# Digital Modulation Technique

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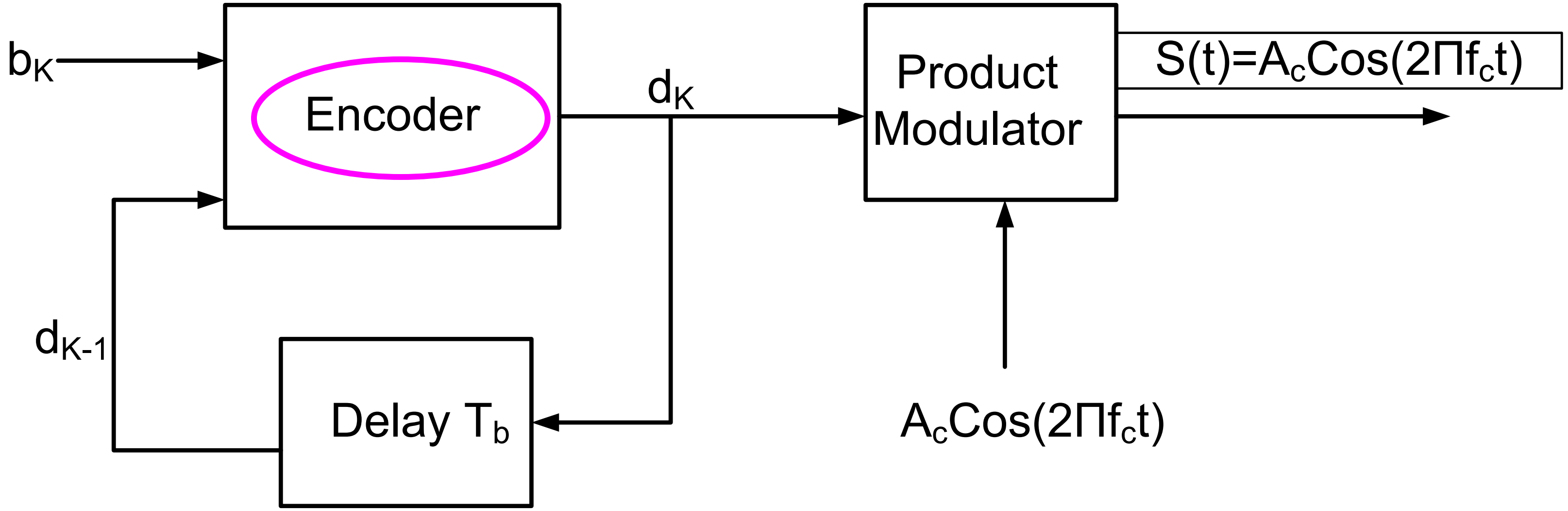
# Goal of Today’s Lecture

- Differential Phase Shift keying
- Quadrature Phase Shift Keying
- Minimum Phase Shift Keying
- Introduction To Information Theory
- Information Measure

