Teacher/Instructor: Mr.G.VIJAYA KUMAR
Department of ECE
Assistant Professor

Lesson Plan for a Day Term/Semester
/Year: Sem-I-Syllabus2020-21

MICROLESSON PLAN (ACCORDING TO BLOOMS DIGITAL TAXONOMY)

Programme	B.Tech, Electronics & Communication Engineering
Semester	III Year-I Semester
SubjectTitle	DIGITAL COMMUNICATIONS
SubjectCode	R1631042
ClassHours	4-Hours per week
TotalHours	68
Credits	3
MaxMarks	100
Unit&Title	Unit-I: Pulse Digital Modulation
TeachingandLearning	Black Board/Power Point Presentation/Videos, E-material.

Detailed–Lesson1

Pulse Digital Modulation

Lesson Objectives:

Factual	Through this detailed Unit-1 ‘**Pulse Digital Modulation’** students will understand about various types of Pulse digital modulation techniques.
Conceptual	Students will be able to analyze the methods of transmission of digital data using baseband modulation techniques.
Procedural	Students should be able to design a pulse digital modulation system with improved SNR.
Applied	Students should be able to implement the various digital modulation techniques in the Simulation Tool.

Prerequisite Knowledge:

Basic knowledge of Analog Communications

Micro Lesson Plan: Day-1: Elements of PCM System

1. Pre-task Activity-Introducing

In pre-task, I planned to give introduction about the various elements in PCM System

Video Link: https://www.youtube.com/watch?v=WUCMavXbJo4&list=PLF84ABD7D4EBA31C4&index=2

Material Link: Pulse Digital Modulation

2. In-class Activity: "Elements of PCM System"

Pulse Code Modulation:
Three steps involved in conversion of analog signal to digital signal

