III B.Tech, II-Sem (ECE)

P	C
3	1.5

DIGITAL COMMUNICATION LAB

OBJECTIVES:

- ❖ To study the signal sampling by determining the sampling rates for baseband signals and reconstruct the signal.
- ❖ To study various modulation and demodulation process.
- ❖ To study the various steps involved in generating and degenerating different pulse modulation techniques.
- ❖ To study various modulation techniques using simulation process (MATLAB).
- ❖ To study the generation and demodulation of PSK, DPSK, FSK.

OUTCOMES:

- ❖ Study and comprehend the basics of Communication system and different Digital Modulation Systems.
- ❖ Analyze the operation of each device in various types of modulation systems.
- ❖ Design and conduct experiments of different Digital modulation systems, in order to interpret the results.
- ❖ Demonstrate the skill to use modern engineering tools like CAD tools.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	1											1	
CO2	3	3	2	1	1				1	2				2	
CO3	1	3	3	2	1	1			2	1		2	3	1	
CO4		2	2	1	3				2	1	1	2		1	3

Minimum of 8 experiments to be conducted (Four from each Part-A&B)

PART-A

1. Sampling Theorem – verification.
2. Time division multiplexing.
3. Pulse code modulation.
4. Differential pulse code modulation.
5. Delta modulation.
6. Frequency shift keying.
7. Differential phase shift keying.
8. QPSK modulation and demodulation.

PART-B

Modeling of Digital Communications using MATLAB

1. Sampling Theorem – verification.
2. Pulse code modulation.
3. Differential pulse code modulation.
4. Delta modulation.
5. Frequency shift keying.
6. Phase shift keying.
7. Differential phase shift keying.
8. QPSK modulation and demodulation.
9. Channel and its characteristics.

Equipment required for Laboratories:

1. RPS - 0 – 30 V
2. CRO - 0 – 20 M Hz.

3. Function Generators - 0 – 1 M Hz
4. RF Generators - 0 – 1000 M Hz./0 – 100 M Hz.
5. Multimeters
6. Lab Experimental kits for Digital Communication
7. Components
8. Radio Receiver/TV Receiver Demo kits or Trainees.

R.G.M.COLLEGE OF ENGINEERING & TECHNOLOGY, NANDYAL – 518 501
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III B.Tech., II-Semester — **Academic Year: 2022-23**

w.e.f: 09-01-2023

A-Section : RB3130 — **B-Section : RB3010**
C-Section : RB3020 — **D-Section : RB3030**

Period/ Day	Section	1 9.00 AM To 9.50 AM	2 9.50 AM To 10.40 AM	3 11.00 AM To 11.50 AM	4 11.50 AM To 12.40 PM	5 1.50 PM To 2.40 PM	6 2.40 PM To 3.30 PM	7 3.30 PM To 4.20 PM
MON	A	DC	IEI/ISTE	MW&OC	DSP	DDV	VLSID	COI
	D	VLSID	MW&OC	DC	CO&A	MW&OC Lab/DC Lab		
	B	DSP Lab			CO&A	VLSID	COI	DC
	C	MW&OC Lab/DC Lab			VLSID	DC	CO&A	MW&OC
TUE	A	VLSID	DSP	MW&OC	CO&A	MW&OC Lab/DC Lab		
	D	DC	CO&A	DSP	VLSID	DSP Lab		
	B	MW&OC Lab/DC Lab			MW&OC	DC	CO&A	DDV
	C	DDV	IEI/ISTE	DSP	DC	VLSID	MW&OC	CO&A
WED	A	VLSID	CO&A	MW&OC	DDV	DSP	COI	DC
	D	MW&OC	DDV	DSP	IEI/ISTE	MW&OC Lab/DC Lab		
	B	DC	CO&A	MW&OC	DSP	VLSID	MW&OC	DSP
	C	VLSID	MW&OC	DSP	DC	DSP Lab		
THU	A	MW&OC	CO&A	DSP	DC	MW&OC Lab/DC Lab		
	D	DSP	DC	VLSID	MW&OC	CO&A	COU	COI
	B	MW&OC Lab/DC Lab			VLSID	CO&A	DSP	LIB
	C	DSP	COU	COI	CO&A	MW&OC	VLSID	LIB
FRI	A	MW&OC	CO&A	DC	DSP	VLSID	DDV	COU
	D	DDV	DSP	CO&A	VLSID	MW&OC	DC	LIB
	B	DSP	CO&A	VLSID	DDV	DC	COI	MW&OC
	C	MW&OC	DSP	COI	CO&A	DSP	DDV	DC
SAT	A	DSP Lab			VLSID	DC	CO&A	LIB
	D	VLSID	CO&A	DC	MW&OC	DSP	DDV	COI
	B	MW&OC	DDV	COU	VLSID	DSP	IEI/ISTE	DC
	C	MW&OC Lab/DC Lab			DDV	DC	VLSID	CO&A

Subject	Section	Name of the Faculty
DSP	A	Mr.N.Nagaraja Kumar
MW&OC	A	Mr.S.Kasif Hussain
DC	A	Mr.D.Rajesh Setty
VLSID	A	Smt.M.Maheswari
CO&A	A	Mr.S.V.Ratan Kumar
DDV	A	Mr.J.Leela Mahendra Kumar
COI	A	Mr.Raja Sekar
DSP Lab	A	Mr.NNK/PCS/Mr.SLVK/BI
DC Lab	A	Mr.DRS/Smt.MM/Mrs.KM
MW&OC Lab	A	Mr.SKH/Dr.JSP&Miss.GBB
IEI/ISTE	A	Miss.NFS/Mr.SAB
Councelling	A	Miss.N.Fouzia Sulthana

Subject	Section	Name of the Faculty
DSP	B	Mr.K.Nagendra Kumar
MW&OC	B	Mr.S.Kashim Noor Basha
DC	B	Mr.M.A.Vijaya Kamalnath
VLSID	B	Smt.B.Nazma
CO&A	B	Mrs.K.Mounika
DDV	B	Mr.Y.S.Ponselvan
COI	B	Mr.K.Rama Krishna
DSP Lab	B	Mr.KNK/Mr.NNK/Mr.SLVK/
DC Lab	B	Mr.MAK/Smt.BN&FM/Mr.CD
MW&OC Lab	B	Mr.SKNB/Mr.KAK
IEI/ISTE	B	Miss.NFS/Mr.SAB
Councelling	A	Miss.N.Fouzia Sulthana

Subject	Section	Name of the Faculty
DSP	C	Mr.K.Nagendra Kumar
MW&OC	C	Mr.S.Kashim Noor Basha
DC	C	Mr.C.Dastagiraiah
VLSID	C	Smt.B.Nazma
CO&A	C	Mr.K.Anil Kumar
DDV	C	Mrs.N.Lakshmi Prasanna
COI	C	Dr.Aliya Sulthana
DSP Lab	C	Dr.VNVSP/Mr.KNK/PCS/SL
DC Lab	C	Smt.BN/Mr.MAVK/Mr.CD
MW&OC Lab	C	Mr.KAK/Mr.SKNB
IEI/ISTE	C	Miss.NFS/Mr.SAB
Councelling	C	Mr.J.Leela Mahendra Kumar

Subject	Section	Name of the Faculty
DSP	D	Mr.Y.Praveen Kumar Reddy
MW&OC	D	Mr.S.Kasif Hussain
DC	D	Mr.D.Rajesh Setty
VLSID	D	Smt.M.Maheswari
CO&A	D	Mrs.G.Yashaswini
DDV	D	Mr.J.Leela Mahendra Kumar
COI	D	Mr.Raja Sekar
DSP Lab	D	Mr.SAB/Mr.KNK/Mr.NNK/S
DC Lab	D	Mr.DRS& Smt.MM/Mrs.KM
MW&OC Lab	D	Mr.MVRS/Mr.SKH
IEI/ISTE	D	Miss.NFS/Mr.SAB
Councelling	A	Miss.N.Fouzia Sulthana

Dr.K.Mallikarjuna
HOD OF ECE

Dr. K. MALLIKARJUNA, Ph.D, MISTE, FIETE, ...
Professor & HOD
Department of ECE
RGM College of Engg. & Tech. (Autonomous)
NANDYAL - 518 501, Kurnool (Dist.), A.P.

Dr.T.Jaya Chandra Prasad
Principal

T. JAYACHANDRA PRASAD
M.E, Ph.D.,
PRINCIPAL
R.G.M College of Engg. & Tech.,
(Autonomous)
NANDYAL-518 501, Nandyal (Dt), A.P.

STUDENT PERFORMANCE EVALUATION

EXTERNAL EVALUATION (50 MARKS)

Block Diagram/ Circuit Diagram	10M
Procedure	05M
Connections/Code	10M
Observations/GRAPHS	10M
Result	05M
Viva voce	10M

INTERNAL EVALUATION (25 MARKS)

Execution	2M
Observations and Graphs	1M
Result	1M
Viva Voce	1M

RGM College of Engineering and Technology

Autonomous

Department of Electronics and Communication Engineering

Digital Communication Laboratory Manual

III B.Tech. II-Semester (R-20 Regulation)

(ESTD-1995)

RGM College of Engineering and Technology

Autonomous

Affiliated to JNTUA-Ananthapuramu, Approved by AICTE-New Delhi

Accredited by NBA-New Delhi, Accredited by NAAC with Grade A+, New Delhi

(A0481206)DIGITAL COMMUNICATION LAB

COURSE OBJECTIVES:

- To study the signal sampling by determining the sampling rates for baseband signals and reconstruct the signal.
- To study various modulation and demodulation process.
- To study the various steps involved in generating and degenerating different pulse modulation techniques.
- To study various modulation techniques using simulation process (MATLAB).
- To study the generation and demodulation of PSK, DPSK, FSK.

COURSE OUTCOMES:

At the end of this course the students are able to;

- Study and comprehend the basics of Communication system and different Digital Modulation Systems.
- Analyse the operation of each device in various types of modulation systems.
- Design and conduct experiments of different Digital modulation systems, in order to interpret the results.
- Demonstrate the skill to use modern engineering tools like CAD tools.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	1											1	
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CO4		2	2	1	3				2	1	1	2		1	3

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INDEX

Objective of Laboratory

The main objective of this lab is to learn MATLAB and know why it is an indispensable tool, especially for electronics and communication engineer.

Evaluation Procedure for Internal Laboratory Examinations

- For Practical subjects there shall be a continuous evaluation during the semester for 25 sessional marks and 50 end examination marks. Of the 25 marks for internal, 20 marks will be awarded for day-to-day work and 5 marks to be awarded by conducting an internal laboratory test.
- **Day-to-day evaluation:**
  - The concerned teachers have to do necessary corrections with explanations and evaluate each lab experiment.
  - Concerned Lab Incharge should also enter the marks in index page of the record and observation book & also at the end of each experiment with signature.
- **Internal Laboratory examination:**

  Ten marks will be awarded for internal Lab exam, the division of the marks as given below:

1. Execution	: 02Marks
2. Observations and Graphs	: 01 Mark
3. Result	: 01 Mark
4. Viva voce	: 01 Mark

  - Internal lab exam will be conducted by the in-charge Faculty member along with Associate Faculty members

Evaluation Procedure for External Laboratory Examinations

- This Examination Will Be Conducted During The Last Week Of The Semester As Per The Schedule Given By The RGMCET. (Autonomous)
- This examination will be conducted by the teacher in-charge of the lab and another two faculty members of the same department (who have more knowledge in the concern lab), recommended by Head of the Department with the approval of Principal.
- The maximum marks for this examination is 50.
- The distribution of marks for the evaluation is as follows.

1. Block Diagram/ Circuit Diagram	: 10 Marks
2. Procedure	: 05 Marks
3. Connections/Code	: 10 Marks
4. Observations/GRAPHS	: 10 Marks
5. Result	:05 Marks
6. Viva voce	: 10 Marks

EXPERIMENT: 1
SAMPLING THEOREM AND ITS VERIFICATION

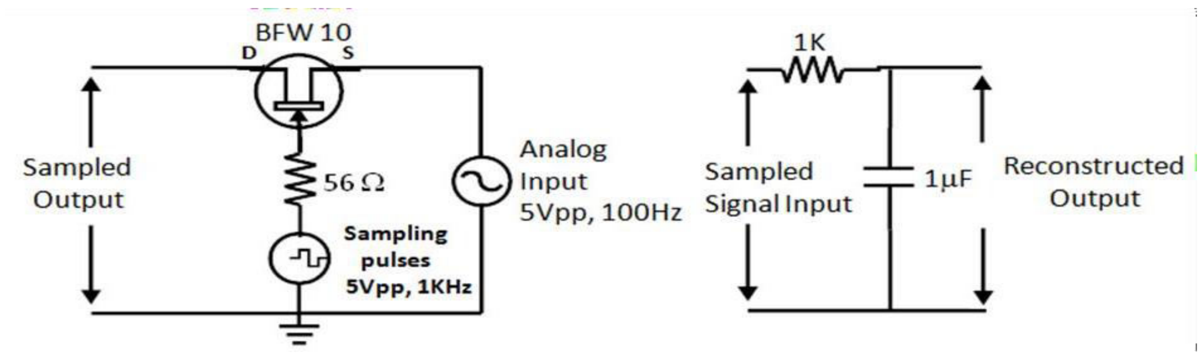
AIM:

1. To acquire the practical knowledge of Sampling Theorem.
2. To sample the given message signal at three different sampling rates i.e., under sampling, Critical sampling and Over sampling.
3. To reconstruct the message signal from the sampled signal.
4. To plot the corresponding waveforms on the Graph sheets.

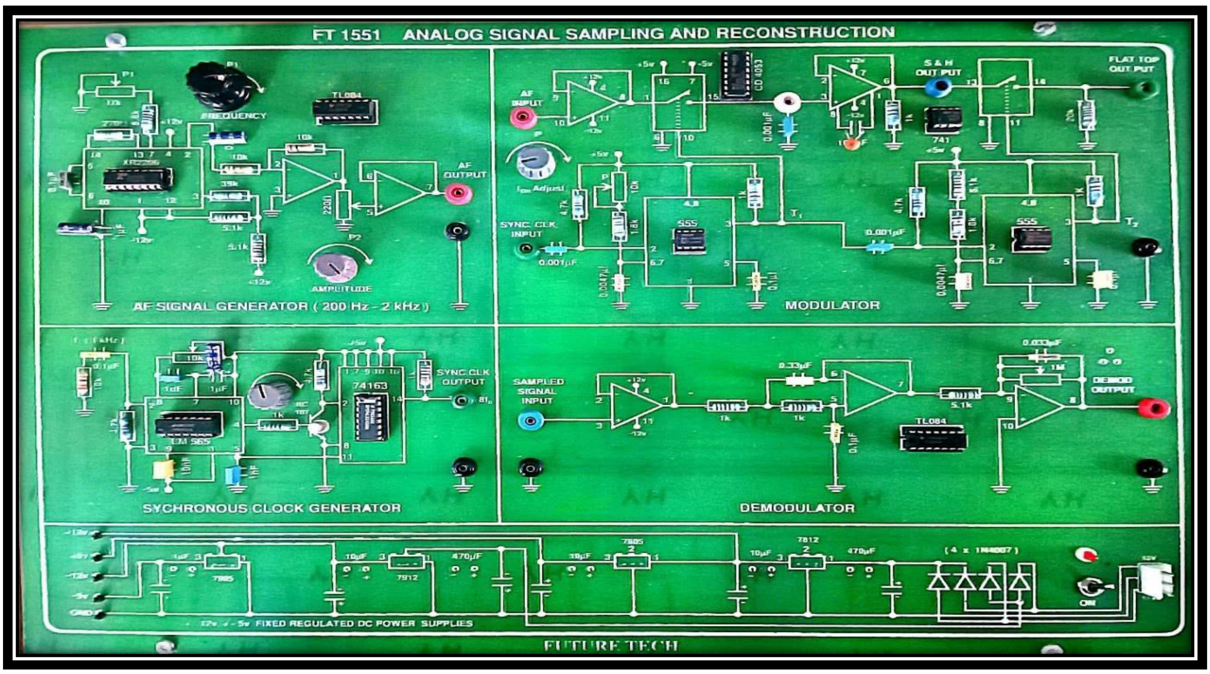
APPARATUS:

1. Sampling Theorem kit
2. Function Generator
3. Patch chords
4. Oscilloscope
5. Oscilloscope Probes
6. Oscilloscope Probes

BLOCK DIAGRAM:



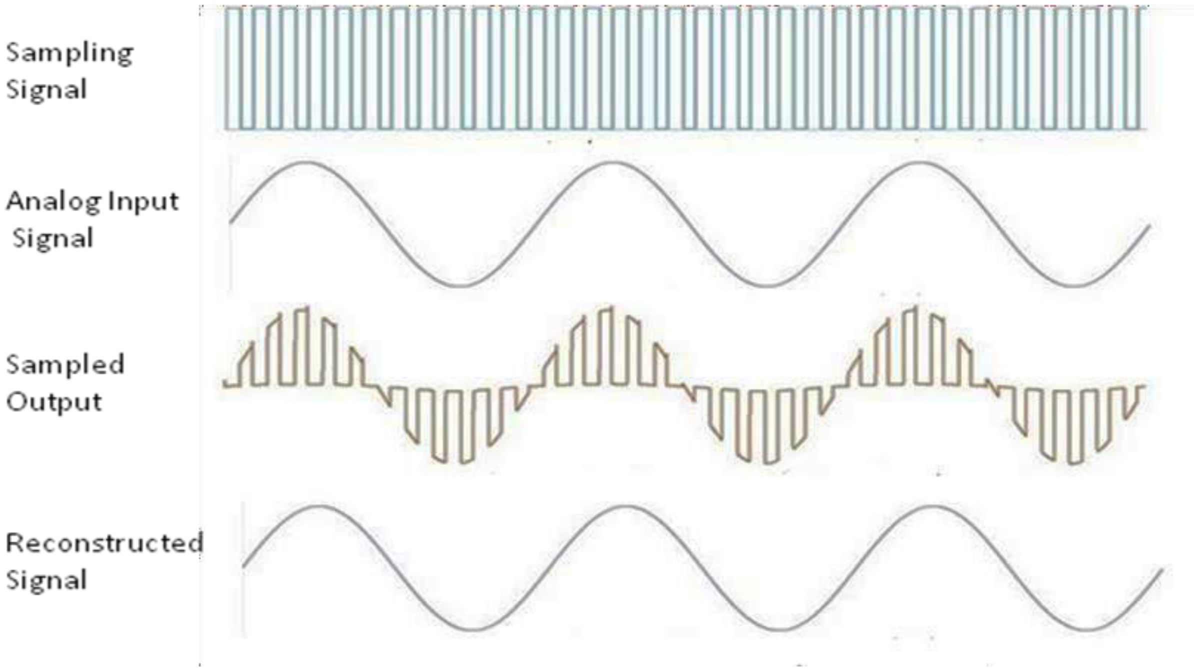
CIRCUIT DIAGRAM:



PROCEDURE:

1. The trainer kit is to be switched on.
2. A sinusoidal signal of requiredamplitude and frequency is to be given as the input to the sampling circuit.
3. A sampling clock of certain amplitude and frequency is to be given as input to the sampling clock.
4. The Frequency of sampling clock is to be varied for Nyquistrate, under sampling and over sampling.
5. The message signal, sampling clock and sampled signal are to be observed on the oscilloscope.
6. The Amplitude and frequency of the corresponding signals is to be noted for all the above cases,
7. The Sampled signal is to be given as an input to the reconstruction filter and the reconstructed output is to be observed.
8. The reconstruction filter should be designed for R and C values depending on the time constant of the message signal.
9. The Corresponding Waveforms are to be plotted on the Graph sheets.

EXPECTED WAVEFORMS



OBSERVATIONS:

Signal: Characteristic:	Under Sampling	Critical Sampling	Over Sampling
Message Signal: Amplitude Time period Frequency			
Sampling Clock Signal: Amplitude Time period Frequency			
Sampled Signal: Amplitude Time period Frequency			
Reconstructed signal: Amplitude Time period Frequency			

THEORY:

CALCULATIONS:

	Under Sampling	**Critical Sampling**	**Over sampling**
R or C			

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

1. Digital audio uses PCM and digital signals for sound reproduction.
2. Sampling rate is necessary to capture audio covering the entire 20-20000HZ range.
3. 3Dsampling is the process of volume reading samples a 3D grid of pixels procedure.

CONCLUSION:

RESULT:

INFERENCE:

PRE-EXPERIMENT VIVA-VOCE:

1. State Sampling Theorem.
2. What are the different types of Sampling Techniques based on the sampling rate?
3. What are the different types of sampling techniques, in general?
4. How does the reconstruction of the message signal possible from the sampled Signal?

POST-EXPEERIMENT VIVA-VOCE:

1. What is the Nyquist rate for Critical sampling?
2. What are difficulties you have faced while reconstructing the message signal for under Sampling?
3. What are difficulties you have faced while reconstructing the message signal for Over Sampling?
4. For which case,do you suggest for the better reconstruction of the messagesignalfrom the sampled signal?