# Differential Phase Shift Keying (DPSK)

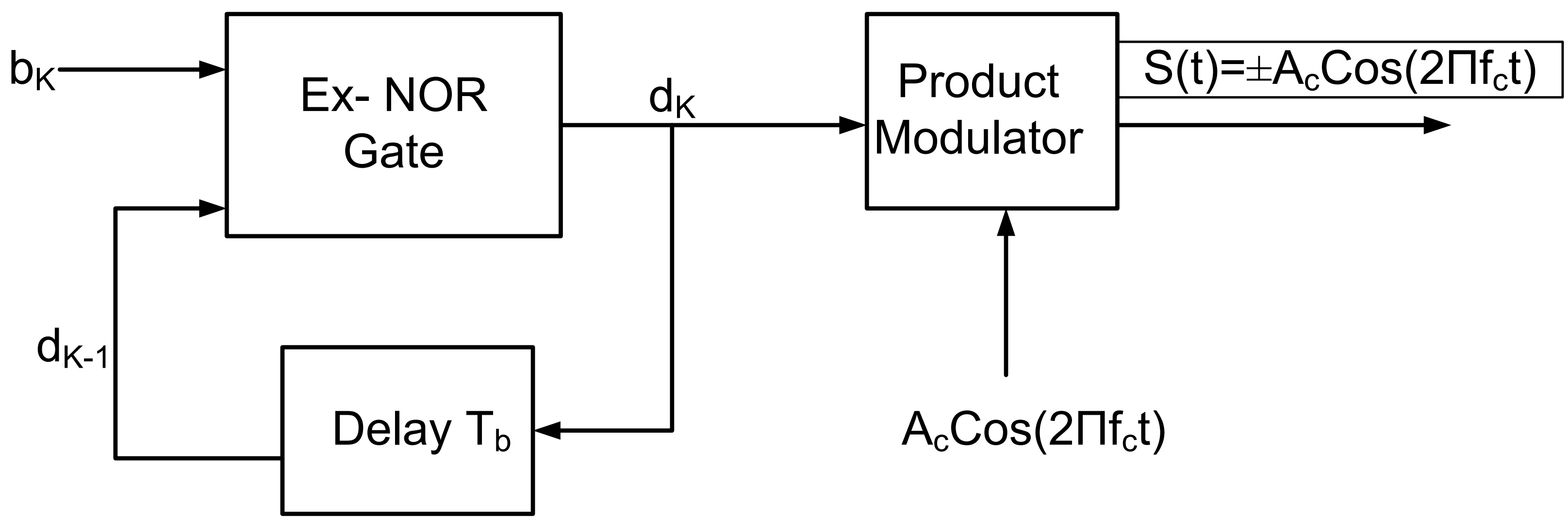
- Why We Require?
  - To Have Non-coherent Detection
  - That Makes Receiver Design
- How can we do?
  - 0 may be used represent transition
  - 1 indicate No Transition

# DPSK Transmitter




What Should We Do to make Encoder?