- Sampling
- Quantization
- Binary encoding

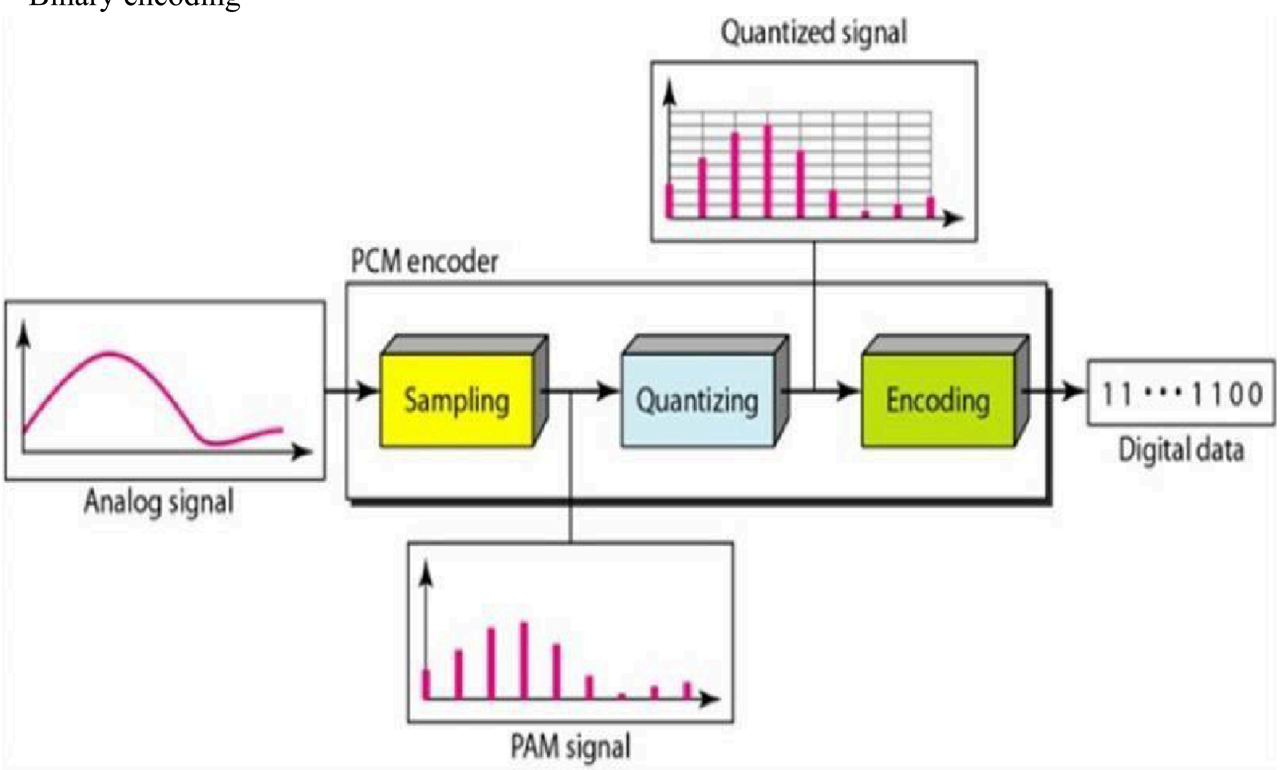


Fig. 1 Conversion of Analog Signal to Digital Signal

Elements of PCM System:

Sampling:

- Process of converting analog signal into discrete signal.
- Sampling is common in all pulse modulation techniques.
- The signal is sampled at regular intervals such that each sample is proportional to amplitude of signal at that instant
- Analog signal is sampled every $Ts\ Secs$, called sampling interval. $fs=1/TS$ is called sampling rate or sampling frequency.
- $fs=2fm$ is Min. sampling rate called **Nyquist rate.** Sampled spectrum (ω) is repeating periodically without overlapping.
- Original spectrum is centered at $\omega=0$ and having bandwidth of ωm. Spectrum can be recovered by passing through low pass filter with cut-off ωm.
- For $fs<2fm$ sampled spectrum will overlap and cannot be recovered back. This is called **aliasing.**