EXPERIMENT: 2

TIME DIVISION MULTIPLEXING & DEMULTIPLEXING

AIM:

- To acquire the practical knowledge of the time division multiplexing &demultiplexing
- To multiplex and multiplex 8 digital signals
- To plot the corresponding waveforms on the graph sheets

APPARATUS:

- TDMkit
- CRO/DSO
- Patch cards
- Probes

BLOCK DIAGRAM

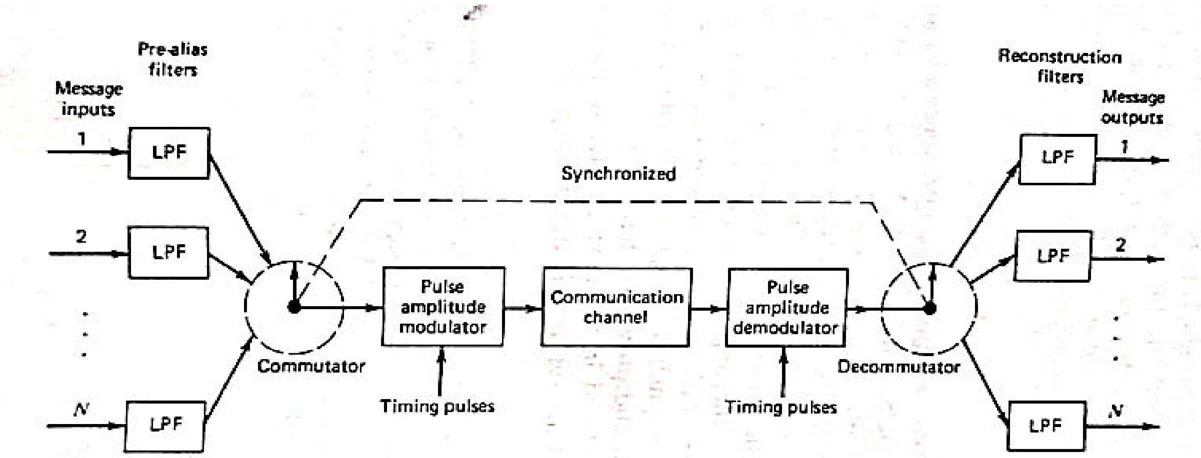
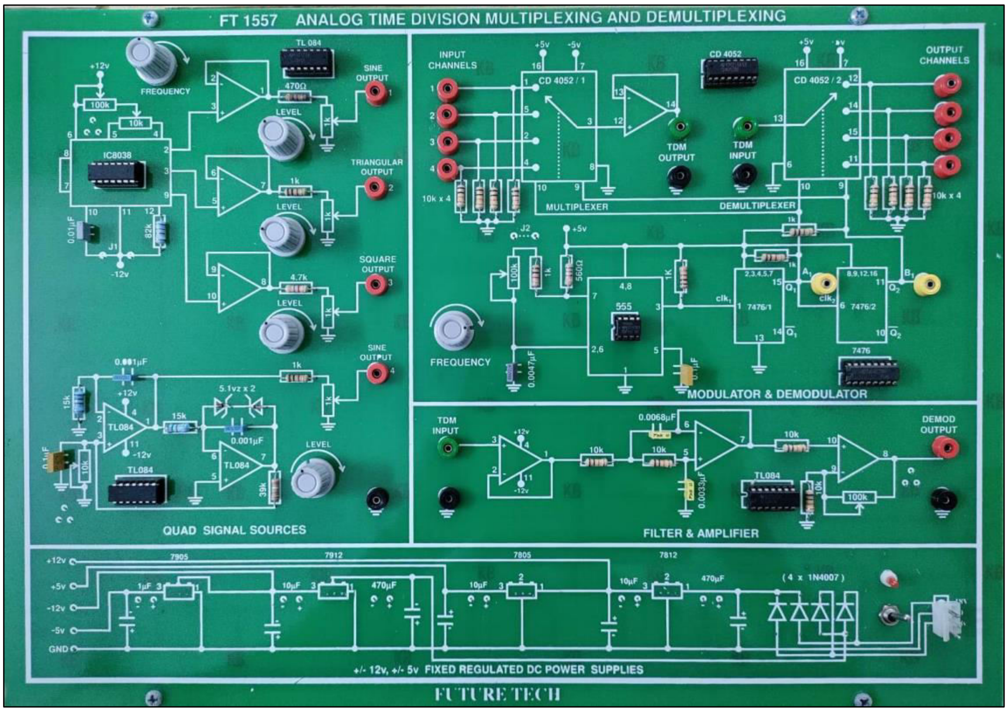
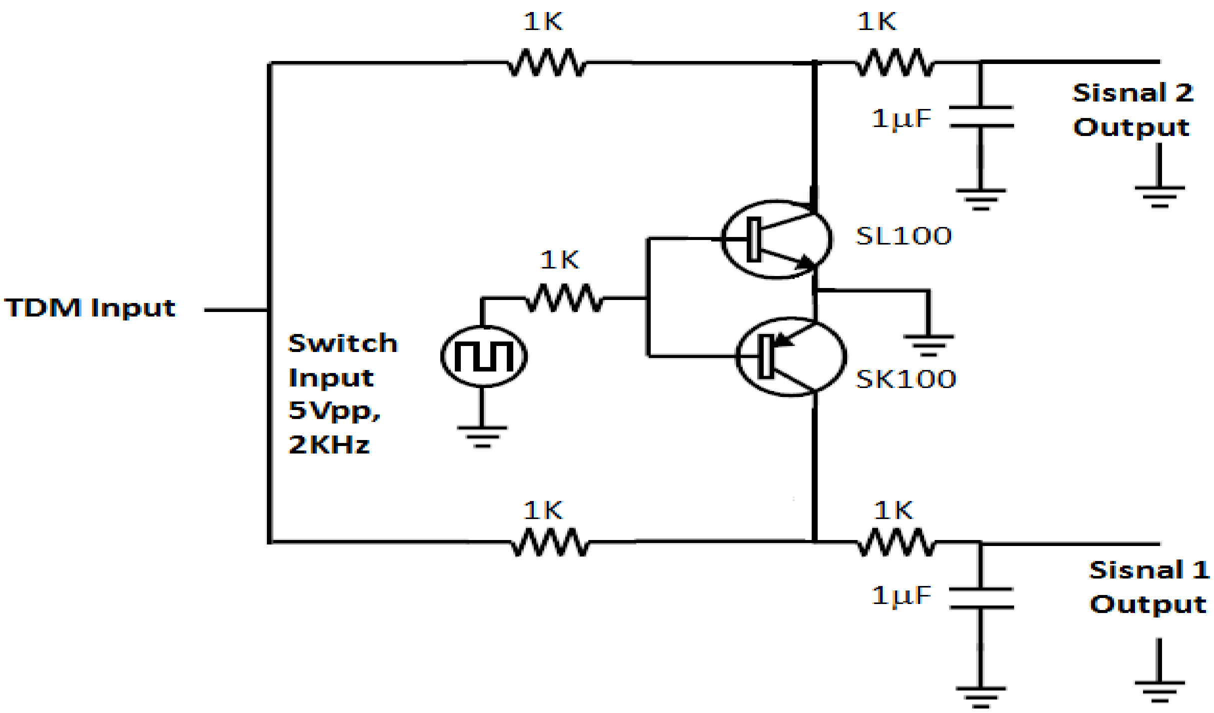


Figure 4.19 Block diagram of TDM system.

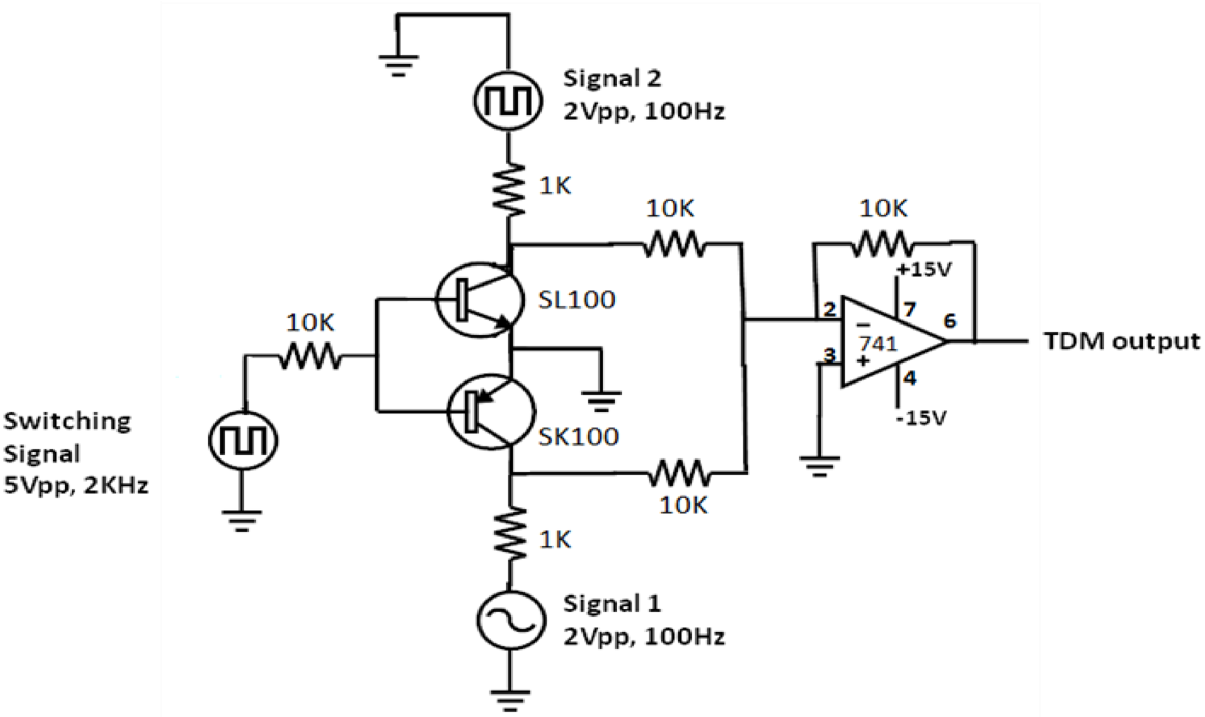
CIRCUIT DIAGRAM:



LOGICDIAGRAM:-



TDM Demultiplexer

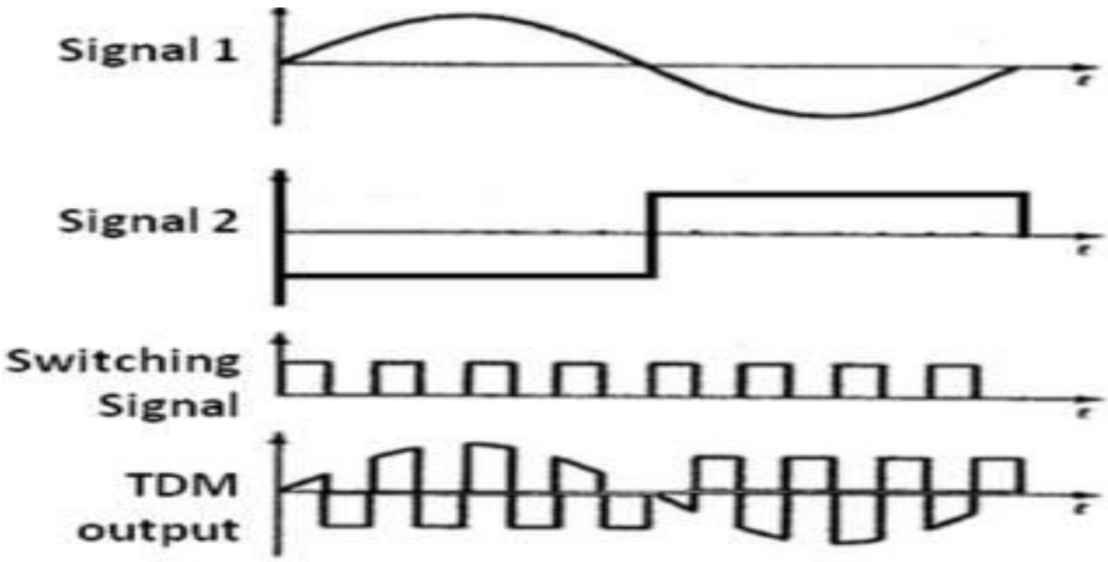


TDM Multiplexer

PROCEDURE:-

1. The1KHz clock signal is to be connected to the address generator input.
2. By giving HIGH or LOW signals to the multiplexer channel, as inputs,the output of the multiplexer and the output of the multiplexer and the output of the multiplexer is to be connected to the demultiplexer.
3. Suppose,1000 0000 signal is connected as input to the 8 to 1 multiplexer.
4. Multiplexer selects the HIGH input of channel 1 for each 8 times of the input clock signal.
5. Once multiplexed, after selection to the particular channel, that channel output is available at the demultiplexing output until the state of the particular channel changed be connected.
6. Repeat the same setup for any i/p condition.
7. Connect 10 kHz clock signal to the address generator i/p.
8. Connect A2 to channel 2 of CRO and trigger with CH-2 -ve slope. Connect the multiplexer channel HL HLHL.
9. Connect multiplexer o/p(i.e. serial) to CH 1 of CRO and observe waveform.
10. Also connect the mux o/p to demux and observe the i/p channels of the mux and the o/p of demux.
11. Now give the data generator o/p to different channels and observe the demux o/p

EXPECTED GRAPHS:-



THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSIONS:

INFERENCE:

PRE – EXPERIMENT VIVA-VOCE:

1. Define time division multiplexing and demultiplexing.
2. Draw the block diagram of time-Division Multiplexed PAM system

POST-EXPERIMENT VIVA – VOCE:

1. Enlist the application TDM system.
2. List out the advantages and disadvantages of TDM **system.**

EXPERIMENT: 3

PULSE CODE MODULATION AND DEMODULATION

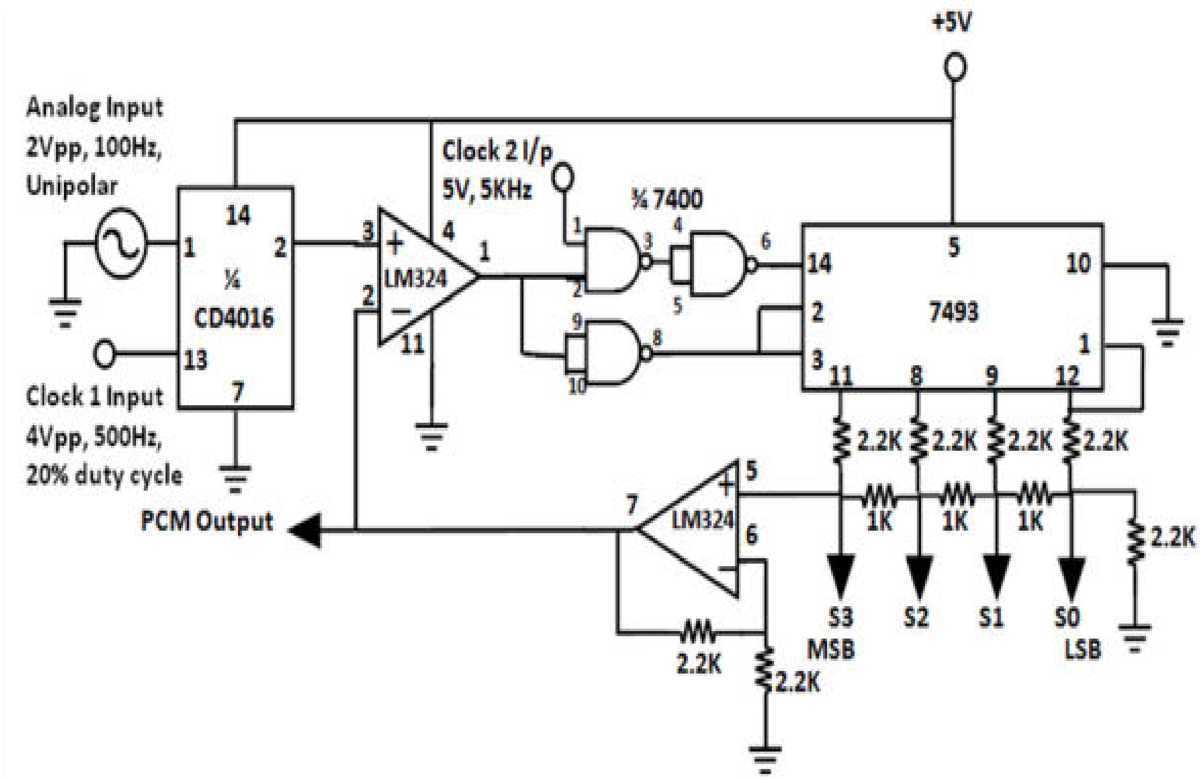
AIM:

1. To acquire the practical knowledge of Pulse Code Modulation And Demodulation
2. To calculate
   i) Signal Power
   ii) Quantization Noise Power
   iii) Signal to Quantization Noise Power [SQNR]
3. To plot the corresponding waveforms on the graph sheets.

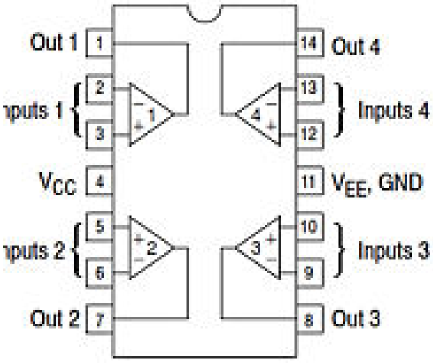
APPARATUS:

1. Pulse Code Modulation and Demodulation Trainer Kit
2. Patch chords
3. Oscilloscope
4. Oscilloscope Probes

BLOCK DIAGRAM:

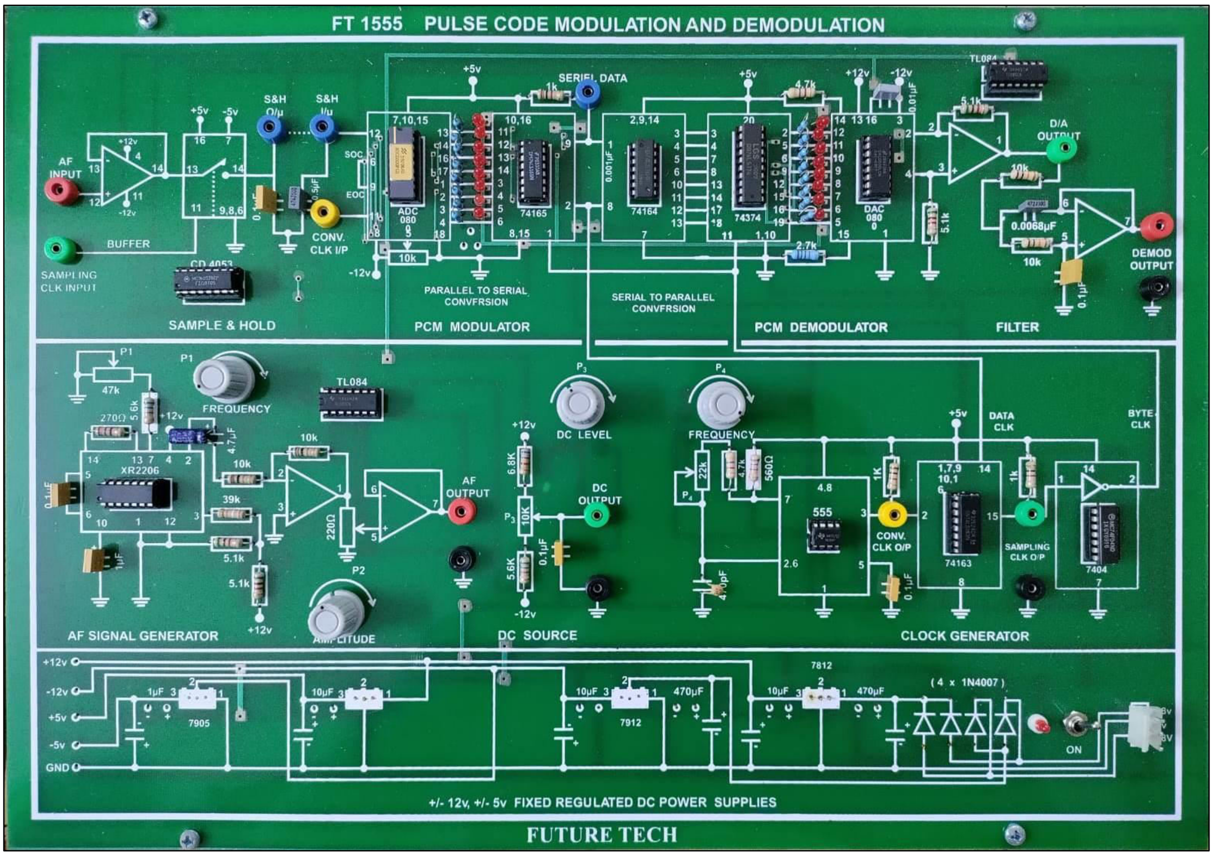


PCM Modulator



LM 324 Pin Connection

CIRCUIT DIAGRAM:



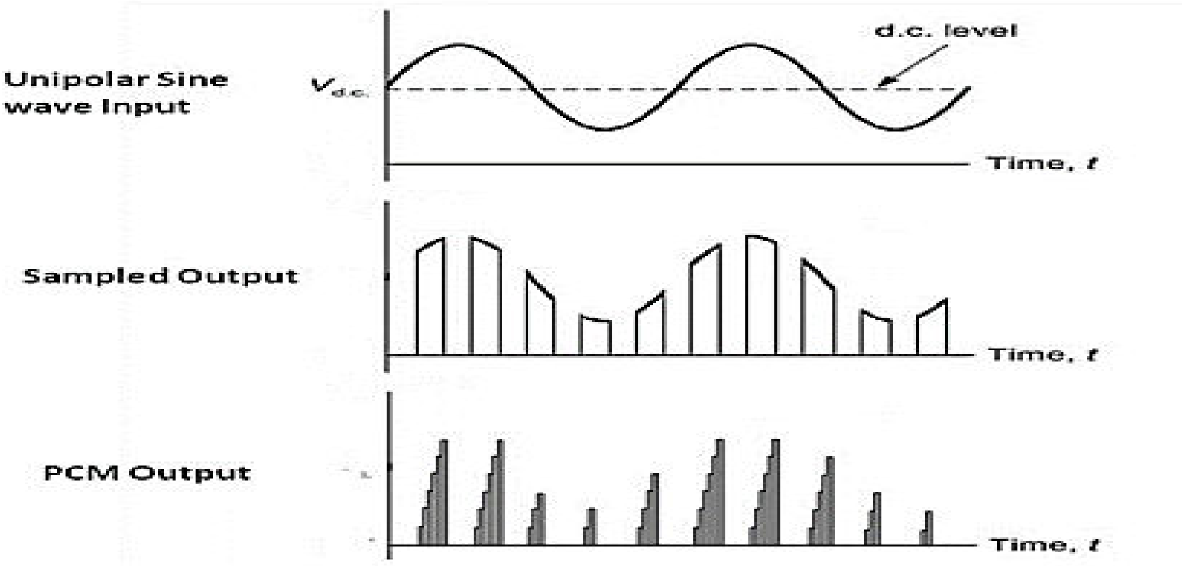
PROCEDURE:

1. The trainer kit is to be switched ON.
2. The Message Signal at the output terminal (AF Output) of the Signal (Source) Generator is to be observed on the Oscilloscope and its Amplitude and Frequency are to be noted down.
3. The Sampling Clock signal at the output terminal of the Clock Generator is to be observed on the Oscilloscope and its Amplitude and Frequency are to be noted down.
4. Now, the Message Signal and the Clock Signal are to be applied as inputs to Pulse Code Modulator.
5. The Quantized Output is to be observed on the Oscilloscope and the step height and

step-width are to be measured.