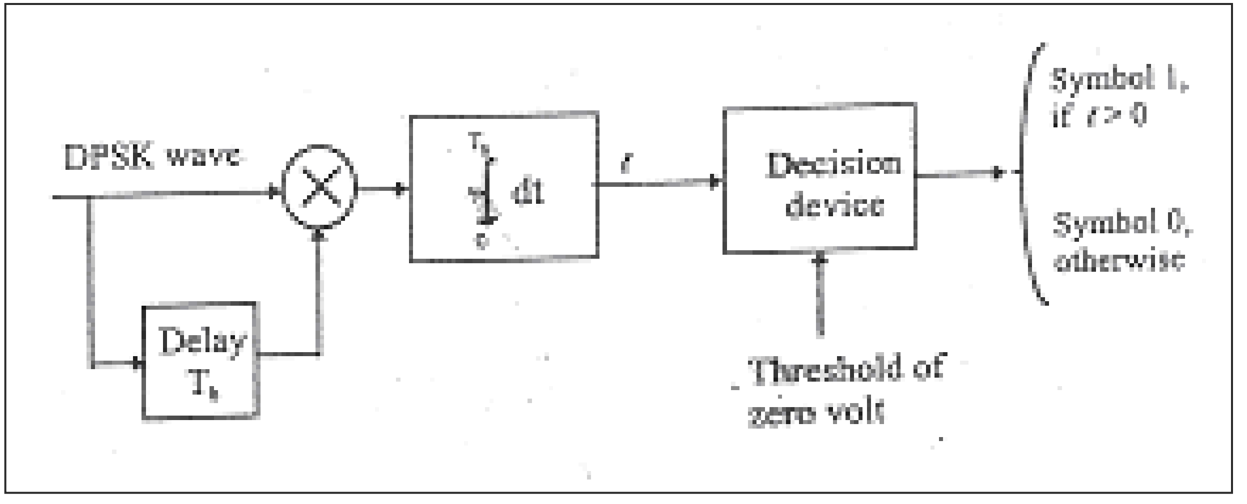
# DPSK Transmitter…………Modified



# Differentially Encoded Sequence

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Binary Data | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| Differentially Encoded Data | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| Phase of DPSK | 0 | π | 0 | 0 | π | 0 | 0 | π | 0 | 0 | 0 |
| Shifted Differentially encoded Data $d_{k-1}$ | | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| Phase of shifted Data | | 0 | π | 0 | 0 | π | 0 | 0 | π | 0 | 0 |
| Phase Comparision Output | | - | - | + | - | - | + | - | - | + | + |
| Detected Binary Seq. | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |

# DPSK Receiver



# Goal of Today's Lecture

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# Quadrature Phase Shift Keying (QPSK)

- Extension of Binary-PSK
- Spectrum Efficient Technique
- In M-ary Transmission it is Possible to Transmit M Possible Signal

