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

INTERNAL ASSESSMENT TEST III

Sub:	DIGITAL COMMUNICATION							Code:	15EC61
Date:	13/ 05 / 2019	Duration:	90 mins	Max Marks:	50	Sem:	VI	Branch:	ECE (A,B,C)

Answer all the questions

		Marks	CO	RBT
1	With neat block diagrams explain coherent binary ASK modulation-demodulation system. Obtain the signal space diagram. Explain the decision rule.	10	3	3
2	With neat block diagrams explain coherent binary FSK modulation-demodulation system. Obtain the signal space diagram. Explain the decision rule.	10	3	3
3	Draw the block diagram of BPSK receiver. Explain the decision rule. Obtain an expression for probability of error assuming equiprobable 0s and 1s.	10	3	3
4	With neat block diagrams explain QPSK modulation-demodulation system. Obtain the signal space diagram.	10	3	3
5	With neat block diagrams explain DPSK modulation-demodulation system. For the binary data 10101101, obtain the differentially encoded sequence. Show the phase of the modulated signal. What is the advantage of DPSK over BPSK?	10	3	3

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

INTERNAL ASSESSMENT TEST III

Sub:	DIGITAL COMMUNICATION							Code:	15EC61
Date:	13/ 05 / 2019	Duration:	90 mins	Max Marks:	50	Sem:	VI	Branch:	ECE (A,B,C)

Answer all the questions

		Marks	CO	RBT
1	With neat block diagrams explain coherent binary ASK modulation-demodulation system. Obtain the signal space diagram. Explain the decision rule.	10	3	3
2	With neat block diagrams explain coherent binary FSK modulation-demodulation system. Obtain the signal space diagram. Explain the decision rule.	10	3	3
3	Draw the block diagram of BPSK receiver. Explain the decision rule. Obtain an expression for probability of error assuming equiprobable 0s and 1s.	10	3	3
4	With neat block diagrams explain QPSK modulation-demodulation system. Obtain the signal space diagram.	10	3	3
5	With neat block diagrams explain DPSK modulation-demodulation system. For the binary data 10101101, obtain the differentially encoded sequence. Show the phase of the modulated signal. What is the advantage of DPSK over BPSK?	10	3	3

Scheme Of Evaluation

Internal Assessment Test III – May 2019

Sub:	DIGITAL COMMUNICATION							Code:	15EC61
Date:	13/ 05 / 2019	Duration:	90 mins	Max Marks:	50	Sem:	VI	Branch:	ECE (A,B,C)/ TCE

Note: Answer All the Questions

Question #		Description	Marks Distribution		Max Marks
1		With neat block diagrams explain coherent binary ASK modulation-demodulation system. Obtain the signal space diagram. Explain the decision rule.		10	10
		• Expression for ASK modulated wave • Constellation diagram • Modulator • Demodulator • Decision rule	2 2 2 2 2		
2		With neat block diagrams explain coherent binary FSK modulation-demodulation system. Obtain the signal space diagram. Explain the decision rule.		10	10
		• Expression for FSK modulated wave • Constellation diagram • Modulator • Demodulator • Decision rule	2 2 2 2 2		
3		Draw the block diagram of BPSK receiver. Explain the decision rule. Obtain an expression for probability of error assuming equiprobable 0s and 1s.		10	10
		• Block diagram of receiver • Decision rule • Probability of error for bit 0 • Average probability of error	2 2 4 2		
4	a	With neat block diagrams explain QPSK modulation-demodulation system. Obtain the signal space diagram.		10	10
		• Expression for QPSK modulated wave • Constellation diagram • Modulator • Demodulator	2 2 3 3		
5	a	With neat block diagrams explain DPSK modulation-demodulation system. For the binary data 10101101, obtain the differentially encoded sequence. Show the phase of the modulated signal. What is the advantage of DPSK over BPSK?		10	10
		• DPSK Modulator • DPSK Demodulator • Differential encoding • Advantage of DPSK over BPSK	3 3 2 2		