6. Then, the PCM signal at the output terminal of the modulator is to be observed on the Oscilloscope and its amplitude and bit duration are to be measured.
7. The PCM signal is to be applied as input to the demodulator and the demodulated signal at the output terminal of the demodulator is to be observed at the output terminal of the demodulator.
8. The amplitude and the frequency of the demodulated signal are to be measured.
9. The corresponding waveforms are to be plotted on the graph sheets.

EXPECTED WAVEFORMS:



OBSERVATIONS;

<u>Message Signal</u>:
Amplitude :
Time Period:
Frequency :
<u>Clock Signal</u>:
Amplitude :
Time Period:
Frequency :
<u>Quantized Signal:</u>
Step-height :
Step-width :
<u>PCM Signal:</u>
Amplitude :
Bit Duration :

Demodulated Signal:	
Amplitude	**:**
Time period	**:**
Frequency	**:**

1. Time Period:
2. Frequency:

CALCULATIONS:

1. Signal Power:
2. Quantization Noise Power:
3. Signal to Quantization Noise Ratio[SQNR]:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

INTERFERENCE:

PRE-EXPERIMENT VIVA-VOCE:

1. Define Pulse Code Modulation.
2. What do you mean by "Quantization"?
3. How do you assign the bits to the Quantization levels?
4. What is the role of Parallel-to-Serial converter in a PCM Transmitter?
5. How do you calculate the SQNR of a PCM signal?
6. What are the advantages and disadvantages of PCM?

POST-EXPERIMENT VIVA-VOCE:

1. How do the amplitude Variations of the message signal affect the Stair-case and PCM signal?
2. Express the SQNR of the PCM signal generated in your experiment.
3. How can the performance of the PCM system be improved?

EXPERIMENT: 4

DIFFERENTIAL PULSE CODE MODULATION AND DEMODULATON

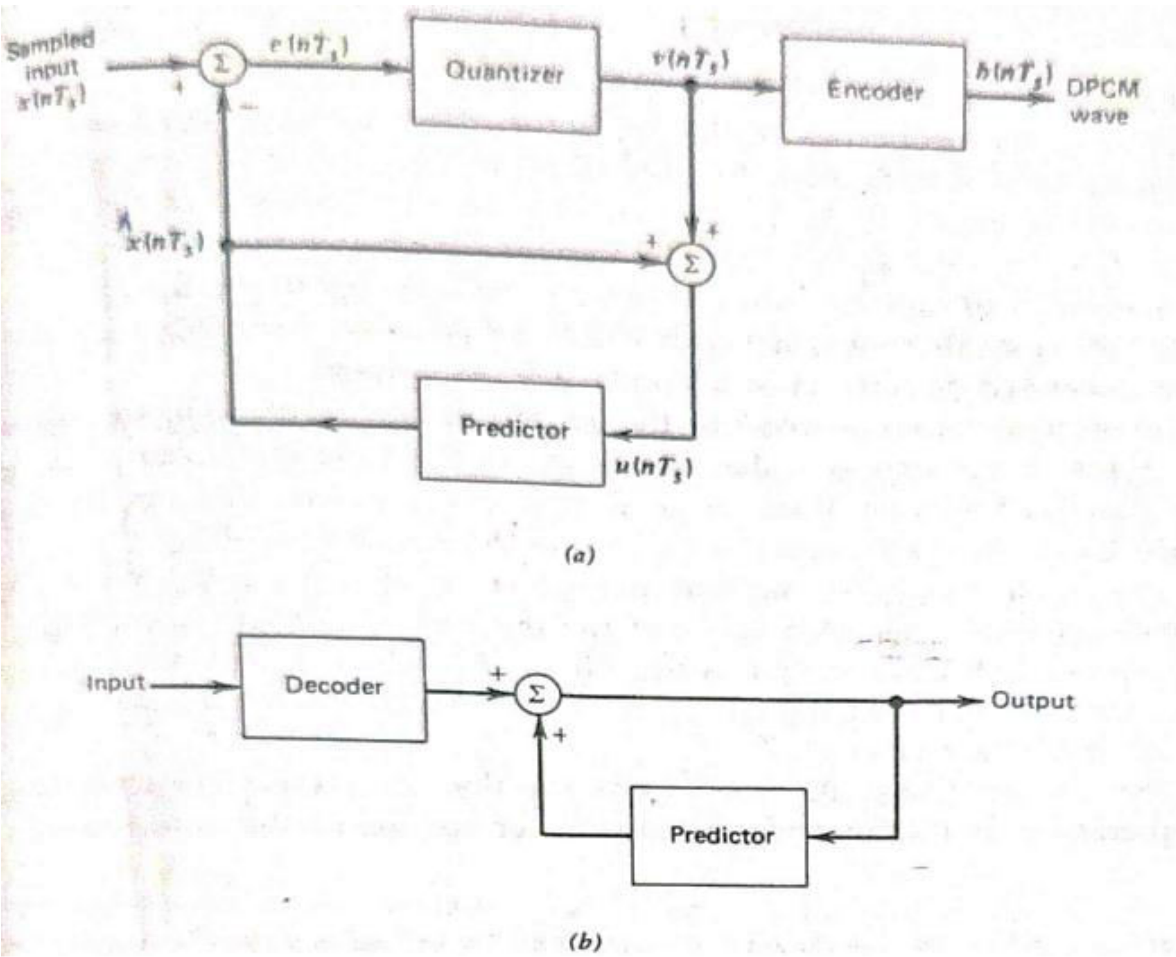
AIM:

1) To acquire the practical knowledge of Differential Pulse Code Modulation and Demodulation
2) To calculate
   a. Signal Power:
   b. Quantization Noise Power:
   c. Signal to Quantization Noise Ratio [SQNR]:
3) To plot the corresponding waveforms on the graphs sheets.

APPARATUS:

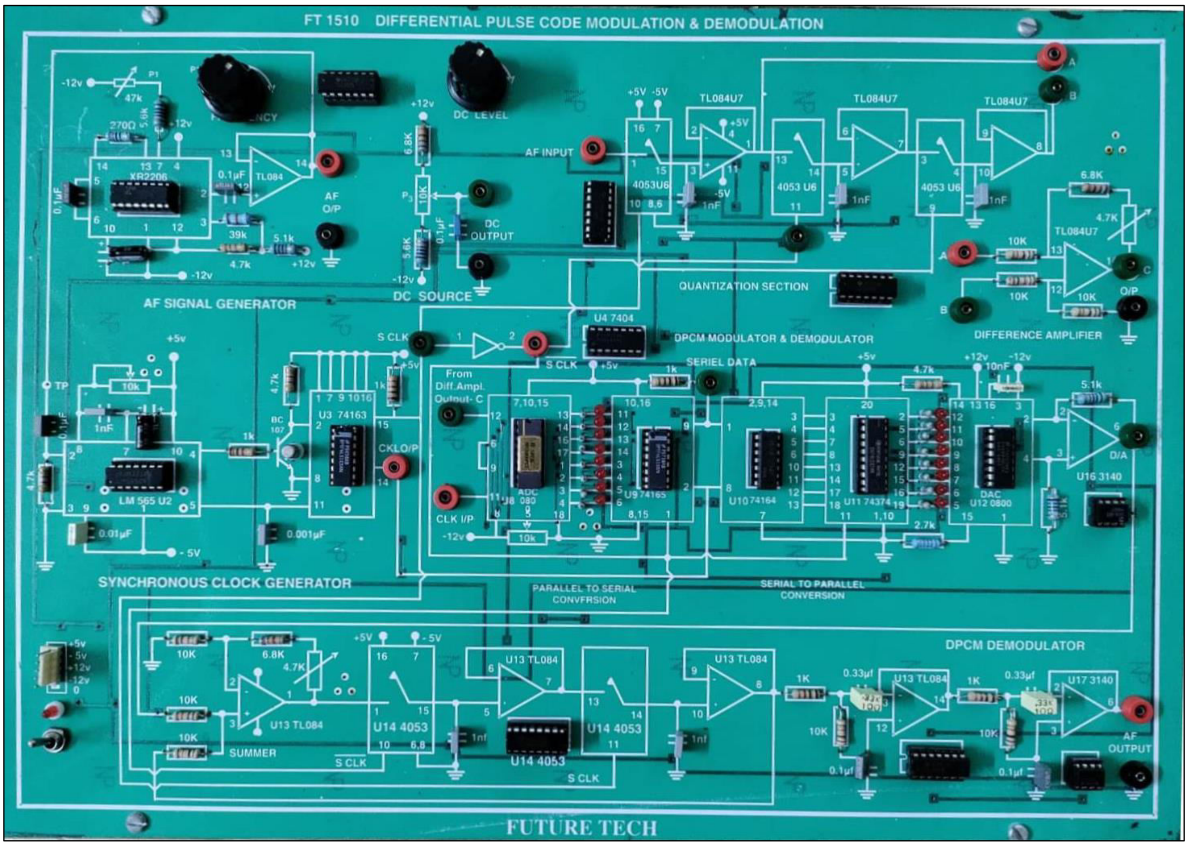
- Differential Pulse Code Modulation and Demodulation Trainer Kit
- Patch chords
- Oscilloscope
- Oscilloscope Probes

Block diagram:



DPCM System. (a) Transmitter. (b) Receiver

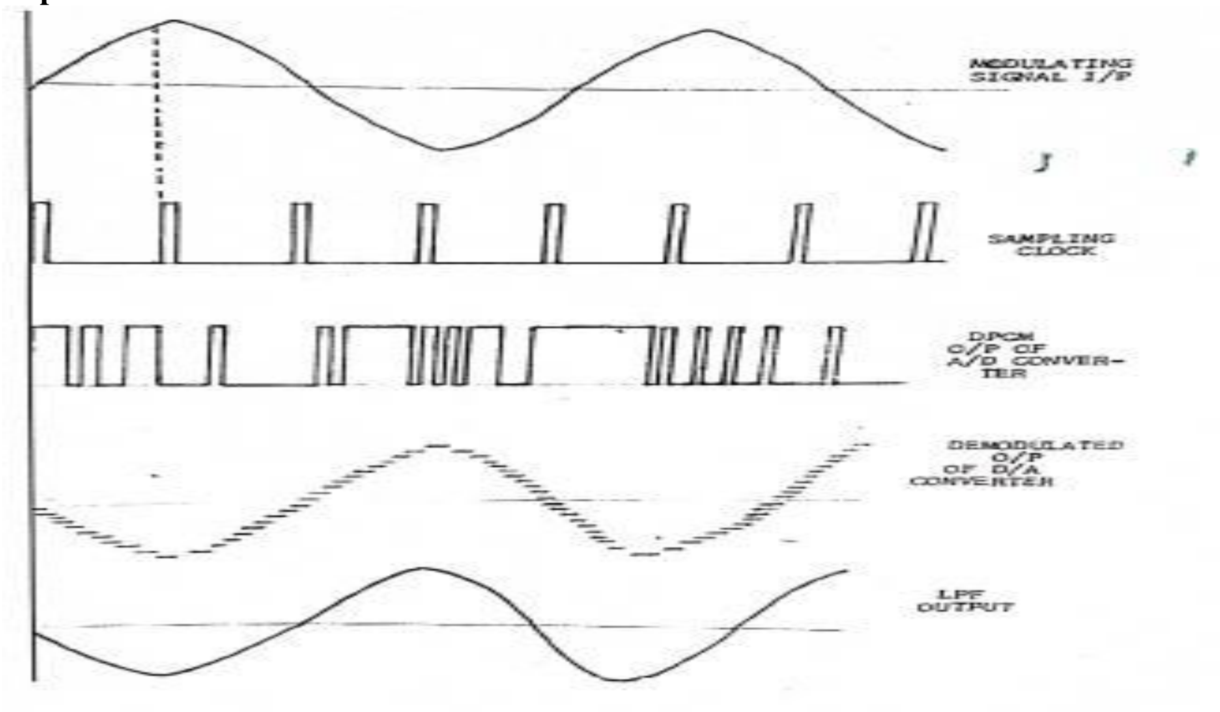
CIRCUIT DIAGRAM:



PROCEDURE:

1) The Trainer Kit to be switched ON
2) The Message Signal at the output terminal (AF Output)of the signal (Source) Generator is to be observed on the Oscilloscope and its Amplitude and Frequency are to be noted down.
3) The Sampling Clock Signal at the output terminal of the Clock Generator is to be observed on the Oscilloscope and its Amplitude and Frequency are to be noted down.
4) Now,the Message signal and the Clock Signal are to be applied as inputs to Differential Pulse Code Modulator.
5) The Quantized Output is to be observed on the Oscilloscope and the step height and step-width are to be measured.
6) Then the DPCM Signal at the output terminal of the modulator is to be observed on the Oscilloscope and its amplitude and bit duration are to be measured.
7) The DPCM Signal is to be applied as input to the Demodulator and the Demodulated signal at the output terminal of the Demodulator.
8) The Amplitude and Frequency of the Demodulated signal are to be measured.
9) The Corresponding Waveforms are to be plotted on the Graph Sheets.

Expected wave form:



OBSERVATIONS:

Message Signal:
Amplitude :
Time Period:
Frequency :
Clock Signal:
Amplitude :
Time Period:
Frequency :
Quantized Signal:
Step-height :
Step-width :
DPCM Signal:
Amplitude :
Bit Duration:
Demodulated Signal:
Amplitude :
Time period :
Frequency :

THEORY :

CALCULATIONS :

Signal Power :

Quantization Noise Power :

Signal to Quantization Noise Ratio [SQNR]:

DISCUSSION :

ADVANTAGES :

DISADVANTAGES :

APPLICATION :

CONCLUSION :

INFERENCE :

PRE-EXPERIMENT VIVA-VOCE:

1. Define Differential Pulse Code Modulation.
2. What do you mean by "Stair-case Approximation"?
3. How do you assign the bits to the Quantization levels?
4. List out the factors which affects the predictor output.
5. How do you calculate the SQNR of a DPCM Signal?
6. What is the advantage of DPCM over PCM?

POST-EXPERIMENT VIVA-VOCE:

1) How do the amplitude variations of the message signal affects the Stair-case and DPCM Signal?
2) Express the SQNR of the DPCM signal generated in your experiment.
3) How can the performance of the DPCM System be improved?
4) What is the role of predictor in DPCM System?

EXPERIMENT: 5
DELTA MODULATION AND DEMODULATION

AIM:

1. To acquire the practical knowledge of Delta Modulation and Demodulation.

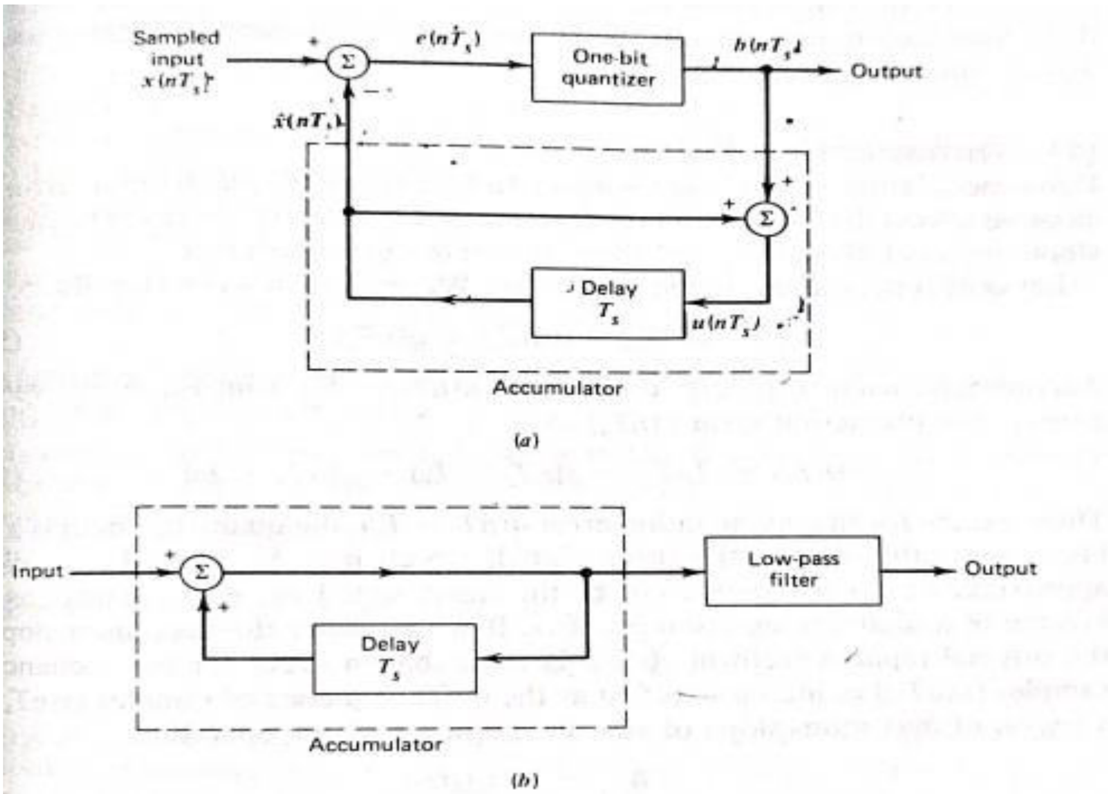
TO CALCULATE:

i) Signal Power:
ii) Quantization Noise Power:
iii) Signal to Quantization Noise Ratio [SQNR]:
iv) To plot the corresponding waveforms on the graph sheets.