$$M = 2^n$$

where,

n= no of Bits that we Combine

signaling Interval $T = nT_b$

In QPSK n=2 === > So M =4

and

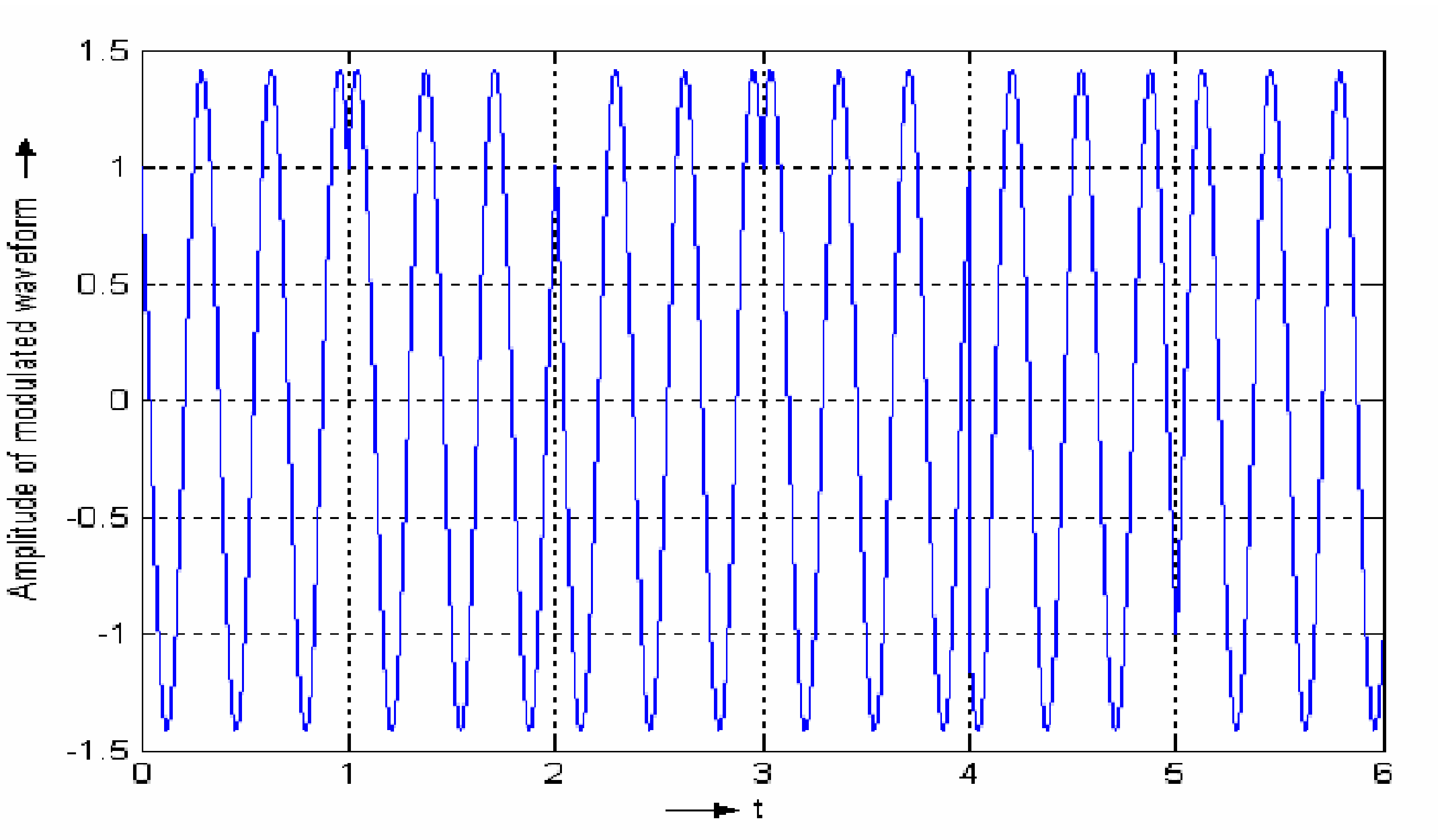
signaling Interval $T = 2T_b$

# Quadrature Phase Shift Keying (QPSK)

- M=4 so we have possible signal are 00,01,10,11
- Or In Natural Coded Form 00,10,11,01