Solutions

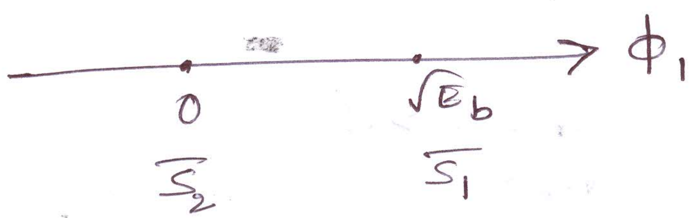
1 $s_1(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_c t) \quad , \quad 0 \le t \le T_b$

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

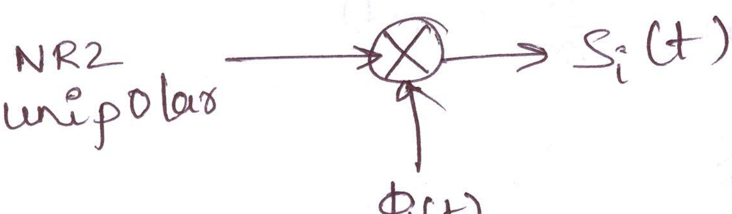
$\phi_1(t) = \sqrt{\frac{2}{T_b}} \cos(2\pi f_c t) \quad , \quad 0 \le t \le T_b$

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

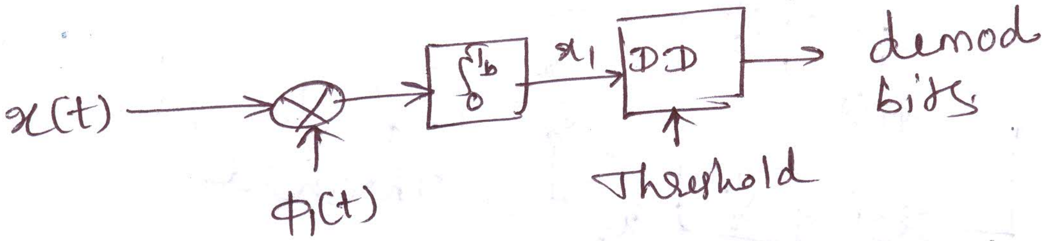
$s_2(t) = 0\, \phi_1(t)$



Modulator



Demodulator



Decision rule:

Bit '1' if $x_1 > \frac{\sqrt{E_b}}{2}$

Bit '0' if $x_1 < \frac{\sqrt{E_b}}{2}$

2 $s_1(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_1 t), \quad 0 \le t \le T_b$

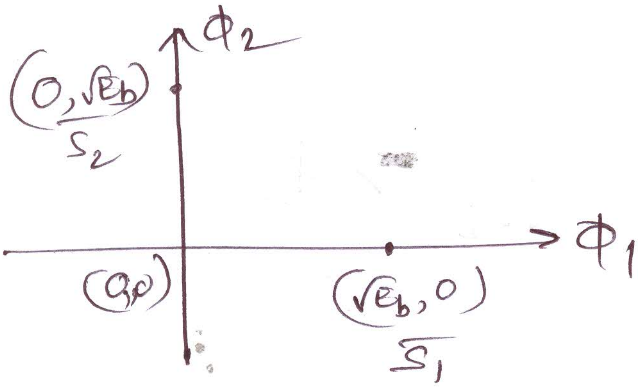
$s_2(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_2 t), \quad 0 \le t \le T_b$