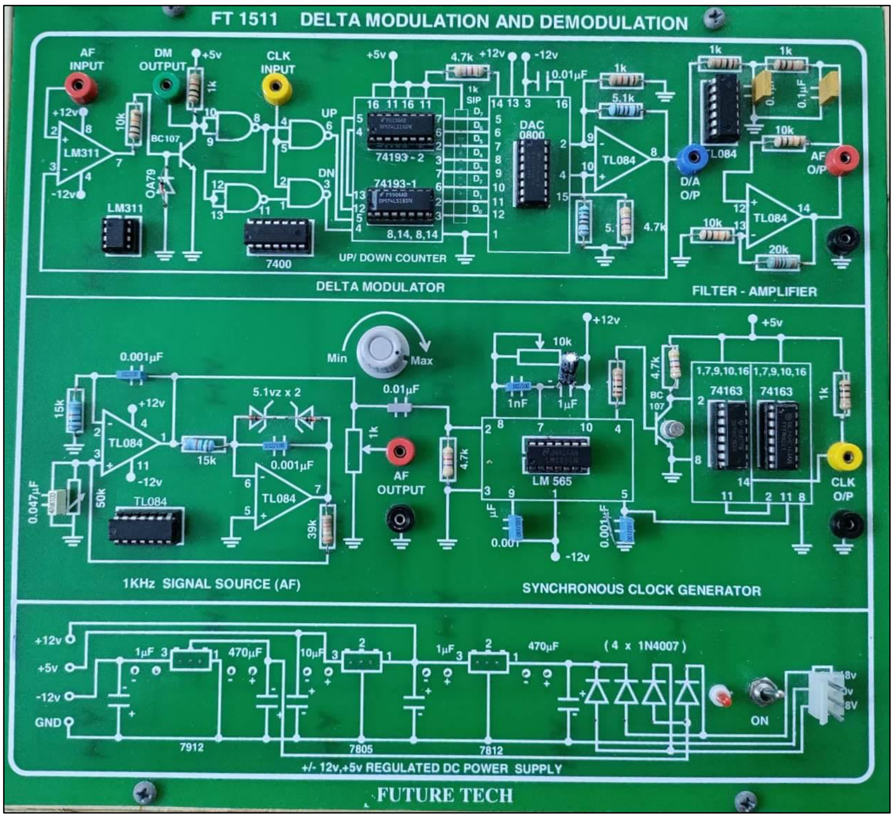
APPARATUS:

- Delta Modulation and Demodulation Trainer Kit
- Patch chords
- Oscilloscope
- Oscilloscope Probes

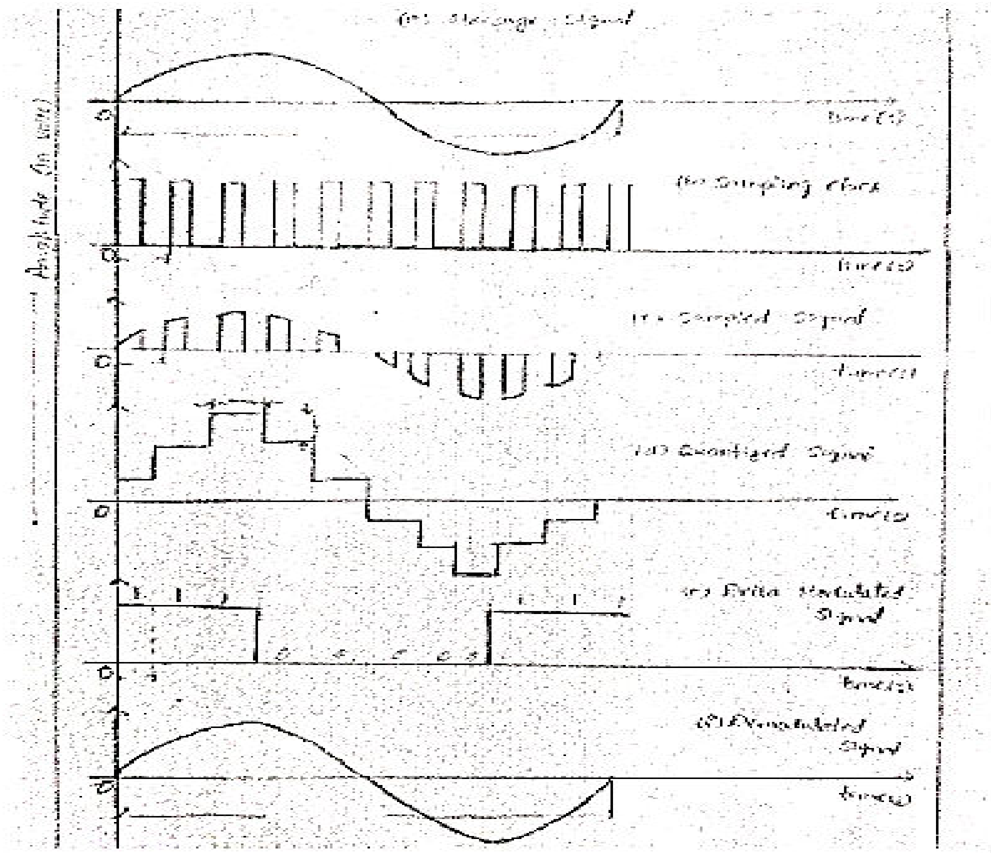
BLOCK DIAGRAM:



CIRCUIT DIAGRAM:



EXPECTED WAVE FORM:



PROCEDURE:

1) The Trainer Kit to be switched ON
2) The Message Signal at the output terminal (AF Output)of the signal (Source) Generator is to be observed on the Oscilloscope and its Amplitude and Frequency are to be noted down.
3) The Sampling Clock Signal at the output terminal of the Clock Generator is to be observed on the Oscilloscope and its Amplitude and Frequency are to be noted down.
4) Now, the Message signal and the Clock Signal are to be applied as inputs to Differential Pulse Code Modulator.
5) The Quantized Output is to be observed on the Oscilloscope and the step height and step-width are to be measured.
6) Then the DM Signal at the output terminal of the modulator is to be observed on the Oscilloscope and its amplitude and bit duration are to be measured.
7) The DM Signal is to be applied as input to the Demodulator and the Demodulated signal at the output terminal of the Demodulator.
8) The Amplitude and Frequency of the Demodulated signal are to be measured.
9) The Corresponding Waveforms are to be plotted on the Graph Sheets.

OBSERVATIONS:

Message Signal:

Amplitude :
Time Period :
Frequency :

Clock Signal :

Amplitude :
Time Period :
Frequency :

Quantized Signal:

Step-height :
Step-width :

DPCM Signal :

Amplitude :
Bit Duration :

Demodulated Signal:

Amplitude :
Time period :
Frequency :

THEORY:

CALCULATIONS:

i) Signal Power :

ii) Quantization Noise Power :

iii) Signal to Quantization Noise Ratio [SQNR]:

DISCUSSION :

ADVANTAGES :

DISADVANTAGES :

APPLICATION :

CONCLUSION :

INFERENCE :

PRE-EXPERIMENT VIVA-VOCE:

1. Define Delta Modulation.
2. What do you mean by "Stair-case Approximation"?
3. How do you assign the bits to the Quantization levels?
4. What happens to the output signal if the amplitude variation of the message signal is
   i. Greater than the step size
   ii. Less than the step size
5. What are the types of Quantization errors in delta modulation?
6. How do you calculate the SQNR of a Delta Modulated Signal?
7. What is the advantage of delta modulation over PCM?

POST-EXPERIMENT VIVA-VOCE:

1) How do the amplitude variations of the message signal affects the Stair-case and DPCM Signal?
2) Express the SQNR of the DPCM signal generated in your experiment
3) How can the performance of the DPCM System be improved?
4) What is the role of predictor in DPCM System?

EXPERIMENT: 6
FSK MODULATION AND DEMODULATION

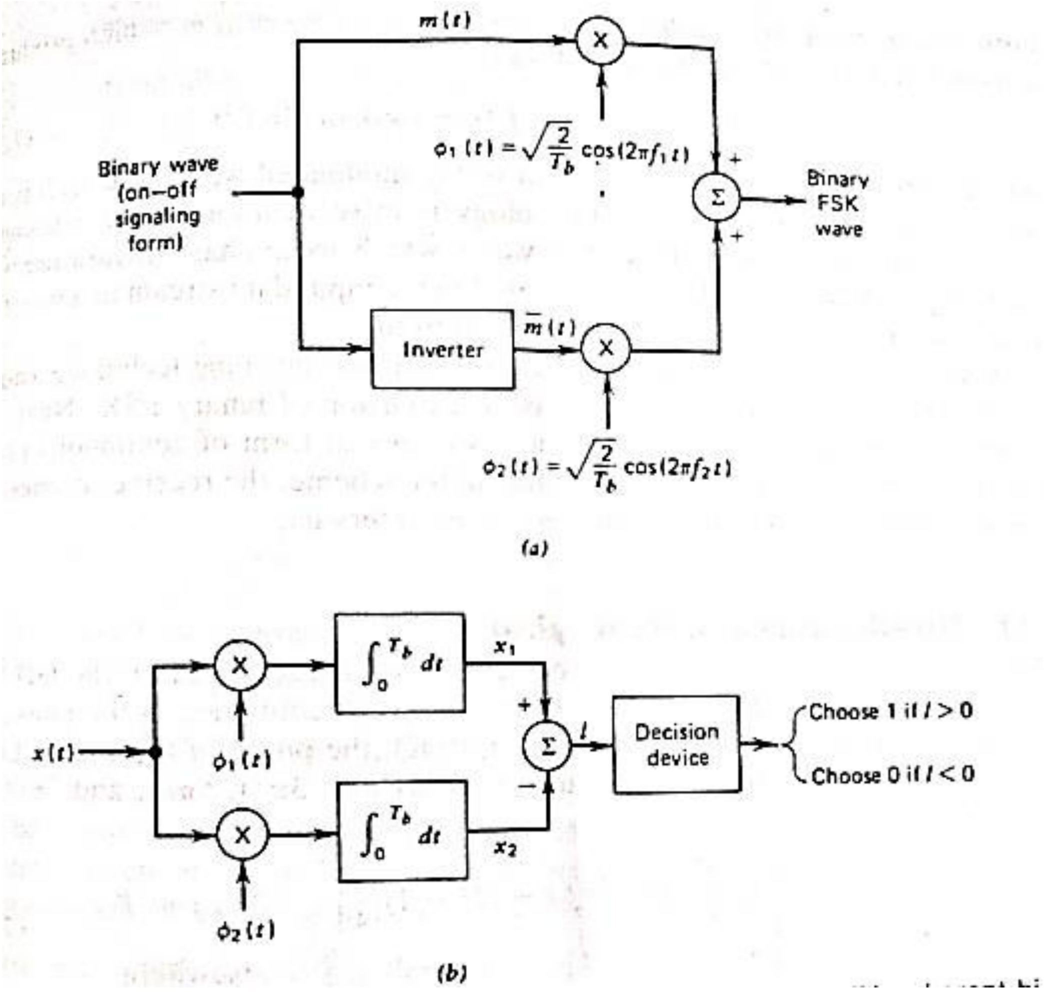
AIM:

1) To acquire the practical knowledge of modulation and demodulation techniques of Shift keying.
2) To measure Mark Frequency and the Space Frequency of the FSK signal.
3) To calculate Band width & data rate.
4) To plot the corresponding Waveforms on graph sheet.

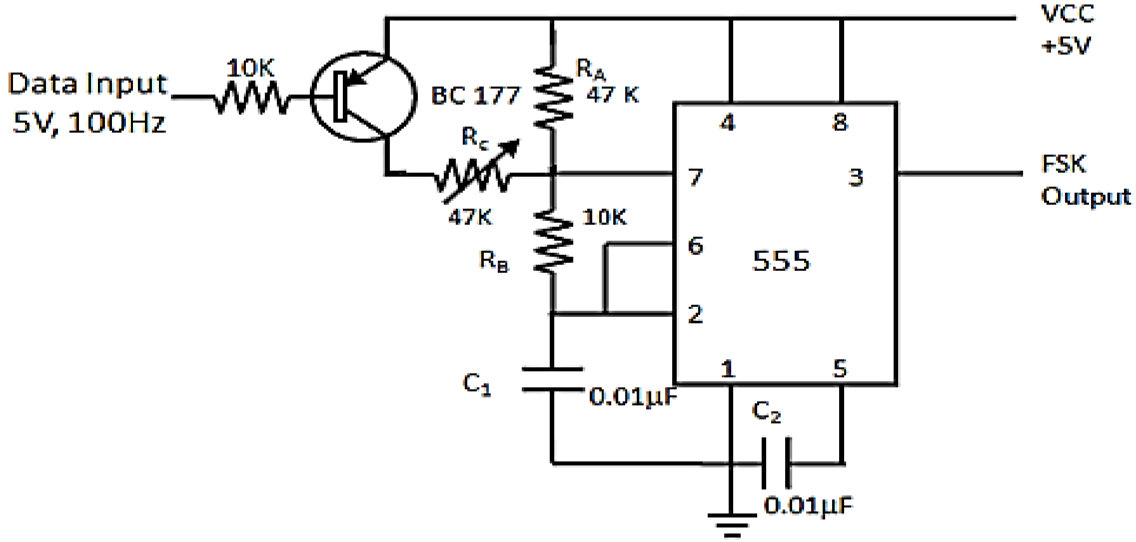
APPARATUS:

- FSK Modulation and Demodulation Trainer Kit
- Digital Storage Oscilloscope/CRO
- Probes
- Patch cords

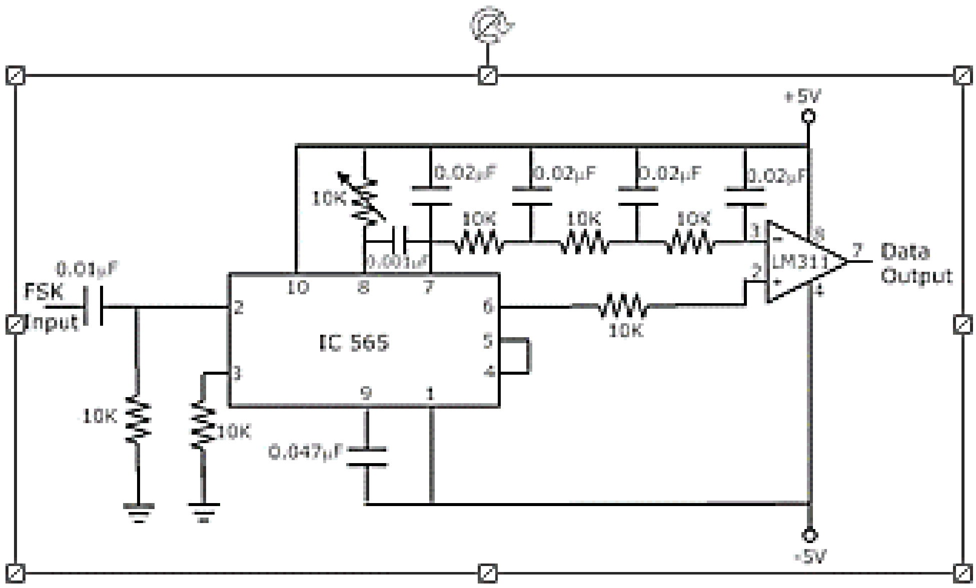
BLOCK DIAGRAM:



LOGIC DIAGRAM:

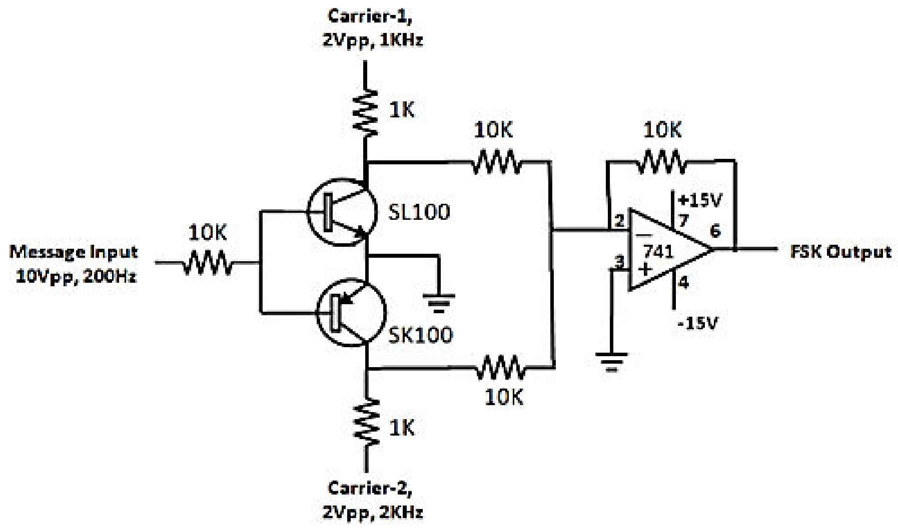


FSK Modulator

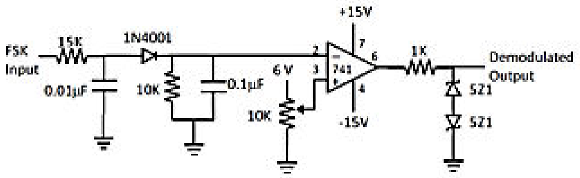


FSK Demodulator

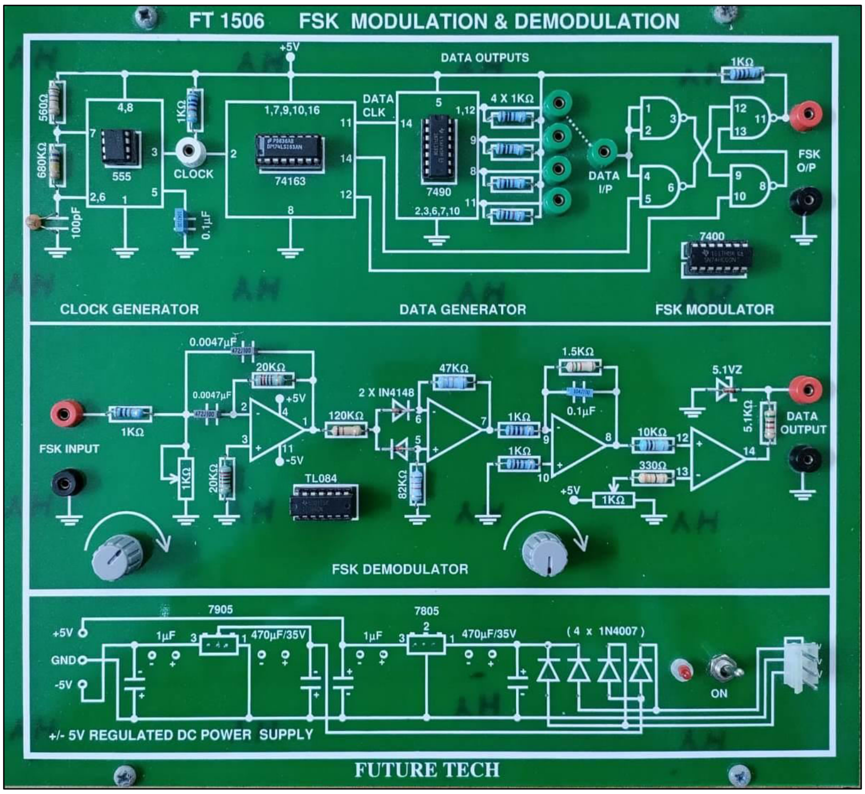
ALTERNATE CIRCUIT:



FSK Modulator



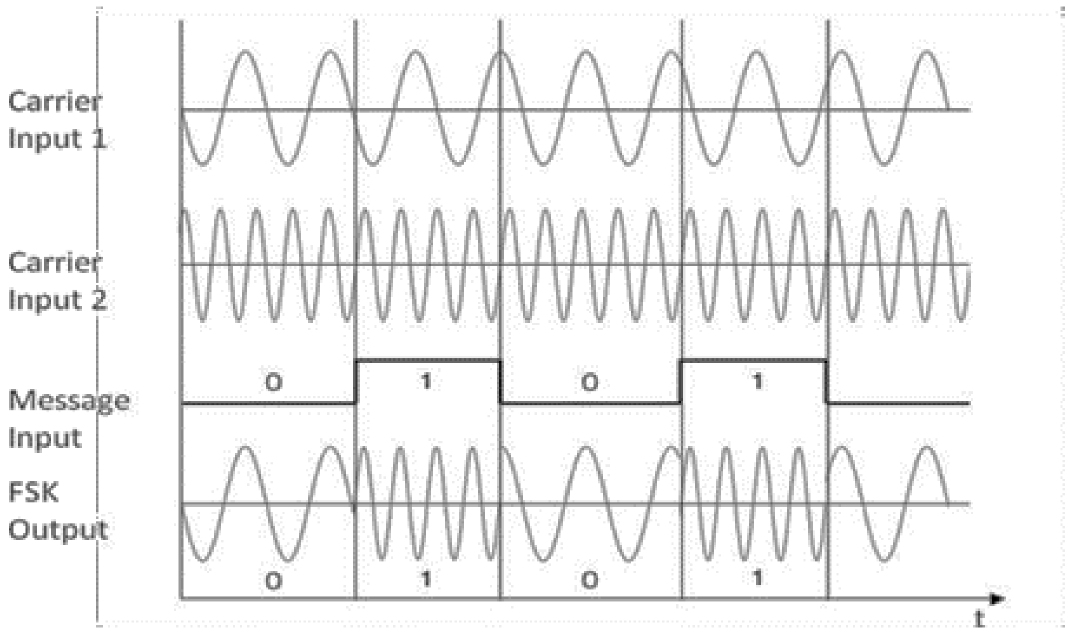
CIRCUIT DIAGRAM:



PROCEDURE:

1) The Trainer Kit is to be switched ON
2) The carrier signal is to be observed on the Oscilloscope and amplitude and frequency of the carrier signal are to be measured.
3) Among D1,D2,D3,D4 provided on the kit,any one of the data is to be selected as modulating signal and its amplitude and Ton,Toff are to be measured.
4) The modulating signal to the datainput and the carrier signal are to be applied as inputs to the FSK modulator.
5) At the output terminal of the Modulator, the FSK output is to be observed on the Oscilloscope and the amplitude and the Mark-Frequency and Space-Frequency of the FSK signal arc to be measured.
6) The modulated signal is to be applied as input to demodulator and the demodulated signal is to be observed at the output terminal of the Demodulator.
7) The corresponding waveforms are to be plotted on the Graph Sheets.

