Click to add title

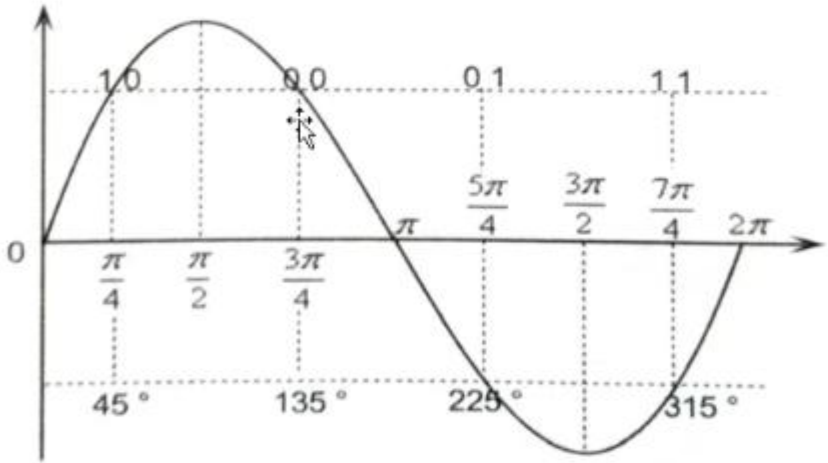


Figure 5.19: Waveform

carrier i.e $\pi/4$, $3\pi/4$, $5\pi/4$ & $7\pi/4$.

* A QPSK Signal can be represented in time domain as:

$$S_i(t) = \begin{cases} \sqrt{\frac{2E}{T}} \cos\left[2\pi f_c t + (2i-1)\pi/4\right] & 0 \le t \le T_b \\ 0 & \text{elsewhere} \end{cases} \longrightarrow (1)$$

Where $i = 1, 2, 3, 4$ and

$E \rightarrow$ Signal energy per Symbol

$T \rightarrow$ Symbol duration.

* There are four message points & associated Signal vectors are defined by

$$S_i(t) = \begin{cases} \sqrt{\frac{2E}{T}} \cos\left[2\pi f_c t + \theta_i\right] & ; 0 \le t \le T \\ 0 & ; \text{otherwise} \end{cases} \longrightarrow (2)$$

Where $\theta_i = (2i-1)\pi/4$

i	$\theta_i = (2i-1)\pi/4$
1	$\pi/4$
2	$3\pi/4$
3	$5\pi/4$
4	$7\pi/4$

We can write eq (2) as

$S_1(t) = \sqrt{\frac{2E}{T}} \cos(2\pi f_c t + \pi/4)$; dibit 10

$S_2(t) = \sqrt{\frac{2E}{T}} \cos(2\pi f_c t + 3\pi/4)$; dibit 00

$S_3(t) = \sqrt{\frac{2E}{T}} \cos(2\pi f_c t + 5\pi/4)$; dibit 01

$S_4(t) = \sqrt{\frac{2E}{T}} \cos(2\pi f_c t + 7\pi/4)$; dibit 11

* Eq (1) can be written as

$\boxed{\cos(A+B) = \cos A \cdot \cos B - \sin A \cdot \sin B}$

3	$5\pi/4$
4	$7\pi/4$

$S_2(t) = \sqrt{\frac{2E}{T}} \cos\left(2\pi f_c t + 3\pi/4\right)$; dibit 00

$S_3(t) = \sqrt{\frac{2E}{T}} \cos\left(2\pi f_c t + 5\pi/4\right)$; dibit 01

$S_4(t) = \sqrt{\frac{2E}{T}} \cos\left(2\pi f_c t + 7\pi/4\right)$; dibit 11

$\boxed{\cos(A+B) = \cos A \cdot \cos B - \sin A \cdot \sin B}$

* Eq ① can be written as

$$S_i(t) = \begin{cases} \sqrt{\frac{2E}{T}} \cos 2\pi f_c t \cdot \cos\left[(2i-1)\pi/4\right] - \sqrt{\frac{2E}{T}} \sin 2\pi f_c t \cdot \sin\left[(2i-1)\pi/4\right] & ; 0 \le t \le T \\ 0 & ; \text{otherwise} \end{cases} \longrightarrow ③$$

* From eq ③, we observe that there are two orthonormal basis functions $\phi_1(t)$ & $\phi_2(t)$ defined by

$$\phi_1(t) = \sqrt{\frac{2}{T}} \cos(2\pi f_c t) \quad ; 0 \le t \le T \qquad \longrightarrow ④$$

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

The elements of the Signal vector, namely S_{i1} & S_{i2}.