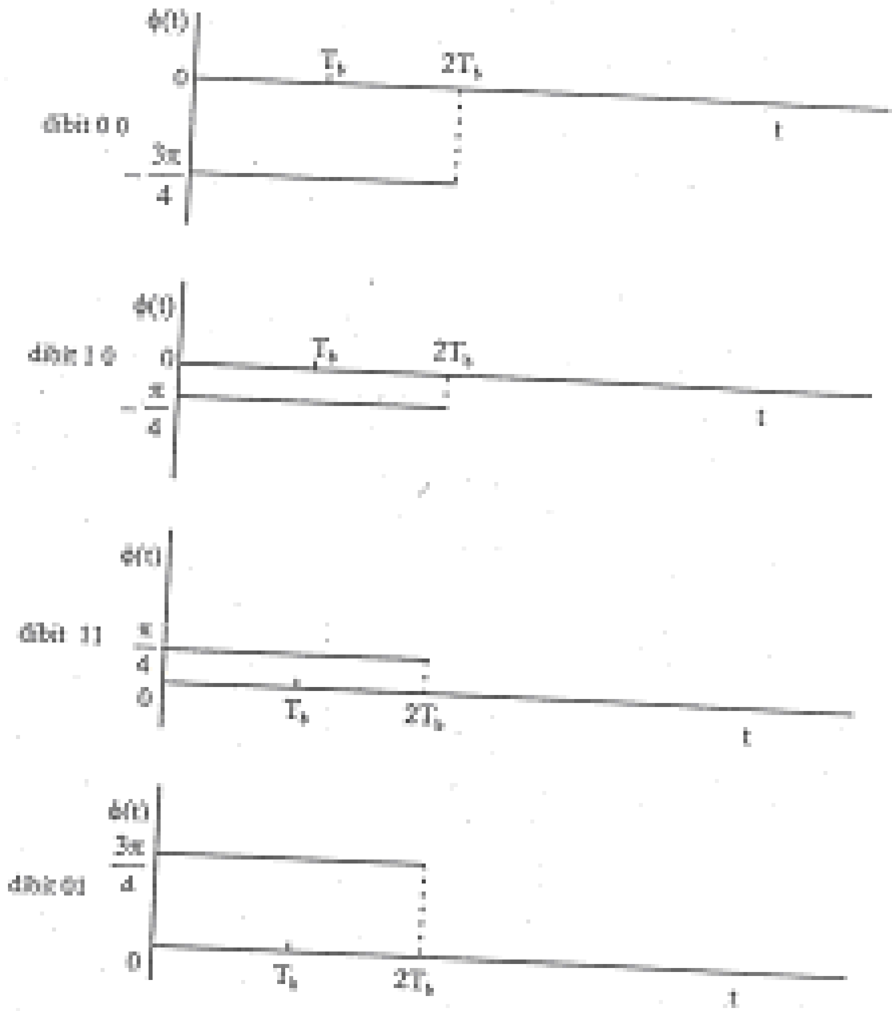
| | | |
|---|---|---|
| $s(t) = A_c \cos(2\pi f_c t - \frac{3\pi}{4})$ | -135 | Binary Dibit 00 |
| $= A_c \cos(2\pi f_c t - \frac{\pi}{4})$ | -45 | Binary Dibit 10 |
| $= A_c \cos(2\pi f_c t + \frac{\pi}{4})$ | 45 | Binary Dibit 11 |
| $= A_c \cos(2\pi f_c t + \frac{3\pi}{4})$ | 135 | Binary Dibit 01 |