EXPECTED WAVEFORMS:



OBSERVATIONS:

Modulating signal(DATA)

Amplitude:

Bit Duration:

Data Sequence:

Carrier signal:

Amplitude:

Time-period:

Frequency:

FSK signal:

Amplitude:

Mark Frequency:

Space Frequency:

Demodulated signal:

Amplitude:

Bit Duration:

Data sequence:

THEORY:

CALCULATIONS:

DISCUSSIONS:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

RESULT:

INFERENCE:

PRE-EXPEREMENT VIVA-VOICE:

1) What is meant by Frequency Shift Keying?
2) What are the advantages of FSK technique over ASK technique?
3) What are basic blocks of an FSK Modulation System?
4) List out the applications of FSK system?

POST-EXPERIMENT VIVA-VOICE:

1) Draw the constellation diagram of FSK.
2) For the given 8 bit data 10111010 draw the FSK output waveforms.
3) Find the Symbol Error Probability for the FSK signal obtained in the experiment.

EXPERIMENT: 7

DPSK MODULATION AND DEMODULATION

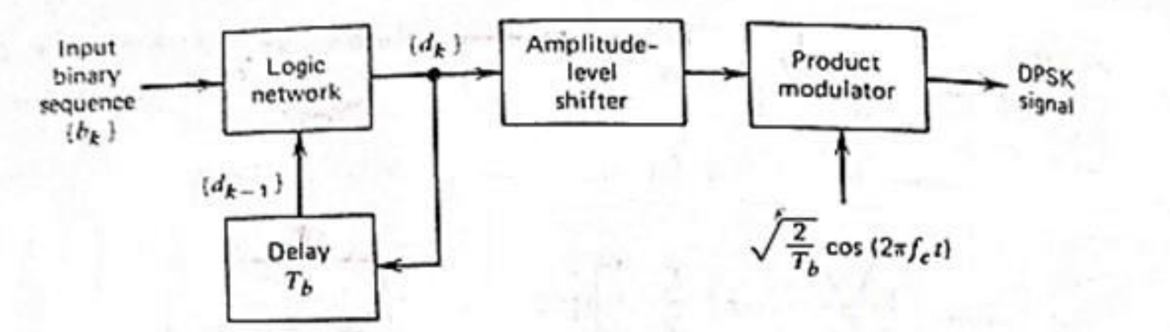
AIM:

1) To acquire the practical knowledge of DPSK Modulation and Demodulation System.
2) To calculate the Error Probability of DPSK System.
3) To plot the corresponding wave forms on the graph sheet.

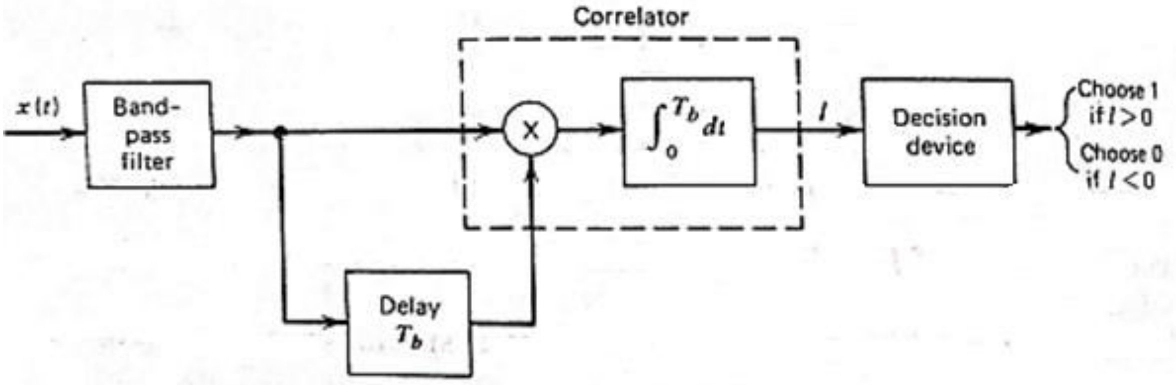
APPARATUS:

- DPSK Modulation and Demodulation Trainer Kit.
- Digital Storage Oscilloscope
- Probes
- Patch cords

BLOCK DIAGRAM:

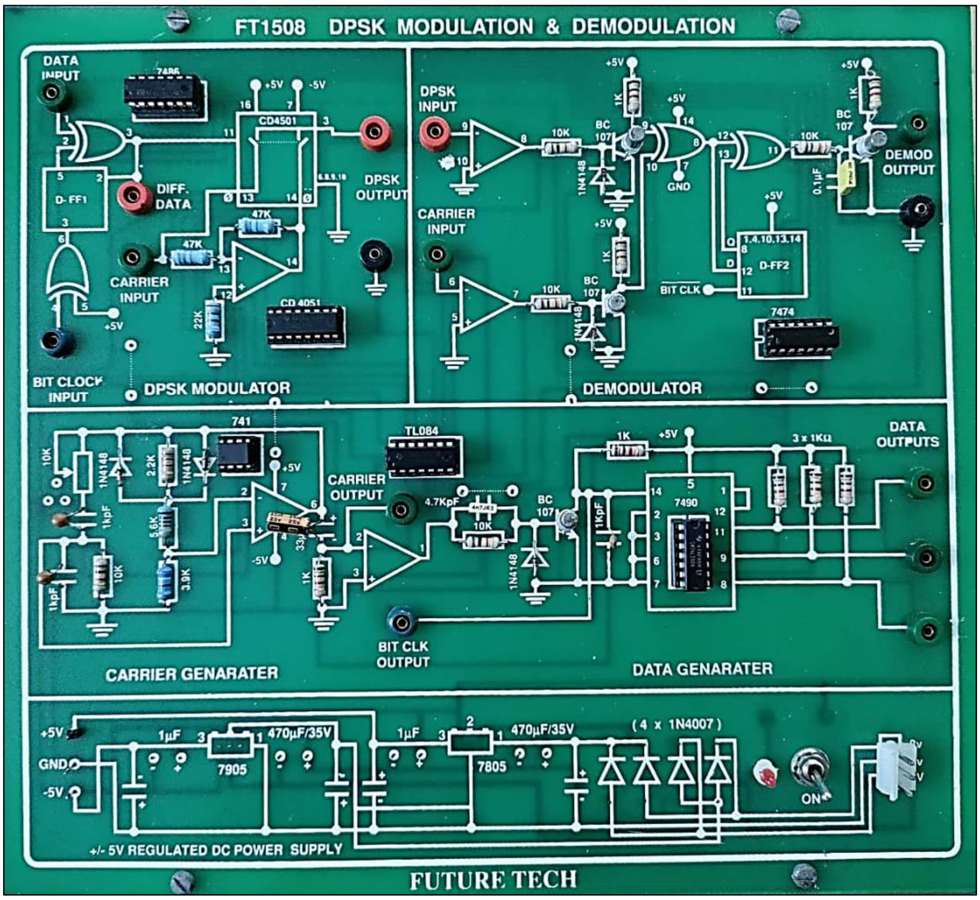


(a)



(b)

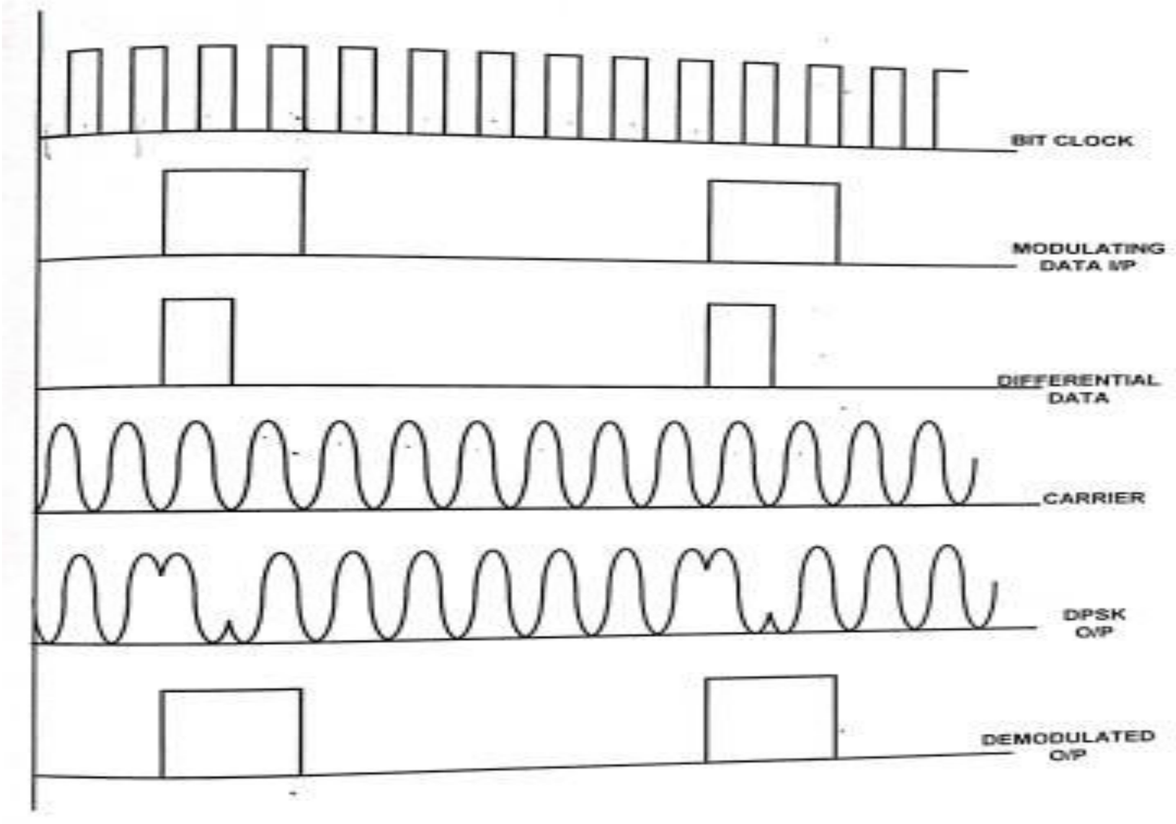
CIRCUIT DIAGRAM:



PROCEDURE:

1) The Trainer Kit is to be switched ON.
2) Among D1, D2, D3, D4 provided on the kit, any one of the data is to be selected as Modulating Signal and its Amplitude and T_{ON}, TOFFare to be measured.
3) The Carrier Signal is to be observed on the Oscilloscope and the Amplitude and the Frequency of the Carrier Signal are to be measured.
4) The Bit-Clock Signal is to be observed on the Oscilloscope and the Amplitude and the Frequency of the Bit-Clock Signal are to be measured.
5) The Modulating Signal to the data input and the Carrier Signal are to be appliedAs inputs to the DPSK Modulator.
6) At the output terminal of the Modulator, the DPSK Signal is to be observed on the Oscilloscope and the Amplitude and the Mark-Frequency and the Space-Frequency of the DPSK Signal are to be measured.
7) The Modulating Signal is to be applied as input to the demodulator and the Demodulating Signal is to be observed at the output terminal of the Demodulator.
8) The Corresponding Waveforms are to be plotted on the Graph Sheets.

Expected wave form:



DPSK Signal Waveforms

OBSERVATIONS:

Modulating Signal(DATA) **Amplitude:** **Bit Duration:** **Data Sequence:**
Carrier Signal: **Amplitude:** **Time-Period:** **Frequency:**
DPSK Signal: **Amplitude:** **Frequency:**
Demodulated Signal: **Amplitude:** **Bit Duration:** **Data Sequence:**

THEORY:

CALUCULATIONS:

DISCUSSIONS:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

INFERENCE:

PRE-EXPERIMENT VIVA-VOICE:

1) What do you understand by DPSK?
2) Enlist the advantages of DPSK System over PSK.
3) List out the application of DPSK system.

POST-EXPERIMENT VIVA-VOICE:

1) What is the Error Probability of a DPSK?Compare the theoretical and Practical values of Pe.
2) What are the disadvantages of DPSK?

EXPERIMENT: 8
QPSK MODULATION AND DEMODULATION

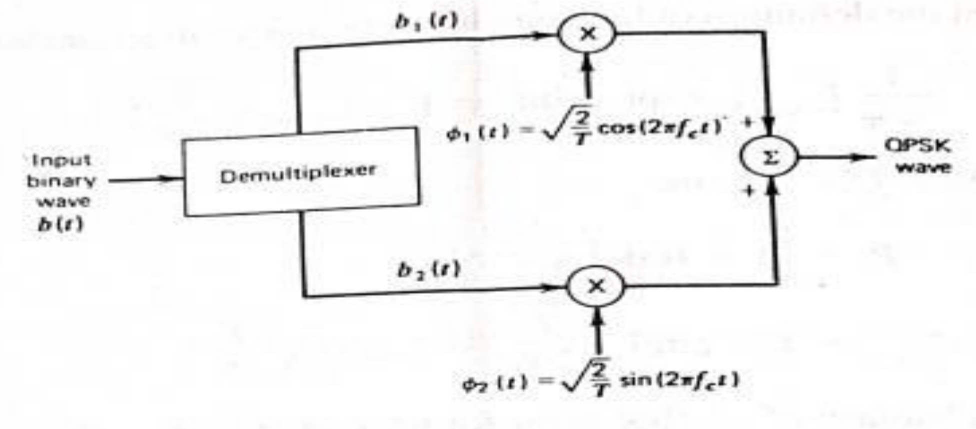
AIM:

1. To acquire the practical knowledge of QPSK modulation and demodulation
2. To calculate the Error Probability of QPSK system
3. To plot the corresponding waveforms on the graph sheet

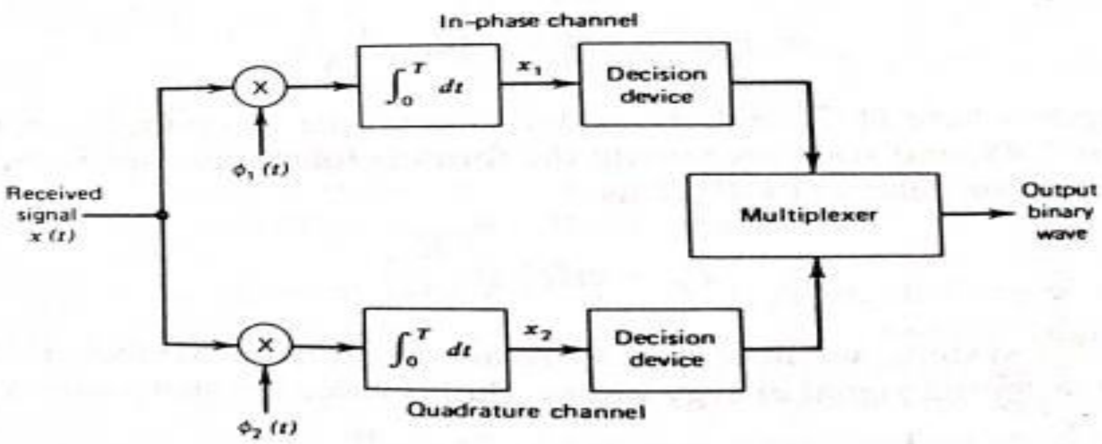
APPARATUS:

- QPSK modulation and demodulation Trainer Kit
- Digital Storage Oscilloscope CRO
- Probes
- Patch cords

BLOCK DIAGRAM:

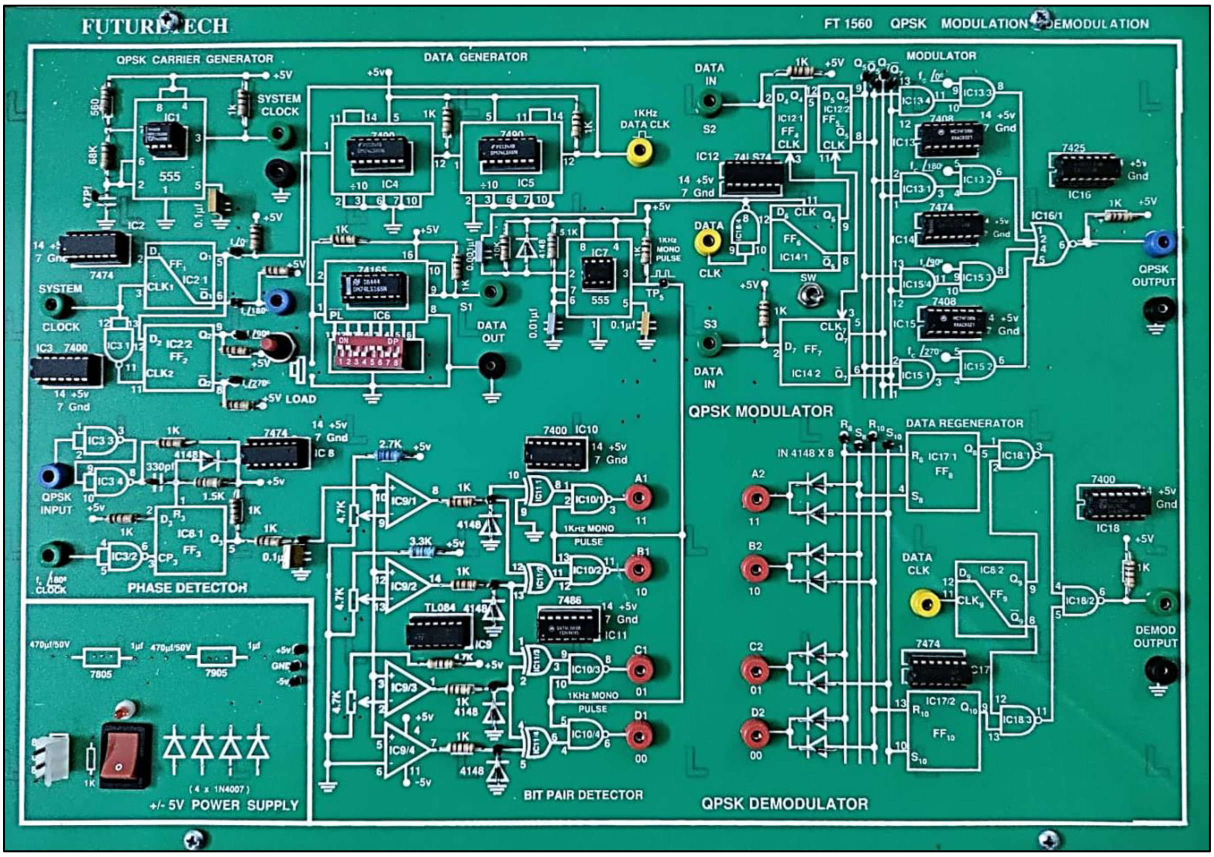


(a)



(b)

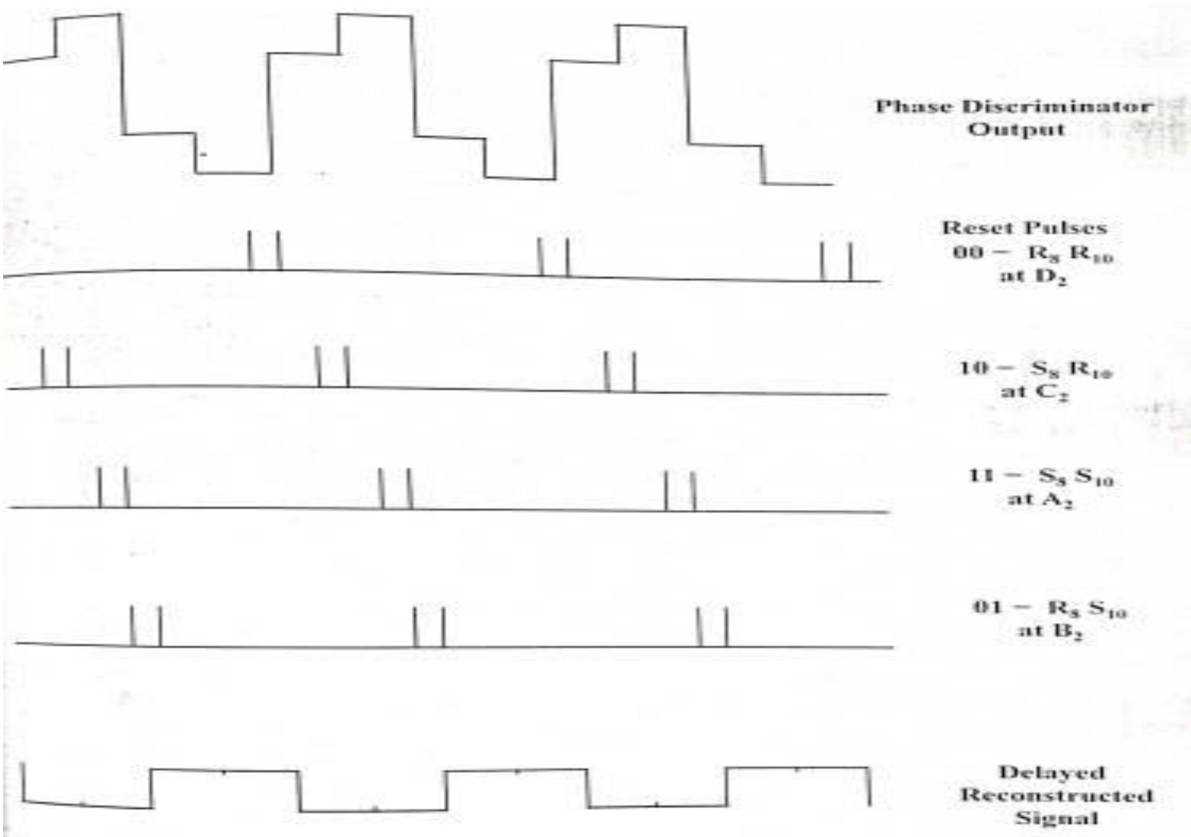
CIRCUIT DIAGRAM:



PROCEDURE:

1. The Trainer Kit is to be switched on.
2. Among D1, D2, D3, D4 provided on the kit, any one of the data is to be selected as Modulating signal and its amplitude and T_{on}, T_{off} are to be measured.
3. The carrier signal is to be observed on the Oscilloscope and the Amplitude and the Frequency of the Carrier signal are to be measured.
4. The Bit-Clock Signal is to be observed on the Oscilloscope and the Amplitude and the Frequency of the Bit-Clock Signal are to be measured.
5. The Modulating Signal to the data input and the Carrier Signal are to be applied as inputs to the QPSK Modulator.
6. AT the output terminal of the Modulator, the QPSK Signal is to be observed on the Oscilloscope and the Amplitude and the Mark-Frequency and the Space-Frequency of the QPSK Signal are to be measured.
7. The Modulated Signal is to be applied as input to demodulator and the Demodulated signal is to be observed at the output terminal of the Demodulator.
8. The Corresponding Waveforms are to be plotted on the Graph Sheets.