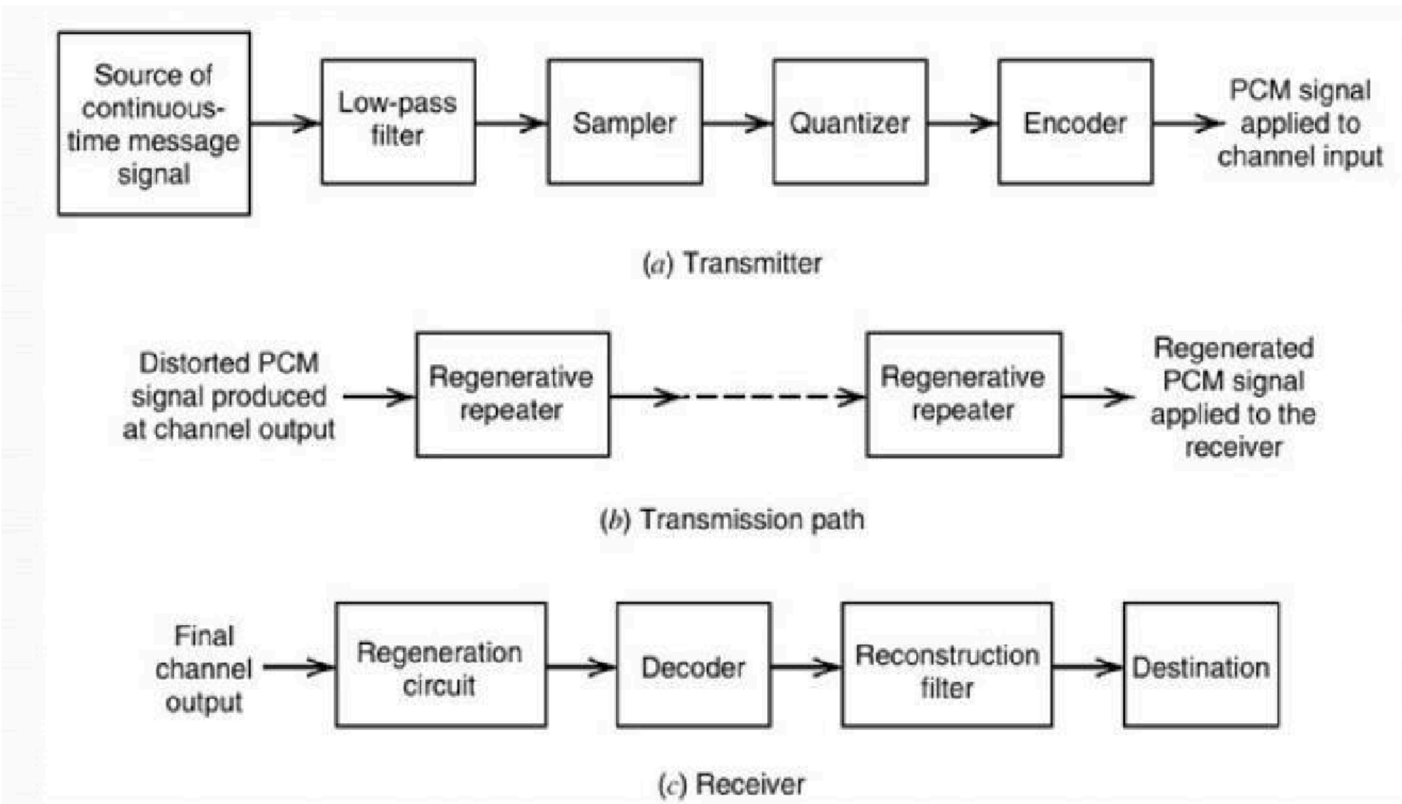


Fig. 2 Elements of PCM System

Sampling methods:

- Ideal – An impulse at each sampling instant.
- Natural – A pulse of Short width with varying amplitude.
- Flat Top – Uses sample and hold, like natural but with single amplitude value.

Instantaneous Sampling or Impulse Sampling:

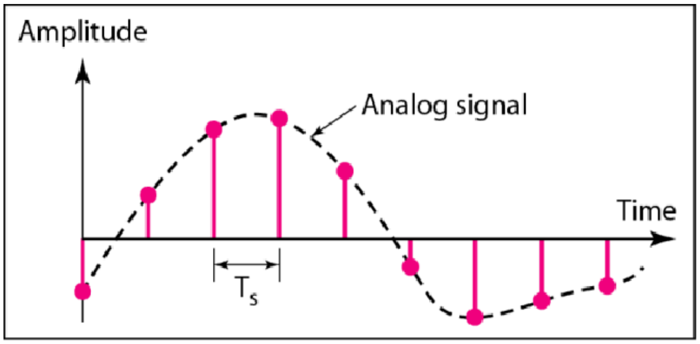
- Sampling function is train of spectrum remains constant impulses throughout frequency range. It is not practical.

Natural sampling:

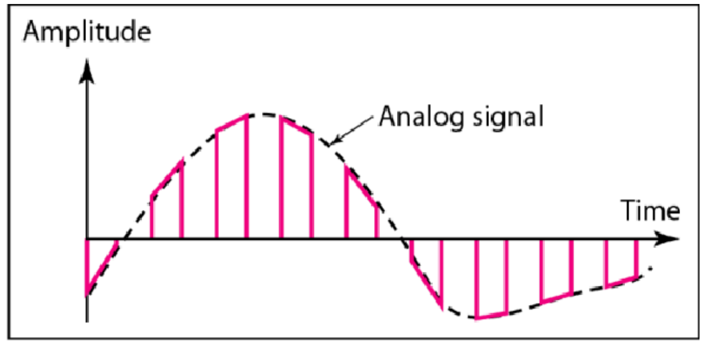
- The spectrum is weighted by a **sinc** function.
- Amplitude of high frequency components reduces.