# QPSK Waveform

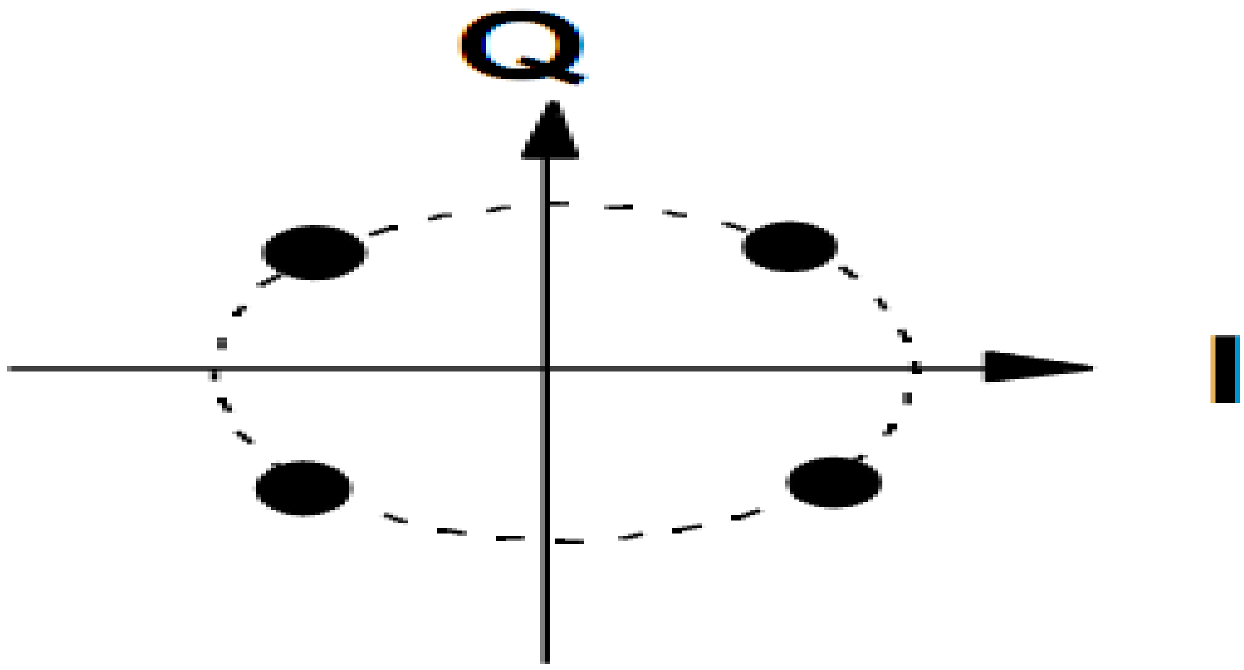



00 11 00 11 10 10

# QPSK Signal Phase



# Constellation Diagram



# Quadrature Phase Shift Keying (QPSK)

The QPSK Formula

$$s(t) = A_c \cos(2\pi f_c t + \phi(t)) \quad \text{..................}(1)$$

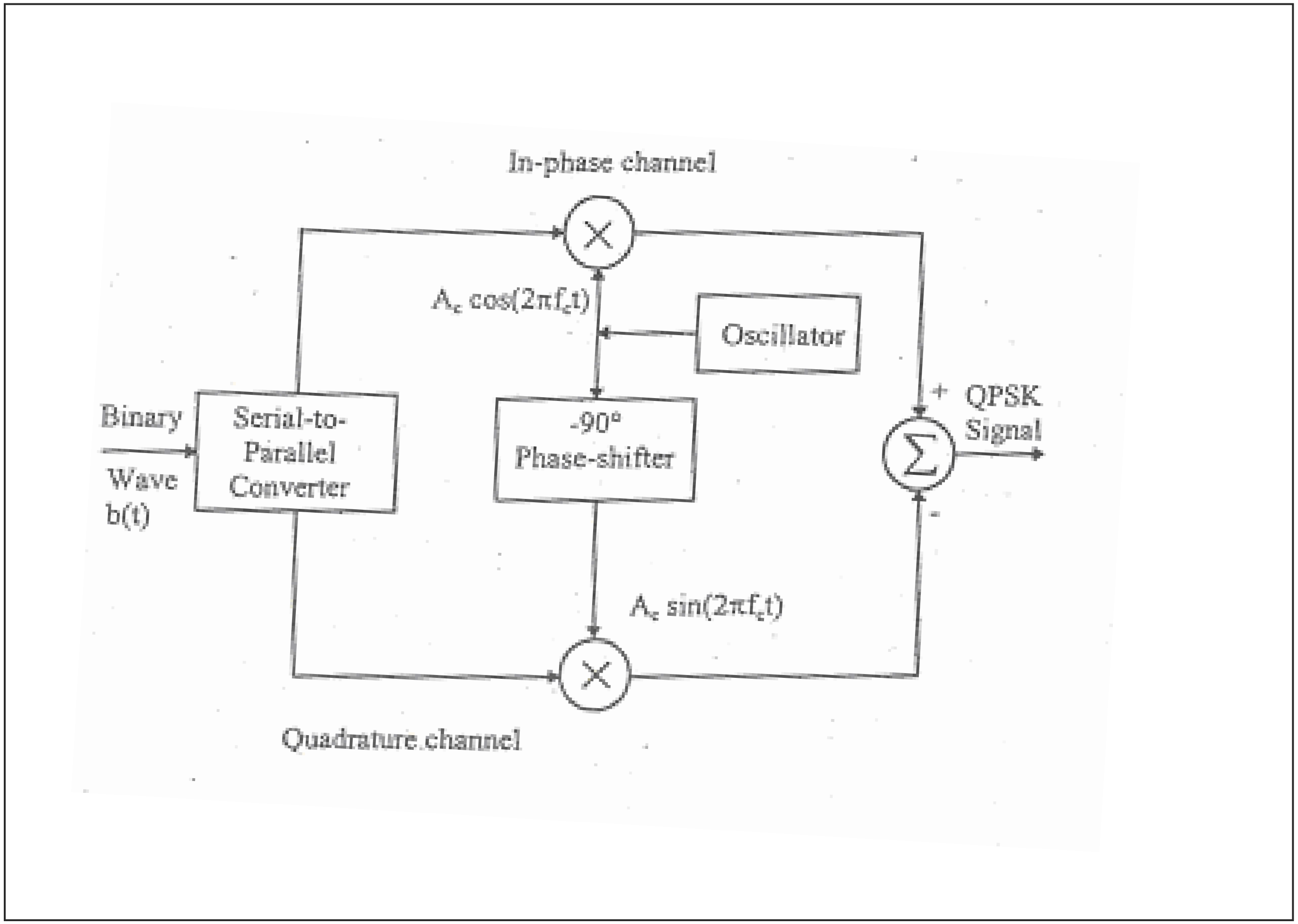