EXPECTED WAVE FORMS:



OBSERVATIONS:

Modulating Signal (DATA):

Amplitude:

Bit Duration:

Data Sequence:

CARRIER SIGNAL:

Amplitude:

Time period:

Frequency:

QSK SIGNAL:

Amplitude:

Frequency:

Demodulated Signal:

Amplitude:

Bit Duration:

Data Sequence:

THEORY:

CALUCLATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

INFERENCE:

PRE-EXPERIMENTVIVA-VOICE:

1. What do you understand by QPSK?
2. Enlist the advantages of QPSK system over PSK.
3. List out the applications of QPSK system.

POST EXPERIMENTVIVA-VOICE:

1) What is the Error Probability of a QPSK signal? Compare the theoretical and practical values of P.
2) What are the disadvantages of QPSK System?

EXPERIMENT: 9
SAMPLING THOEREM-ITS VERIFICATION

AIM:

1) To write and simulate the MAT Lab code for Natural Software.
2) To plot the corresponding Waveforms on the Graph Sheets

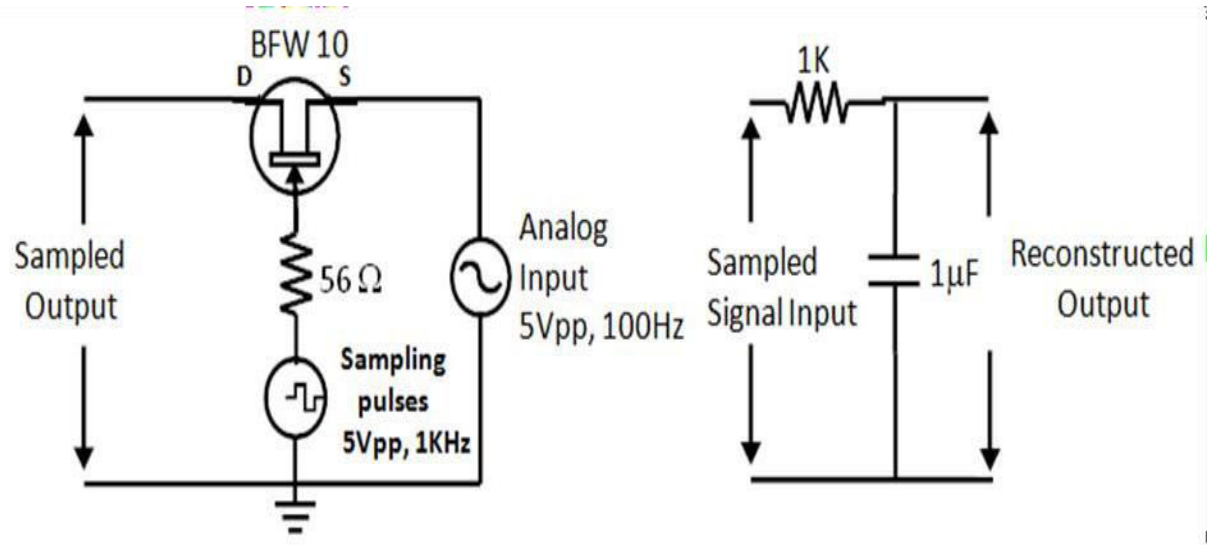
APPARATUS:

- PC Installed with Windows XP or higher by double clicking its icon
- Power Supply

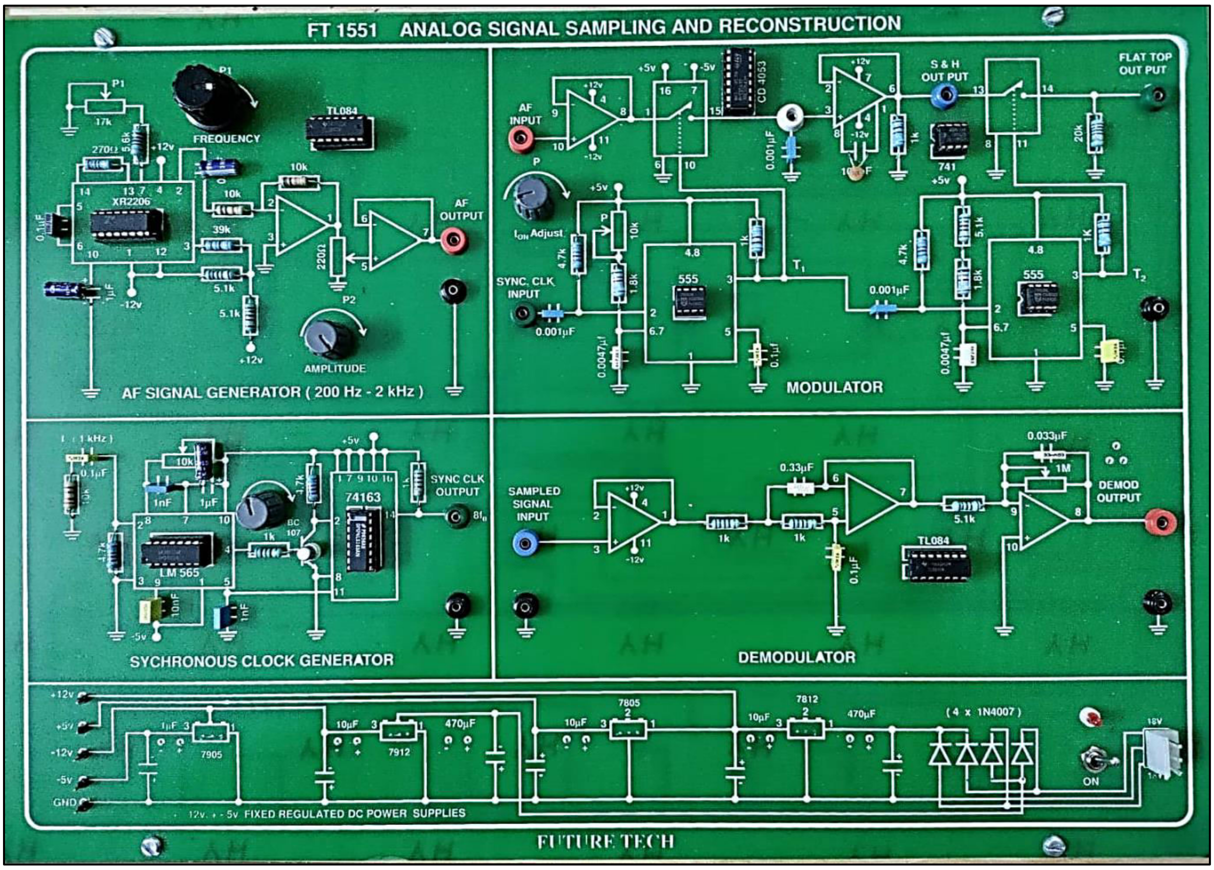
PROCEDURE:

1) Open the MATLAB software by double clicking the icon
2) MATLAB logo will appear and after few moments Command Prompt will appear.
3) Go to the File Menu and select a New M-File (File_New_M-File) or in the left hand Corner a blank white paper icon will be there. Click it once.
4) A blank M-file will appear with a title ‘untitled’
5) Now start typing your program .After completing save the M-file with appropriatename. To execute the program Press F5 or go to Debug menu and select Run.
6) After execution, output will appear in the command window. If there is an error then with an alarm, type of error will appear in red color.
7) Rectify the error if any and go to Debug Menu and select Run.

BLOCK DIAGRAM:



CIRCUIT DIAGRAM:



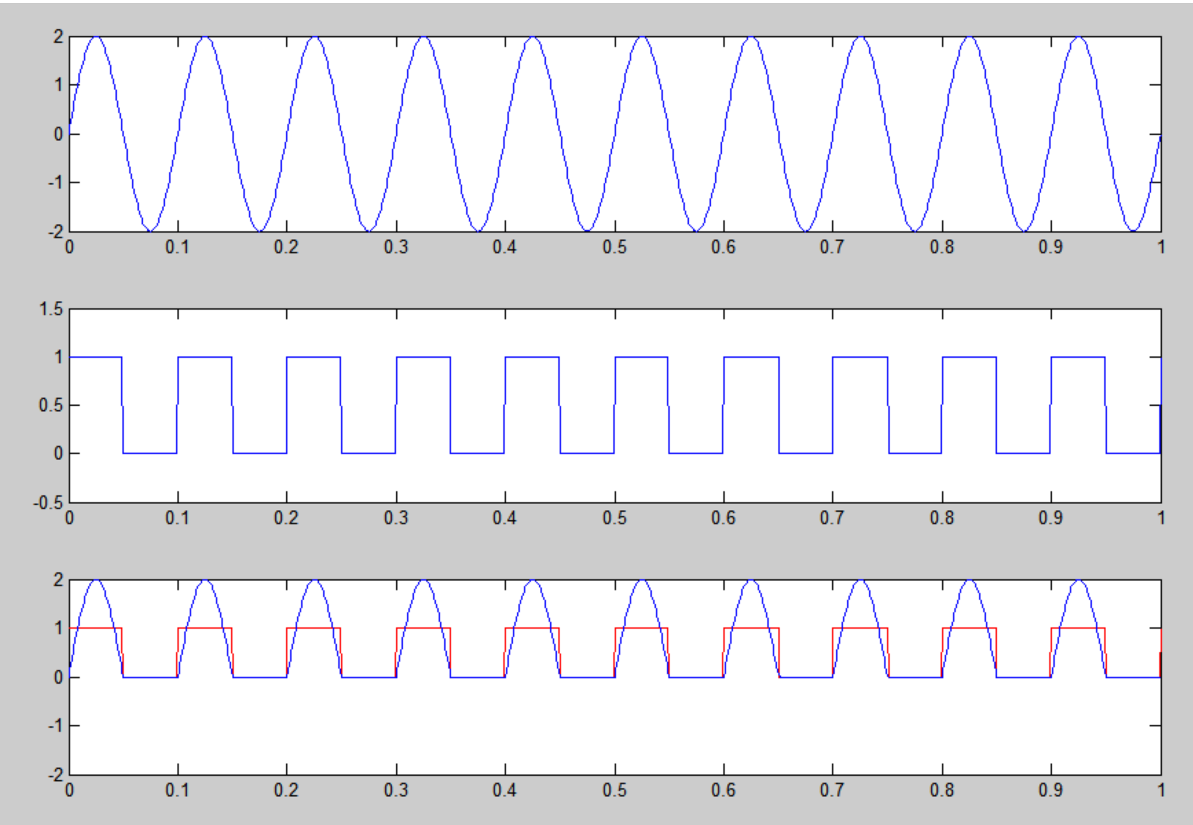
MATLab CODE:

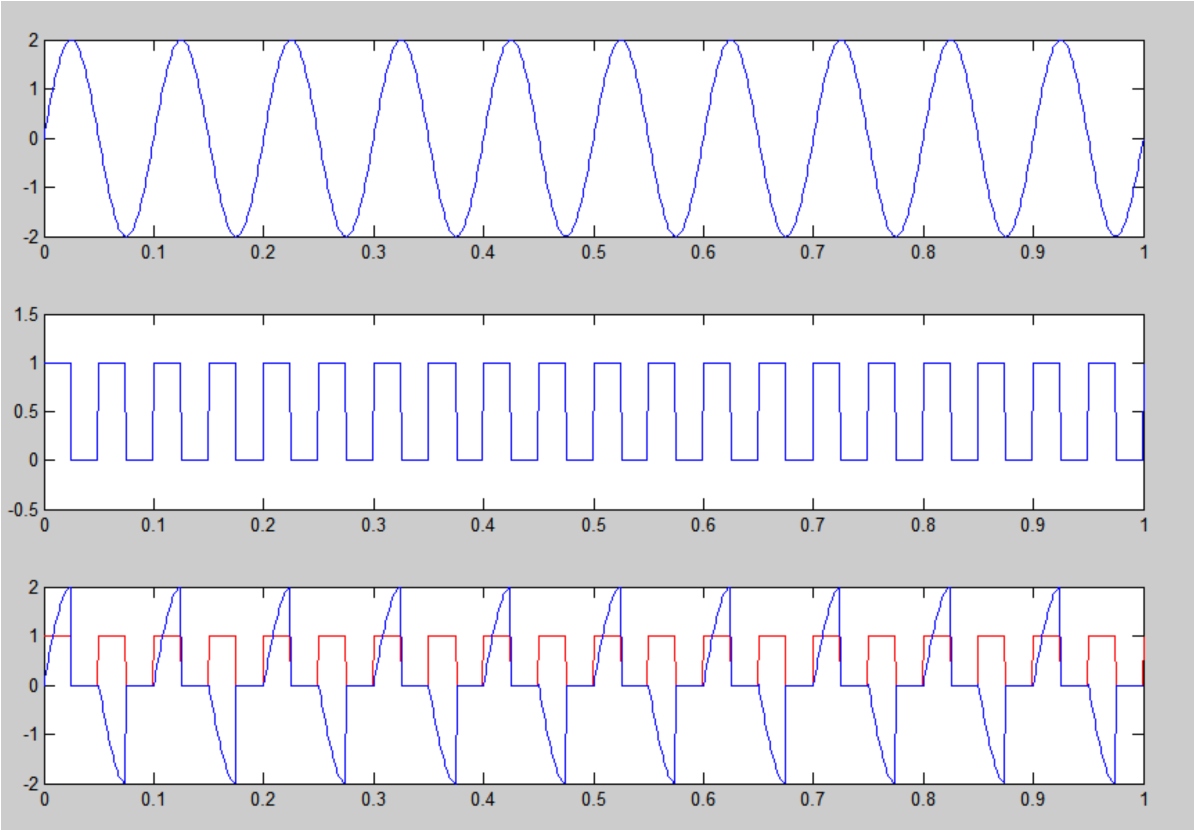
```
clc;
clearall;
closeall;
t=0:0.001:1;
fm=10;
fs1=fm;
fs2=2*fm;
fs3=4*fm;
a=2;%amplitude of analog signal
Vm=a*sin(2*pi*fm*t);
Vc1=square(2*pi*fs1*t);
n=length(Vc1)
fori=1:n
if (Vc1(i)<=0)
Vc1(i)=0;
else
Vc1(i)=1;
end
end
%under modulation
```

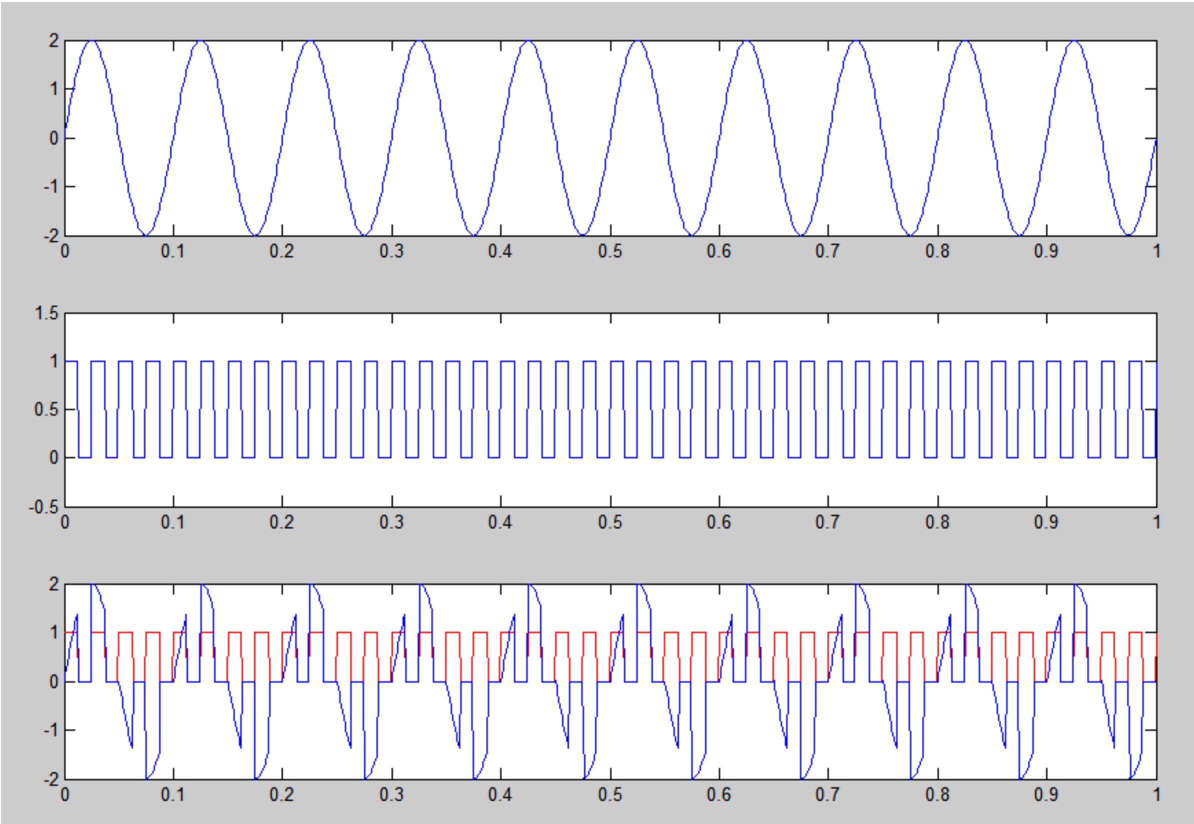
```
figure(1)
y1=Vc1.*Vm;
subplot(3,1,1);
plot(t,Vm);
subplot(3,1,2);
plot(t,Vc1);
axis([0 1 -0.5 1.5])
subplot(3,1,3);
plot(t,Vc1,'r-');
holdon;
plot(t,y1);
axis([0 1 -a a])

%critical modulation

Vc2=square(2*pi*fs2*t);
n=length(Vc2)
fori=1:n
if (Vc2(i)<=0)
Vc2(i)=0;
else
Vc2(i)=1;
end
end
figure(2)
y2=Vc2.*Vm;
subplot(3,1,1);
plot(t,Vm);
subplot(3,1,2);
plot(t,Vc2);
axis([0 1 -0.5 1.5])
subplot(3,1,3);
plot(t,Vc2,'r-');
holdon;
plot(t,y2);
axis([0 1 -a a])

%over modulation

 Vc3=square(2*pi*fs3*t);
n=length(Vc3)
fori=1:n
if (Vc3(i)<=0)
```

```
Vc3(i)=0;
else
Vc3(i)=1;
end
end
figure(3)
y3=Vc3.*Vm;
subplot(3,1,1);
plot(t,Vm);
subplot(3,1,2);
plot(t,Vc3);
axis([0 1 -0.5 1.5])
subplot(3,1,3);
plot(t,Vc3,'r-');
holdon;
plot(t,y3);
axis([0 1 -a a])
```

WAVEFORMS:




2
1
0
-1
-2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.5
1
0.5
0
-0.5


2
1
0
-1
-2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.5
1
0.5
0
-0.5

THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGE:

APPLICQATION:

CONCLUSION:

INFERENCE:

PRE-EXPERIMENT VIVA-VOCE:

1) State Sampling Theorem
2) What are the different types of Sampling Techniques based on the sampling rate?
3) What are the different types of sampling techniques, in general?
4) How does the reconstruction of the message signal possible from the sampled Signal?