i	$S_i(t)$	I/p dibit	Phase of QPSK Signal	Co-ordinates of message points	
				S_{i1}	S_{i2}
1	$S_1(t)$	10	$\pi/4$	$+\sqrt{E/2}$	$-\sqrt{E/2}$
2	$S_2(t)$	00	$3\pi/4$	$-\sqrt{E/2}$	$-\sqrt{E/2}$
3	$S_3(t)$	01	$5\pi/4$	$-\sqrt{E/2}$	$+\sqrt{E/2}$
4	$S_4(t)$	11	$7\pi/4$	$+\sqrt{E/2}$	$+\sqrt{E/2}$

4	$S_4(t)$	11	$7\pi/4$	$+\sqrt{E/2}$	$+\sqrt{E/2}$

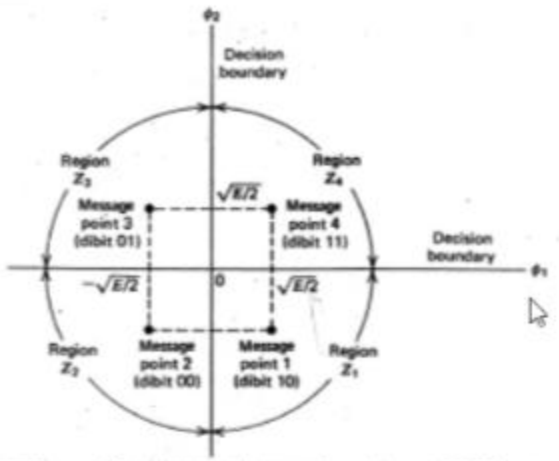


Figure Signal space diagram for coherent QPSK system.

<u>QPSK Transmitter :-</u>

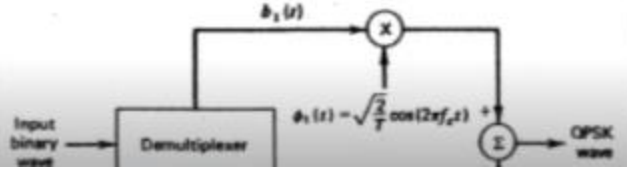
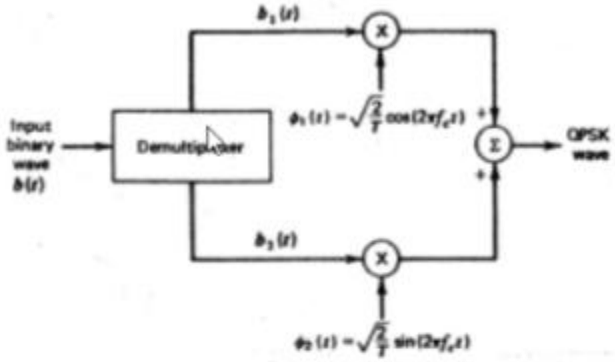


Figure Signal space diagram for coherent QPSK system.

QPSK Transmitter :-

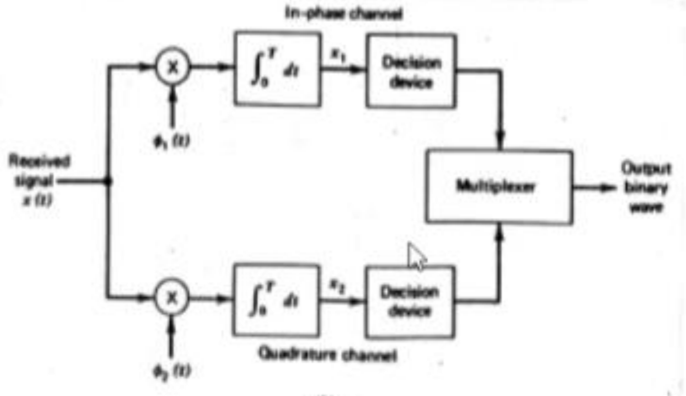


* The I/p binary Sequence b(t) represented in polar form is divided into odd [$b_1(t)$] & even [$b_2(t)$] numbered bits by using demultiple

frequency but quadrature in phase.

* Since each symbol carries two bits, the signalling rate decreased.
  ∴ BW required is half the bandwidth required compared to BPSK

QPSK Receiver :-



(b)

* The QPSK receiver consists of a pair of correlators with locally generated carrier signals $\phi_1(t)$ & $\phi_2(t)$.
* The o/p of the two correlators are x_1 & x_2 are compared with a threshold '0'.

If $x_1 > 0 \rightarrow$

If $x_1 < 0 \rightarrow$