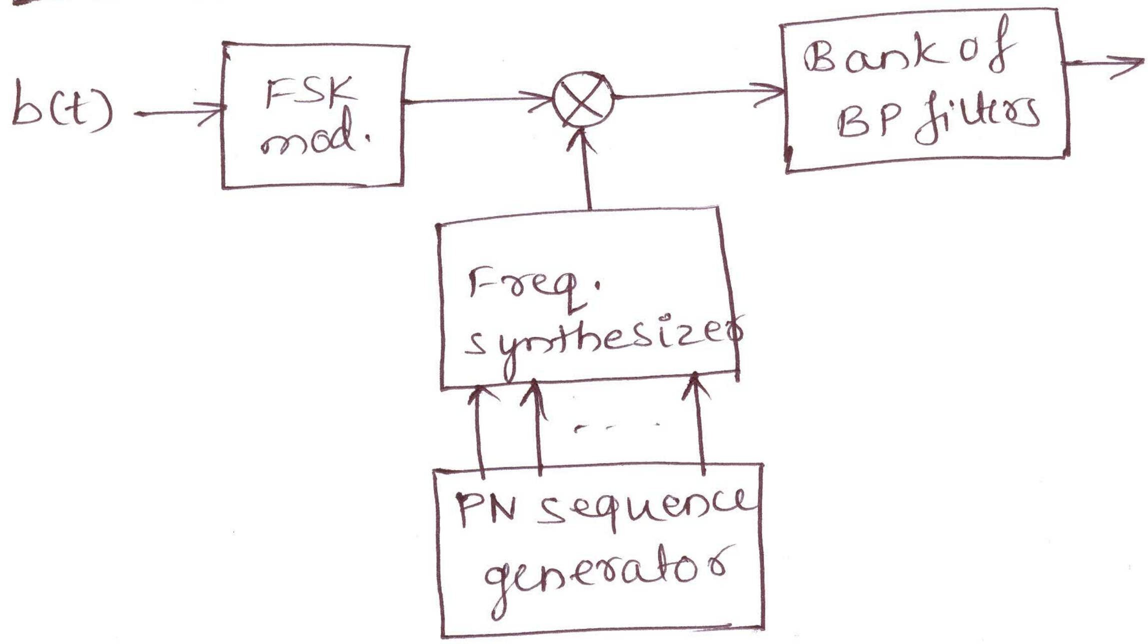


$$s(t)\,c(t) = [x(t) + j(t)]\,c(t)$$

$$= [b(t)\,c(t) + j(t)]\,c(t)$$

$$= b(t) + j(t)\,c(t).$$

8 FHSS Transmitter



FHSS Receiver