POST – EXPERIMENT VIVA-VOCE:

1. What is theNyquist rate forCritical sampling?
2. What are difficulties you have faced wile reconstructing the message signal for under Sampling?
3. What are the difficulties you have faced while reconstructing the message signal for over Sampling?
4. For which case,do you suggest for the better reconstruction of the message signal from the sampled signal?

EXPERIMENT: 10
PULSE CODE MODULATION

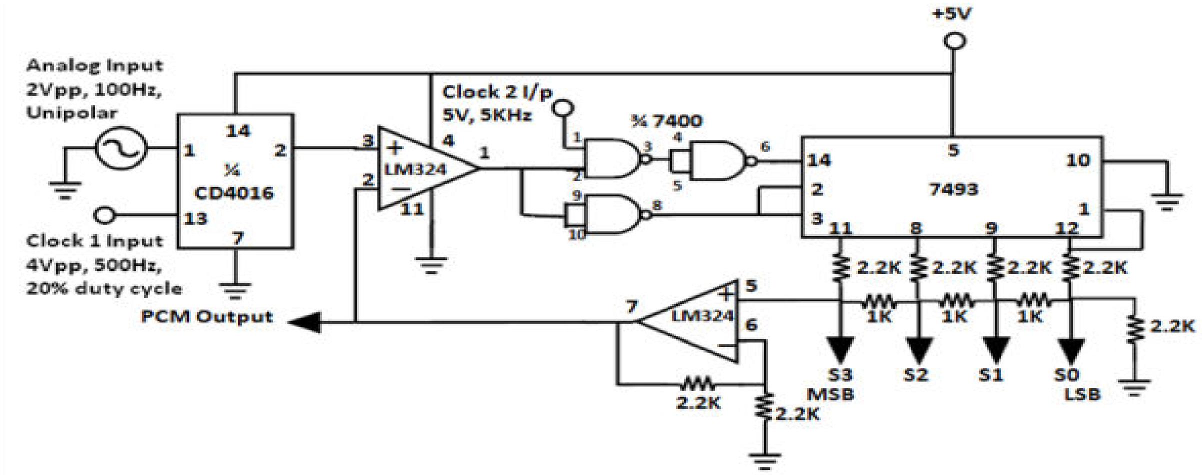
AIM:

1. To write and simulate the MAT Lab code for Pulse Code Modulation and Demodulation.
2. To plot the corresponding waveforms on the Graph sheet

APPARATUS:

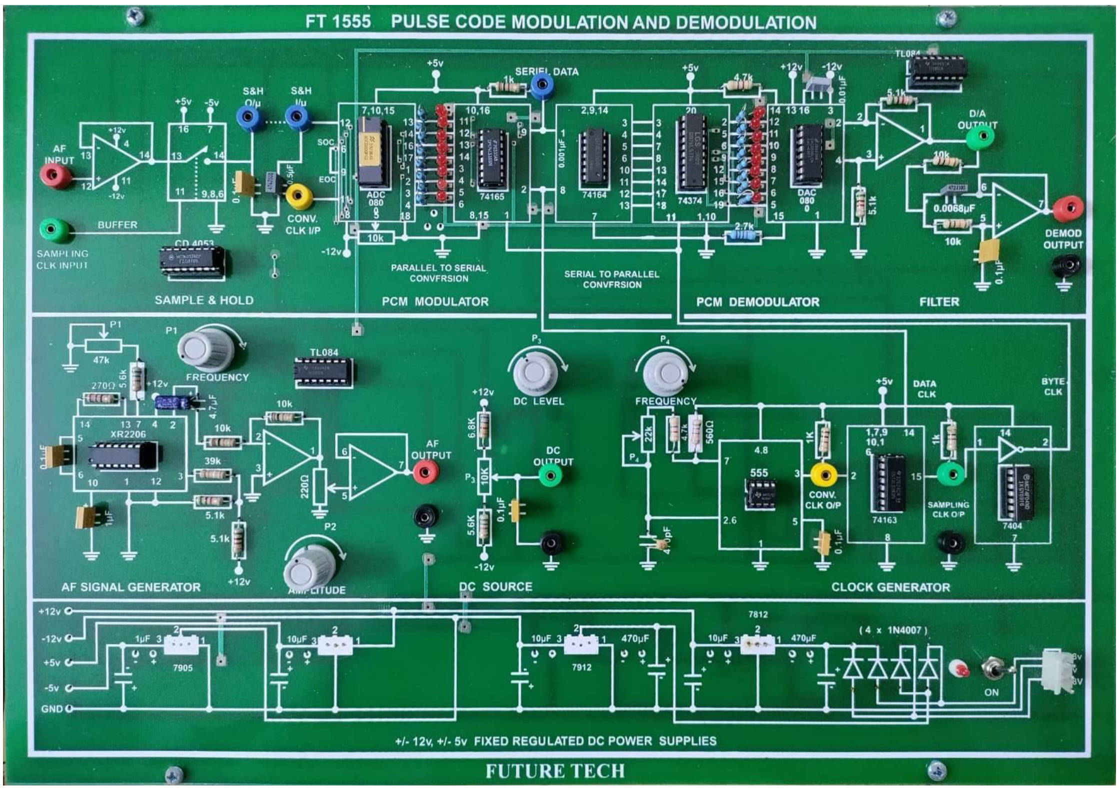
- PC installed with windows XP or higher Version and MAT Lab Software
- Power supply

BLOCK DIAGRAM:



PCM Modulator

CIRCUIT DIAGRAM:



PROCEDURE:

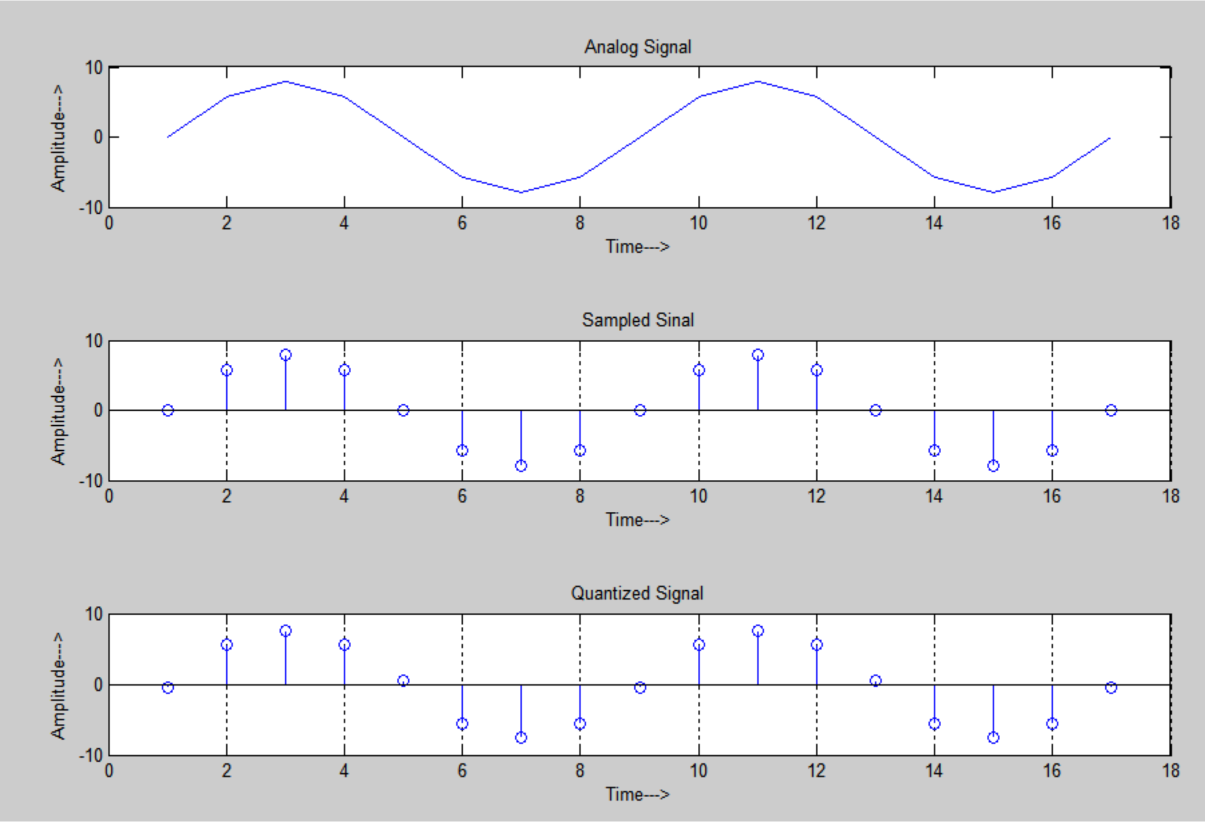
1. Open the MAT Lab Software by double clicking its icon.
2. MAT Lab logo will appear and after few moments command Prompt will appear
3. Go to the File Menu and select a New M-File. (File_New_M-File) or in the left hand corner a blank white paper icon will be there .click it once.
4. A blank M-File will appear with a title 'untitled'.
5. Now start typing your program. After completing, save the M-file with appropriate name. To execute the program press F5or go to debug menu and select run.
6. After executing, output will appear in the command window. If there is an error then with an alarm, type of error will appear in red colour.
7. Rectify the error if any and go to **Debug Menu and select run.**

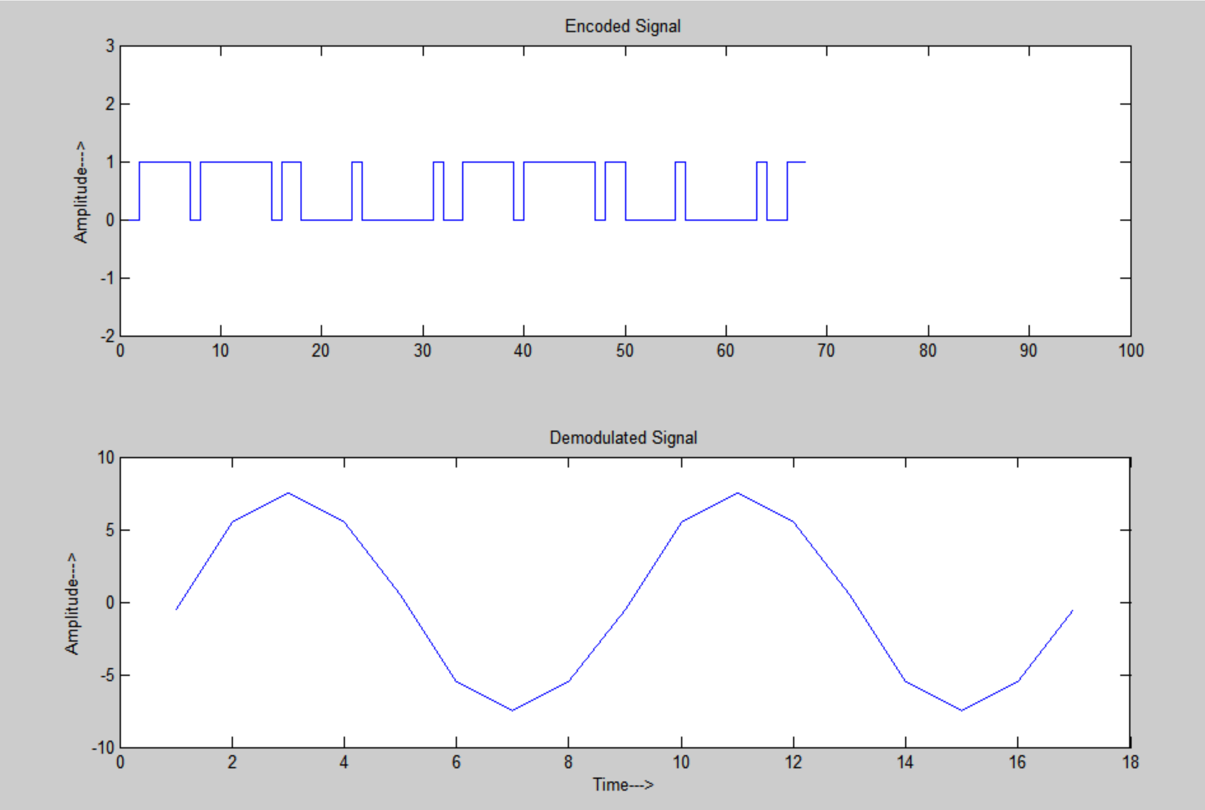
MATLAB CODE:

```
clc;
closeall;
clearall;
n=input('Enter n value for n-bit PCM system : ');
n1=input('Enter number of samples in a period : ');
L=2^n;
% % Signal Generation
% x=0:1/100:4*pi;
% y=8*sin(x); % Amplitude Of signal is 8v
% subplot(2,2,1);
% plot(x,y);grid on;
% Sampling Operation
x=0:2*pi/n1:4*pi; % n1 nuber of samples have tobe selected
s=8*sin(x);
subplot(3,1,1);
plot(s);
title('Analog Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
subplot(3,1,2);
stem(s);grid on; title('Sampled Sinal'); ylabel('Amplitude--->'); xlabel('Time--->');
% Quantization Process
vmax=8;
vmin=-vmax;
del=(vmax-vmin)/L;
part=vmin:del:vmax; % level are between vmin and vmax with difference of del
code=vmin-(del/2):del:vmax+(del/2); % Contaion Quantized valuses
[ind,q]=quantiz(s,part,code); % Quantization process
% ind contain index number and q contain quantized values
l1=length(ind);
```

```
l2=length(q);
fori=1:l1
if(ind(i)~=0) % To make index as binary decimal so started from 0 to N
ind(i)=ind(i)-1;
end
i=i+1;
end
fori=1:l2
if(q(i)==vmin-(del/2)) % To make quantize value inbetween the levels
q(i)=vmin+(del/2);
end
end
subplot(3,1,3);
stem(q);grid on; % Display the Quantize values
title('Quantized Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
% Encoding Process
figure
code=de2bi(ind,'left-msb'); % Cnvert the decimal to binary
k=1;
fori=1:l1
for j=1:n
coded(k)=code(i,j); % convert code matrix to a coded row vector
j=j+1;
k=k+1;
end
i=i+1;
end
subplot(2,1,1); grid on;
stairs(coded); % Display the encoded signal
axis([0 100 -2 3]); title('Encoded Signal');
ylabel('Amplitude--->');
% Demodulation Of PCM signal
qunt=reshape(coded,n,length(coded)/n);
index=bi2de(qunt','left-msb'); % Getback the index in decimal form
q=del*index+vmin+(del/2); % getback Quantized values
subplot(2,1,2); grid on;
plot(q);
% Plot Demodulated signal
title('Demodulated Signal');
ylabel('Amplitude--->');
xlabel('Time--->');
```

WAVE FORM:


Analog Signal
Amplitude--->
Time--->
Sampled Sinal
Amplitude--->
Time--->
Quantized Signal
Amplitude--->
Time--->


Encoded Signal
Amplitude--->
Demodulated Signal
Amplitude--->
Time--->

THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

INTERENCE:

PRE-EXPERIMENT VIVA-VOCE:

1. Define Pulse Code Modulation.
2. What do you mean by "Quantization"?
3. How do you assign the bits to the Quantization levels?
4. What is the role of Parallel-to-Serial converter in a PCM Transmitter?
5. How do you calculate the SQNR of a PCM Signal?
6. What are the advantages and disadvantages of PCM?

POST-EXPERIMENT VIVA-VOCE:

1. How do the Amplitude Variations of the Message signal affect the stair-case and PCM Signal?
2. Express the SQNR of the PCM Signal generated in your experiment.
3. How can the performance of the PCM System be improved?

EXPERIMENT: 11
DIFFERENTIAL PULSE CODE MODULATION

AIM:

1. To write the MAT Lab code for Differential pulse code Modulation and Demodulation.
2. To plot the corresponding Waveforms on the Graph sheet

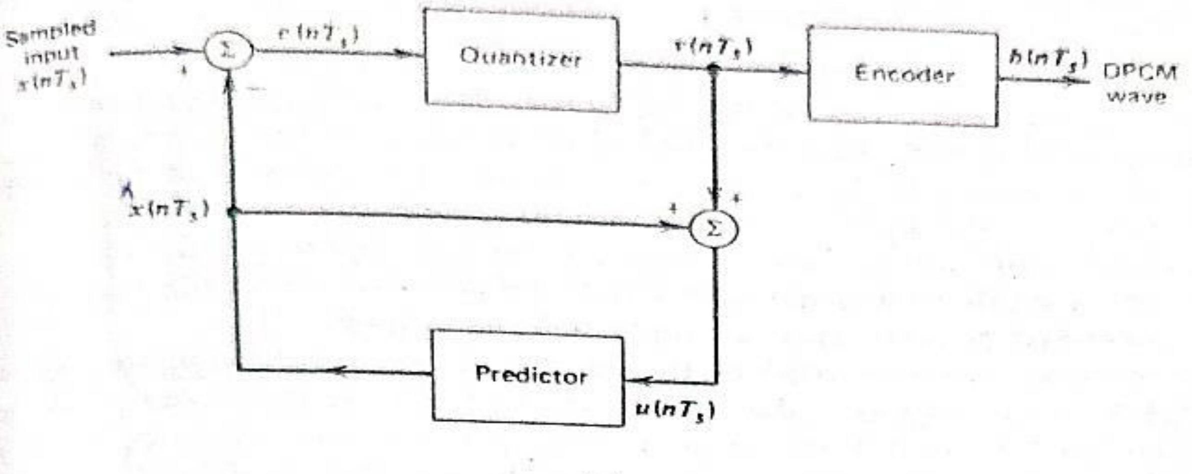
APPARATUS:

- Pc installed with windows XP or higher version and MATLAB software.
- Power supply

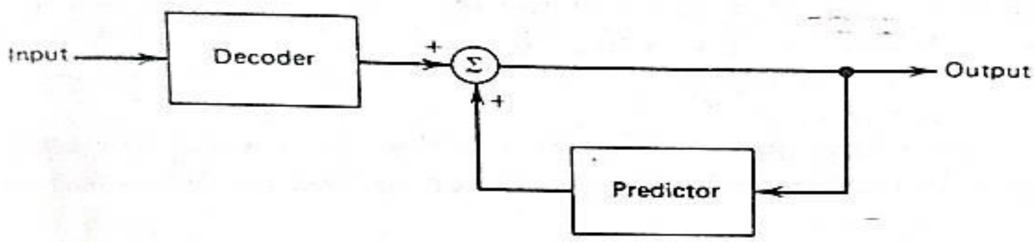
PROCEDURE:

1. Open the MATLAB software by double clicking its icon
2. MATLAB logo will appear and after few moments command prompt will appear
3. Go to the file Menu and select a New M-file. (File_New_M-File) or in the left hand corner a blank white paper icon will be there. Click it once.
4. A blank M-file will appear with a title ‘untitled’
5. Now start typing your program. After completing, save the M-file with appropriate name. To execute the program Press F5 or go to debug menu and select Run.
6. After execution, output will appear in the command window. If there is an error then with an alarm, type of error will appear in red color.
7. Rectify the error if any and go to Debug Menu and select Run.