$\phi_1(t) = \sqrt{\frac{2}{T_b}} \cos(2\pi f_1 t), \quad 0 \le t \le T_b$

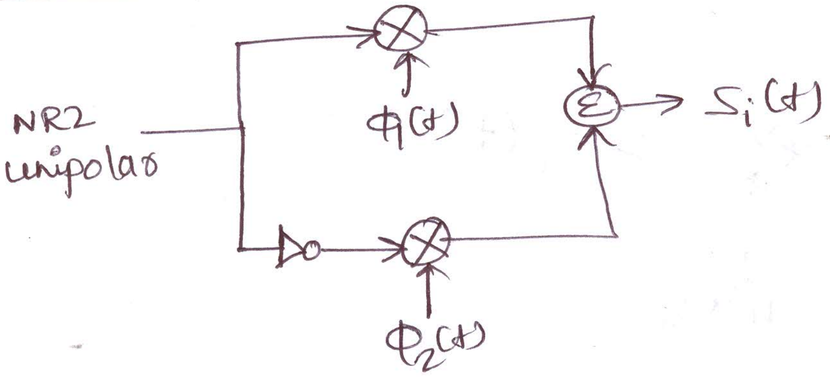
$\phi_2(t) = \sqrt{\frac{2}{T_b}} \cos(2\pi f_2 t), \quad 0 \le t \le T_b$

$s_1(t) = \sqrt{E_b}\,\phi_1(t) + 0\,\phi_2(t)$

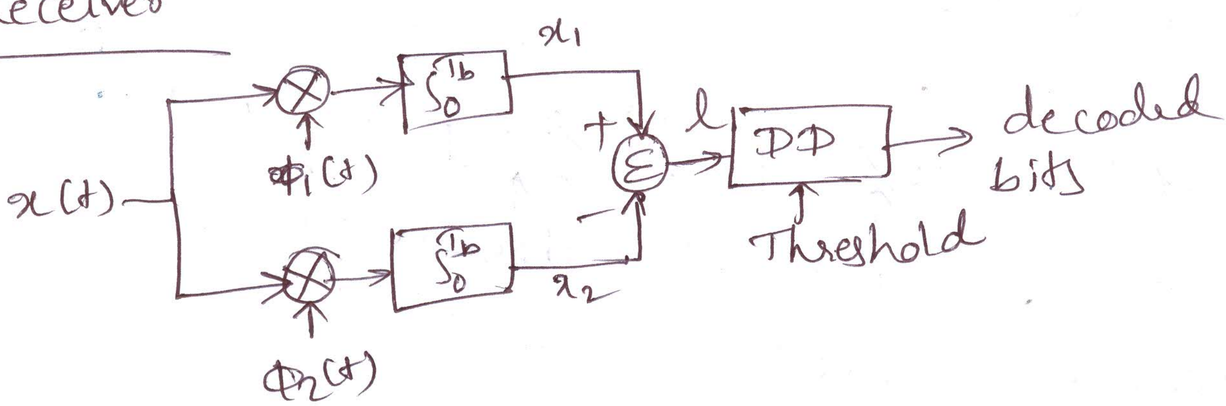
$s_2(t) = 0\,\phi_1(t) + \sqrt{E_b}\,\phi_1(t)$



Transmitter



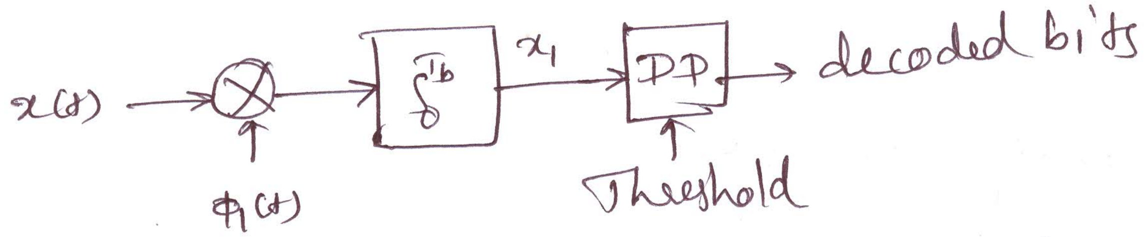
Receiver



Bit '1' if $l > 0$

Bit '0' if $l < 0$

3 BPSK receiver



Bit '1' if $x_1 > 0$

Bit '0' if $x_1 < 0$

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

$$\therefore P_e(0) = \int_0^{\infty} \frac{1}{\sqrt{\pi N_0}} e^{-\frac{(x_1+\sqrt{E_b})^2}{N_0}} dx_1$$