Flat top sampling:

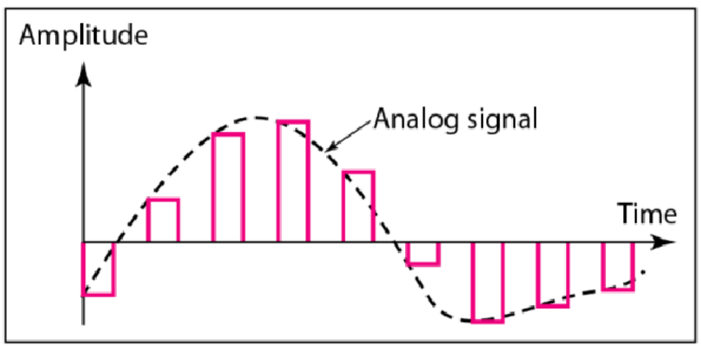
- Here top of the samples remains constant.
- In the spectrum high frequency components are attenuated due sinc pulse roll off. This is known as **Aperture effect.**
- If pulse width increases aperture effect is more i.e. more attenuation of high frequency components.



a. Ideal sampling



b. Natural sampling



c. Flat-top sampling

Transmission BW in PCM:

Let the quantizer use 'v' number of binary digits to represent each level. Then the number of levels that can be represented by 'v' digits will be,

$$q = 2^v \qquad \dots \quad 1$$

Here 'q' represents total number of digital levels of q-level quantizer.

For example if $v = 3$ bits, then total number of levels will be,

$$q = 2^3 = 8 \text{ levels}$$

Each sample is converted to 'v' binary bits. i.e. Number of bits per sample = v

We know that, Number of samples per second = f_s

∴ Number of bits per second is given by,

$$\begin{aligned}(\text{Number of bits per second}) &= (\text{Number of bits per samples}) \\ &\quad \times (\text{Number of samples per second}) \\ &= v \text{ bits per sample} \times f_s \text{ samples per second} \qquad \dots \quad 2\end{aligned}$$

The number of bits per second is also called signaling rate of PCM and is denoted by 'r' i.e.,

$$\boxed{\text{Signaling rate in PCM : } r = v\, f_s} \qquad \dots \quad 3$$

Here $f_s \geq 2W$.

Bandwidth needed for PCM transmission will be given by half of the signaling rate i.e.,

$$\text{Transmission Bandwidth of PCM : } \begin{cases} B_T \geq \frac{1}{2} r & \dots \quad 4 \\ B_T \geq \frac{1}{2} v\, f_s \quad \text{Since } f_s \geq 2W & \dots \quad 5 \\ B_T \geq v\, W & \dots \quad 6 \end{cases}$$

3. Post–task Activity:

- In Post task activity revising the class, clarifying the doubts and asking questions to know the response.

Assignment:

1. A television (TV) signal with a bandwidth of 4.2 MHz is transmitted using binary PCM. The number of representation levels is 512. Calculate the following parameters. (i) The code word length (ii) The final bit rate (ii) The transmission bandwidth

Sol: - Given TV signal bandwidth $W = 4.2 MHz$

The no. of representation levels $q = 512$

i, Code word length

no. of quantization levels $q = 2^\nu$

$2^9 = 512 = 2^\nu$

$\nu = 9$ bits/sample

So code word length = 9

ii, Final bit rate (or) signalling rate

$r = \nu f_s$

Sampling frequency $f_s = 2W$

$f_s = 2 \times 4.2 MHz = 8.4 MHz$

bitrate $r = \nu f_s = 9 \times 8.4 \times 10^6 = 75.6$ Mbps

iii, Transmission bandwidth $B_T \geq \frac{1}{2} r$

$B_T \geq \frac{1}{2} \times 75.6M$

$B_T \geq 37.8 MHz$

2. Write a Matlab code for Pulse code Modulation

MATLAB Program:

Matlab code for pulse modulation:

```
am = input ("Enter the Continous time Signal Amplitude");
fm = input ("Enter the Continous time Signal frequency");
fs = 100*fm;
t = 0: 1/fs: 1;
x = am * sin(2*pi*fm*t);
Subplot (3,1,1)
plot (t,x,'r');
xlabel ('time');
yLabel ('Amplitude');
title ('Continous time Signal');
subplot (3,1,2);
stem (t,x,'r');
xlabel ('time');
ylabel ('Amplitude');
title (' Sampled message signal');
enc = [];
for (i=1: Length(x))
   if (x(i)>0  && x(i)<=1)
   e = [100];
   xq[i] = 0.5;
   elseif  (x(i)>1 && x(i)<=2)
    e=[1 0 1]
    xq [i] = 1.5;
```

```
elseif (x(i)>2 && x(i)<=3)
  e=[1 1 0];
  xq(i)=2.5;
elseif (x(i)>3 && x(i)<=4)
  e=[1 1 1]
  xq(i)=3.5;
elseif (x(i)>-4 && x(i)<=-3)
  e=[0 0 0];
  xq(i) = -3.5;
elseif (x(i)>-3 && x(i)<=-2)
  e=[0 0 1];
  xq(i)=-2.5;
elseif (x(i)>-2 && x(i)<=-1)
  e=[0 1 0];
  xq(i) = -1.5;
elseif (x(i)>-1 && x(i)<=0)
  e=[0 1 1];
  xq(i)=-0.5;
end
enc=[enc e]
subplot(3,1,3);
plot(t,xq,'b')
title('Quantized Signal');
```

4. Discussion

- Students will be able to design PCM systems with different quantization techniques.

5. Textbooks

1. Digital communications - Simon Haykin, John Wiley, 2005
2. Principles of Communication Systems – H. Taub and D. Schilling, TMH, 2003

Post Quiz:

1. Indicate which of the following pulse modulation systems is analog

a. PCM
b. Differential PCM
c. PWM
d. Delta modulation

Answer: PWM

2. Indicate which of the following systems is digital?

a. Pulse-position modulation
b. Pulse-code modulation
c. Pulse-width modulation
d. Pulse-frequency modulation

Answer: Pulse-code modulation

3. For an efficient communication in PCM system number of samples per second must at least be equal to twice the highest modulating frequency. Comment

a. Not necessary
b. A very important consideration
c. Who cares
d. 80- 50, true

Answer: A very important consideration

4. The main advantage of PCM signal is

a. lower bandwidth
b. higher bandwidth
c. lower noise
d. none of these

Answer: lower noise

5. In PCM, if the transmission path is very long

a. repeater stations are used
b. the pulse width may be increased
c. pulse amplitude is increased
d. pulse spacing is reduced

Answer: repeater stations are used

6. For uniform quantization with 32 levels, the qunantized output can be represented by n binary digits where n is

a. 5
b. 8
c. 6
d. 4

Answer: 5

7. In a PCM system, the number of quantization levels are 16 and the maximum signal frequency is 4 kHz, the bit transmission rate is

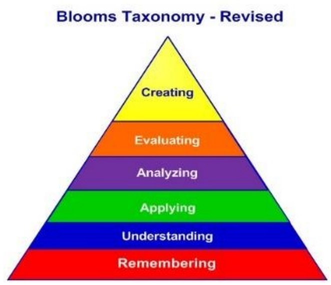
a. 64 bps
b. 16 kbps
c. 32 kpbs
d. 32 bps

Answer: 32 kpbs

8. In a PCM system, the amplitude levels are transmitted in a 7 unit code. The sampling is done at the rate of 10 kHz. The BW should be

a. 5 kHz
b. 35 kHz
c. 70 kHz
d. 5 MHz

Answer: 35 kHz



TaxonomyofObjectives –SpecificObjectives

Knowledge Dimension	The CognitiveProcessDimension					
	Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
A.Factual Knowledge	**SO-1**					
B.Conceptual Knowledge		**SO-2,3**				
C. Procedural Knowledge			**SO-4**			
D.Meta Cognitive Knowledge						