Where, ϕ(t)=135,45,-45,-135

Simplifying Equation 1

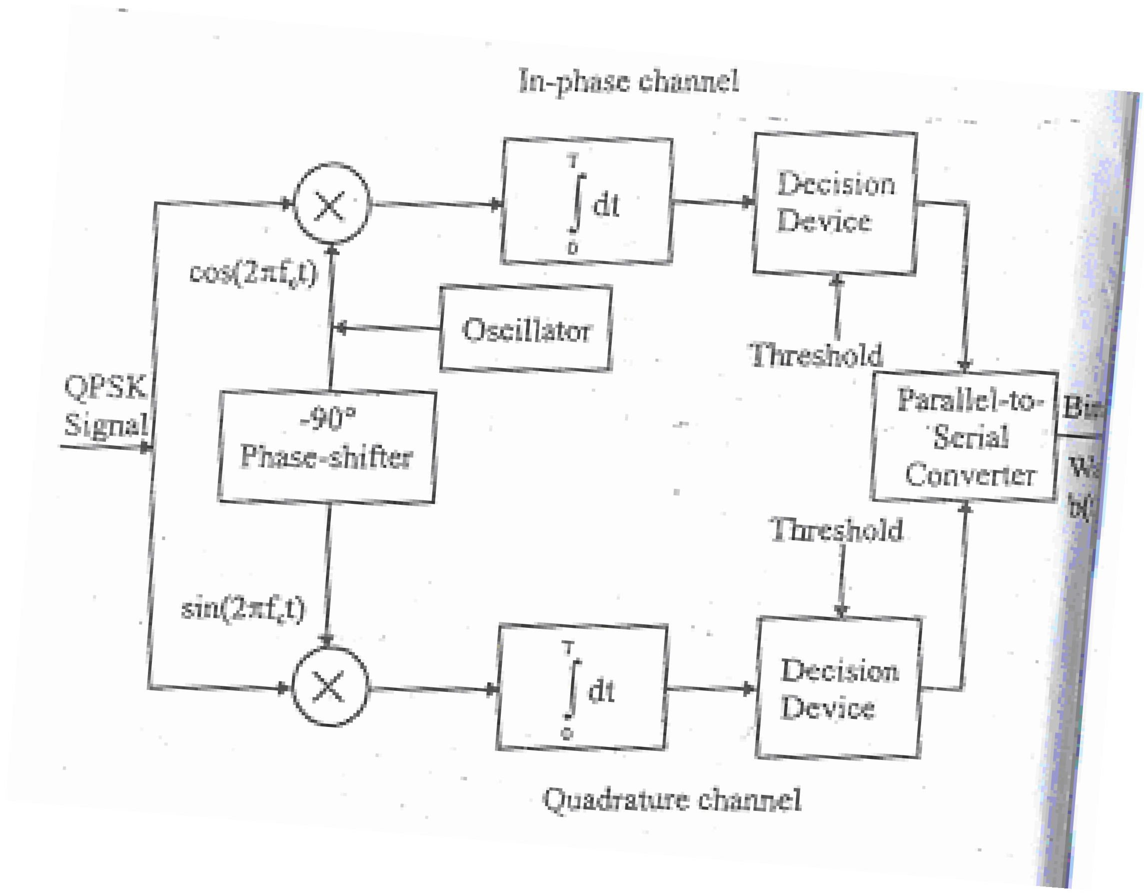
$$S(t) = A_c \cos\phi(t).\cos(2\pi f_c t) - A_c \sin\phi(t)\sin(2\pi f_c t)$$

This Gives the Idea about Transmitter design

# QPSK Transmitter



# QPSK Receiver



# Thank You