$$\frac{(x_1+\sqrt{E_b})^2}{N_0} = \frac{z^2}{2}$$

$$P_e(0) = \frac{1}{\sqrt{2\pi}} \int_{\sqrt{\frac{2E_b}{N_0}}}^{\infty} e^{-\frac{z^2}{2}} dz$$

$$= Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$$

$$P_e(1) = Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$$

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

$$= Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$$

4 $S_i(t) = \sqrt{\frac{2E}{T}} \cos\left(2\pi f_c t + (2i-1)\frac{\pi}{4}\right) \quad i = 1, 2, 3, 4$

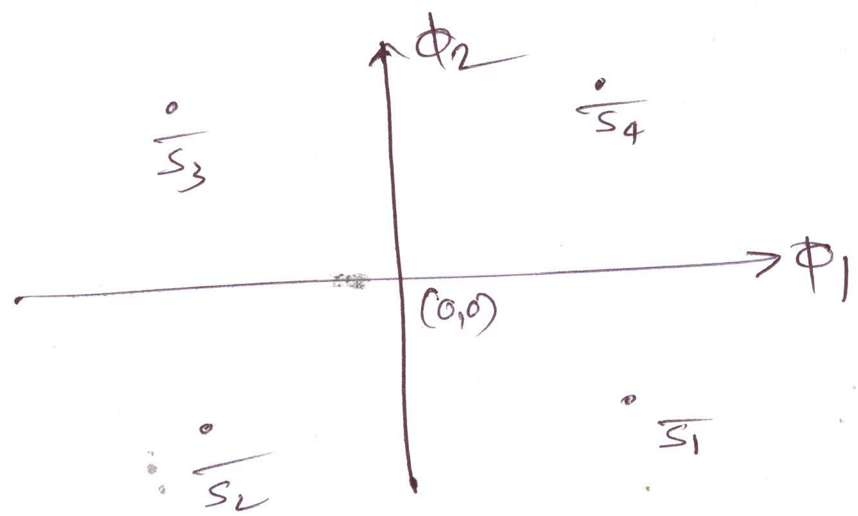
$$S_i(t) = \sqrt{\frac{2E}{T}} \cos\left((2i-1)\frac{\pi}{4}\right) \cos(2\pi f_c t) - \sqrt{\frac{2E}{T}} \sin\left((2i-1)\frac{\pi}{4}\right) \sin(2\pi f_c t)$$

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

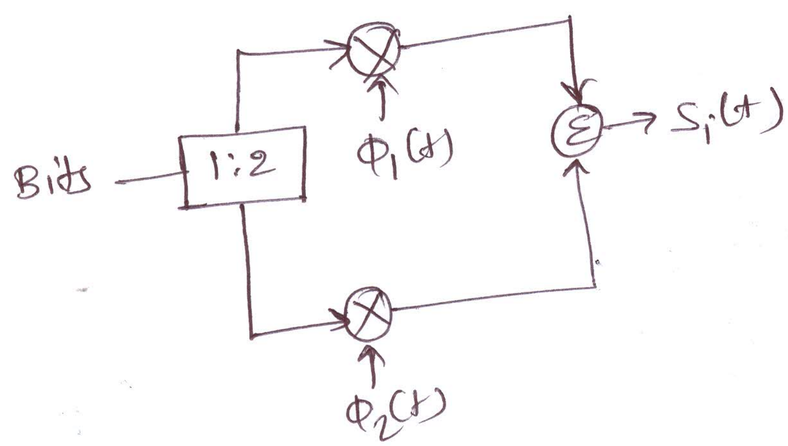
$\phi_2(t) = \sqrt{\frac{2}{T}} \sin(2\pi f_c t), \quad 0 \le t \le T$

Coordinates are

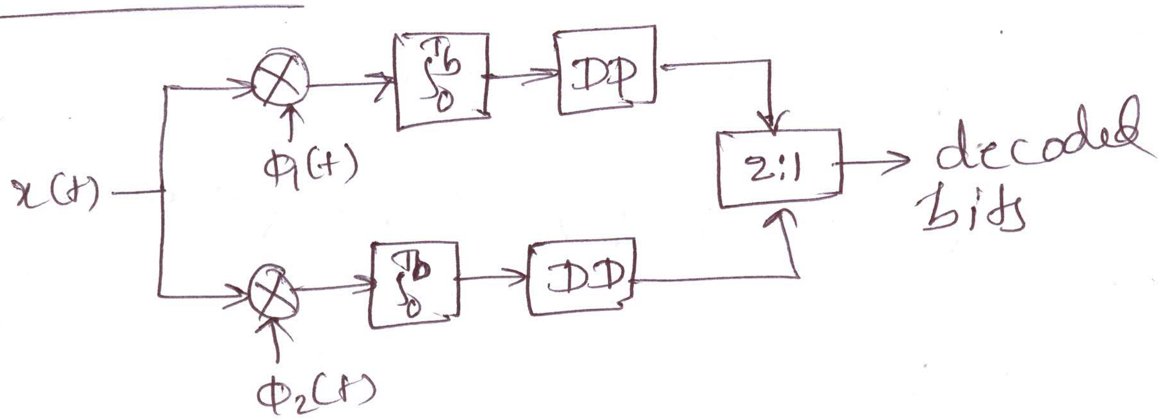
$$\begin{bmatrix} \sqrt{E}\cos\left((2i-1)\frac{\pi}{4}\right) \\ -\sqrt{E}\sin\left((2i-1)\frac{\pi}{4}\right) \end{bmatrix}$$



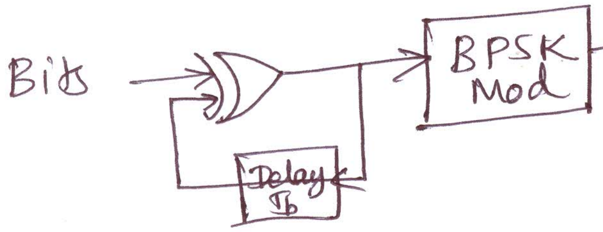
Modulator



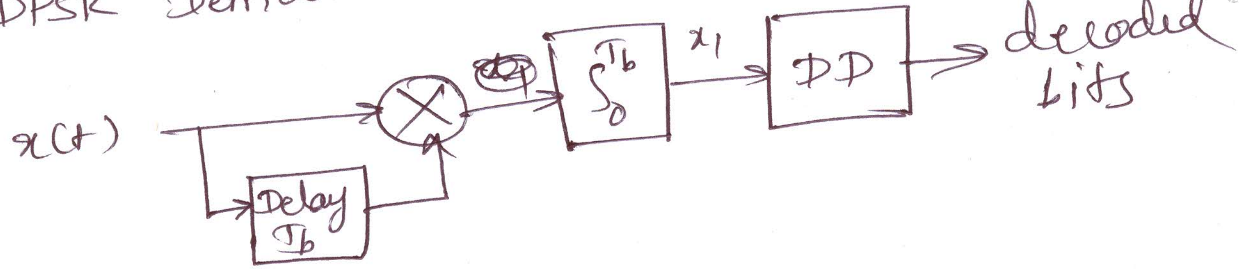
Demodulator



5 DPSK Modulator



DPSK Demodulator



Bit '1' if $x_1 < 0$

Bit '0' if $x_1 > 0$

b_k 1 0 1 0 1 1 0 1

d_k 1 0 0 1 1 0 1 1 0

ϕ 0 π π 0 0 π 0 0 π

* DPSK does not require exact phase of received signal

* DPSK can recover bits correctly even in the presence of bit reversal.