BLOCK DIAGRAM:

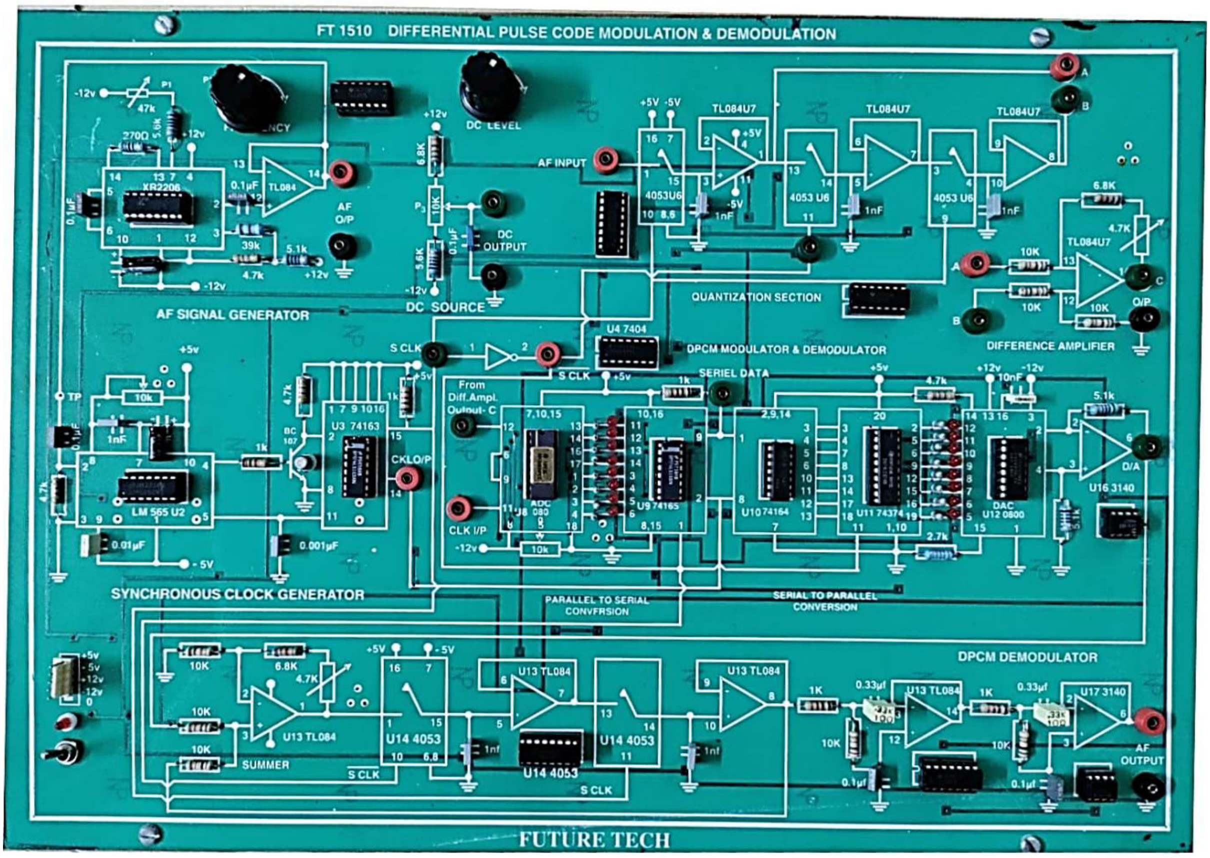


(a)



(b)

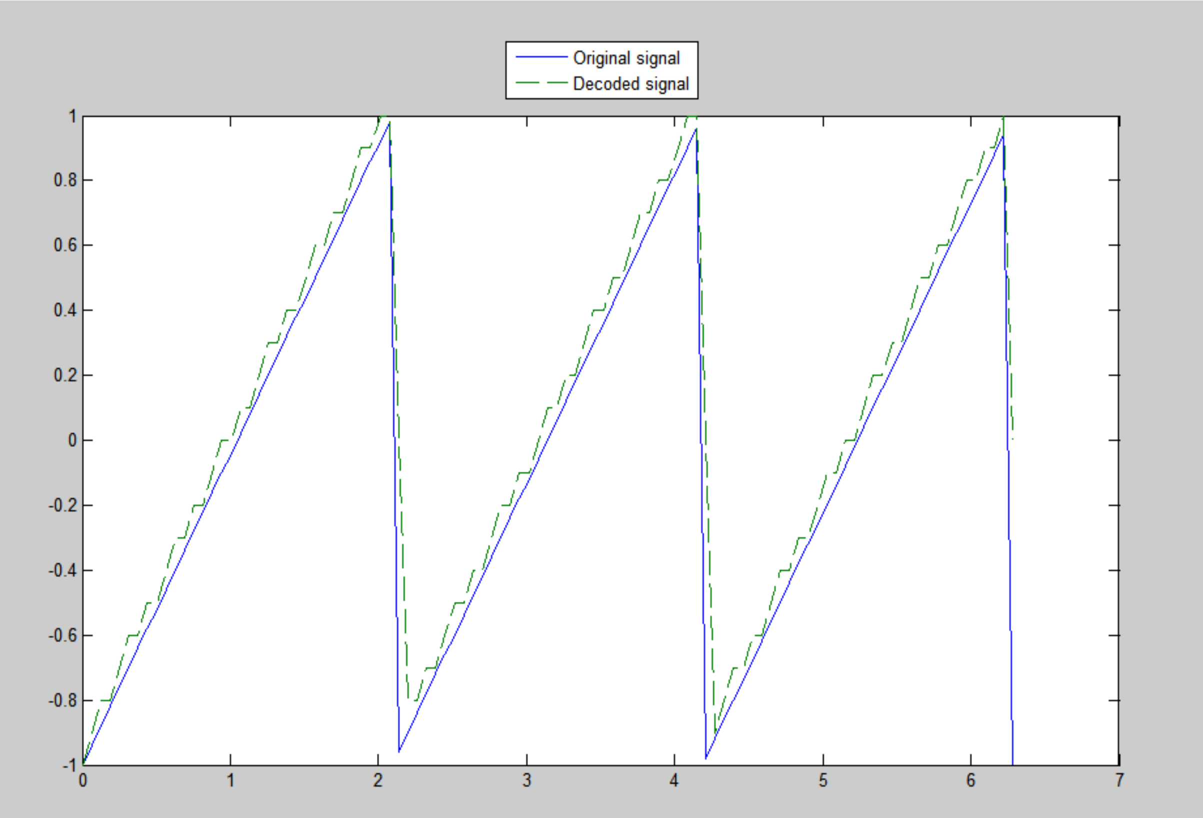
CIRCUIT DIAGRAM:



MATLAB CODE:

```
    predictor = [0 1]; % y(k)=x(k-1)
partition = [-1:.1:.9];
codebook = [-1:.1:1];
t = [0:pi/50:2*pi];
x = sawtooth(3*t); % Original signal
% Quantize x using DPCM.
encodedx = dpcmenco(x,codebook,partition,predictor);
% Try to recover x from the modulated signal.
decodedx = dpcmdeco(encodedx,codebook,predictor);
plot(t,x,t,decodedx,'--')
legend('Original signal','Decoded signal','Location','NorthOutside');
distor = sum((x-decodedx).^2)/length(x) % Mean square error
```

WAVEFORMS:



THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

INFERENCE:

PRE-EXPERIMENT VIVA-VOCE:

1. Define Differential Pulse code Modulation.
2. What do you mean by “QUANTIZATION”?
3. How do you assign the bits to the Quantization levels?
4. What is the role of predictor in a DPCM Transmitter?
5. How do you calculate the SQNR of a DPCM signal?
6. What are the advantages **and disadvantages of DPCM?**

POST-EXPERIMENT VIVA-VOCE:

1. How do the amplitude variations of the message signal affect the stair-case and DPCM signal?
2. Express the SQNR in dB of the DPCM signal generated in your experiment.
3. How can be the performance of the DPCM system be improved?

EXPERIMENT: 12
DELTA MODULATION

AIM:

1. To write and simulate the MATLab code for Delta Modulation.
2. To write the Corresponding Waveforms on the Graph Sheet.

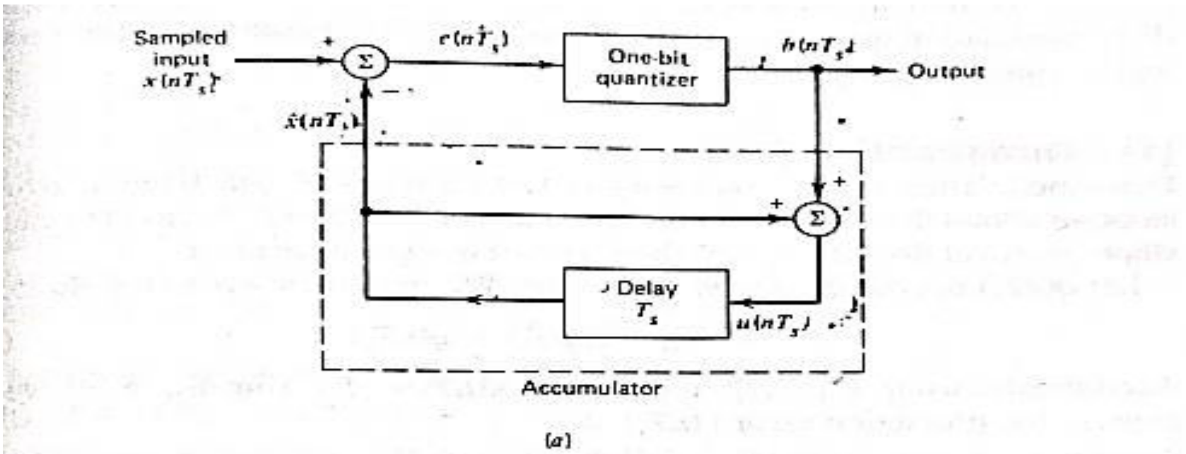
APPARATUS:

- PC Installed with Windows XP or higher Version and MATLab Soft.
- Power Supply.

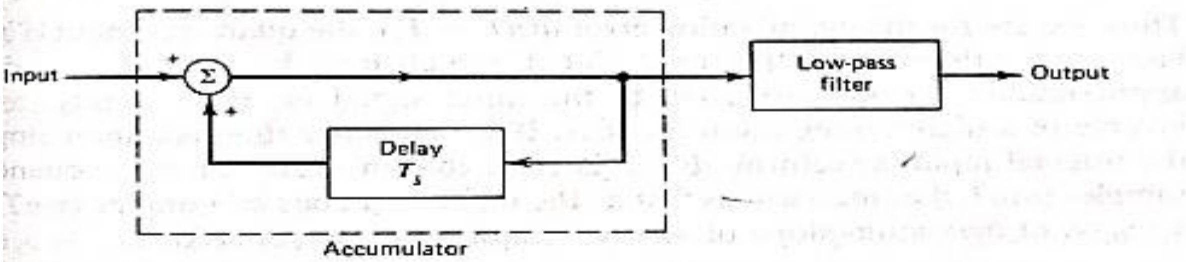
PROCEDURE:

1. Open the MATLAB software by double clicking its icon.
2. MATLAB logo will appear and after few moments Command Prompt will appear.
3. Go to the File Menu and select a New M-file. (File _New _M-file) or in the left hand corner a blank white paper icon will be there .Click it once.
4. A blank M-file will appear with a title 'untitled'
5. Now start typing your program. After completing, save the M-file with appropriate name. To execute the program Press F5 or go Debug Menu and select Run.
6. After execution, output will appear in the Command window. If there is an error then with an alarm, type of error will appear in red color?
7. Rectify the error if any go to Debug Menu and select Run.

BLOCK DIAGRAM:

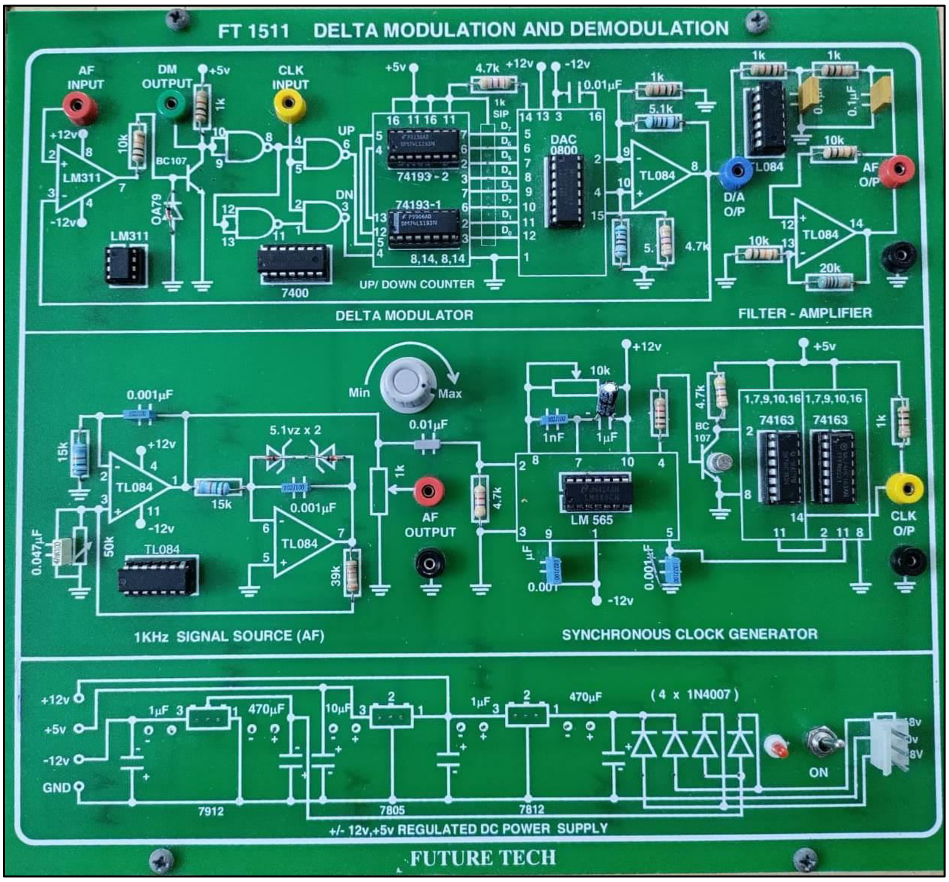


(a)



(b)

CIRCUIT DIAGRAM:

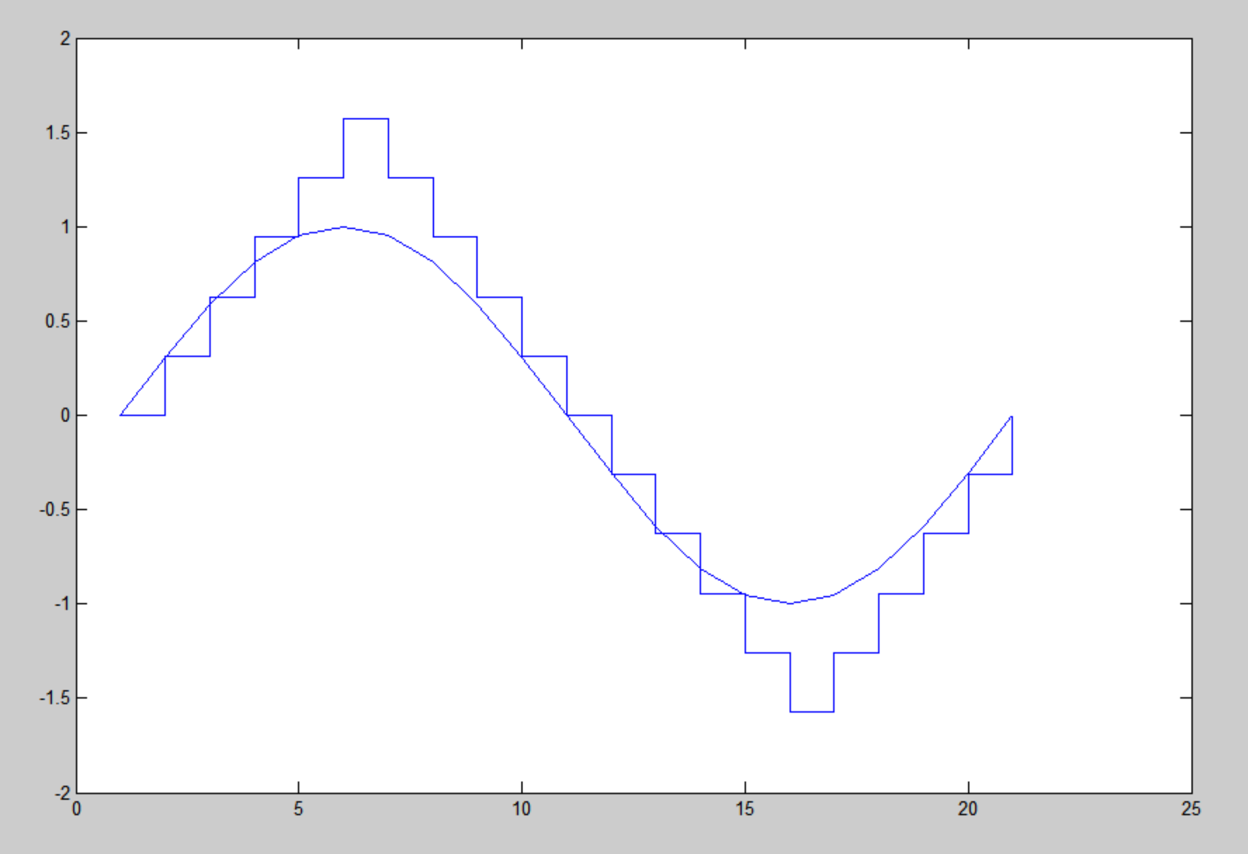


MATLAB CODE:

```
clc;
clearall;
closeall;
fs=20;
t=0:1/fs:1;
am=1;
fm=1;
m=sin(2*pi*fm*t);
plot(m);
d=2*pi*fm*am/fs;
for n=1:length(m);
if(n==1)
e(n)=m(n);
eq(n)=d*sign(e(n));
mq(n)=eq(n);
else
e(n)=m(n)-m(n-1);
eq(n)=d*sign(e(n));
mq(n)=mq(n-1)+eq(n);
```

```
end
end
holdon;
stairs(mq);
```

WAVEFORMS:



THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONSL:

CONCLUSION:

INFERENCE:

PRE-EXPERIMENT VIVA-VOCE:

1. Define Delta-Modulation.
2. What do you mean by "Stair-case Approximation"?
3. How do you assign the bits to the Quantization levels?
4. What happens to the output signal if the amplitude variation of the message signal?
    a. isgreater than the step size.
    b. less than the step size
5. What are the types of Quantization Errors in Delta Modulation?
6. How do you calculate the SQNR of a Detla Modulated Signal?
7. What is the advantage of delta modulation over PCM?

POST-EXPERIMENT VIVA-VOCE:

1. How do the amplitude Variations of the Message Signal effect the Stair-Case and modulated signal?
2. Express the SQNR of the delta modulated signal generated in your experiment.
3. How can the performance of the Delta-Modulation System be improved?

EXPERIMENT: 13
FREQUENCY SHIFT KEYING

AIM:

1. **To write and simulate the MATlab® code for Frequency Shift Keying Technique.**
2. **To plot theCorresponding Waveforms on the Graphsheet.**

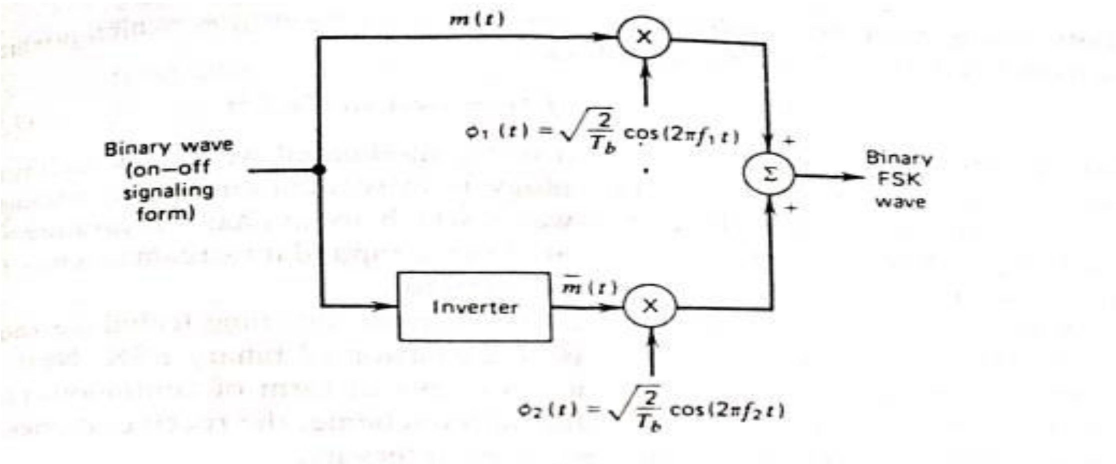
APPARATUS:

- **Pc installed with Windows XP or higher Version and MATlab Software.**
- **Power supply.**

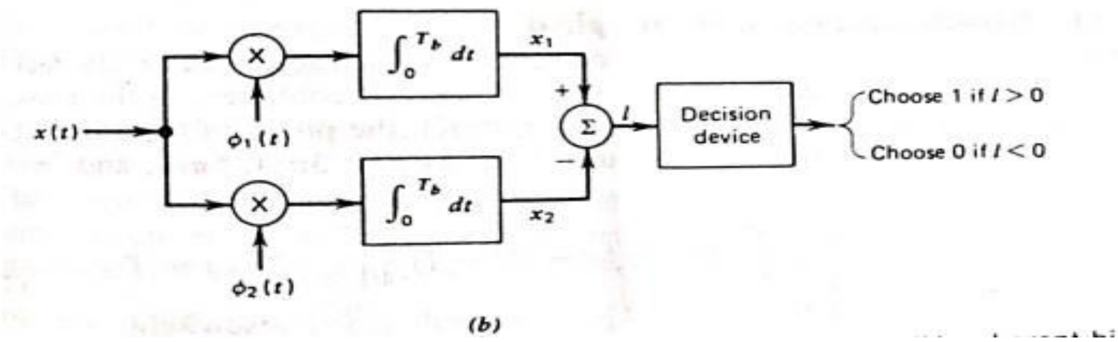
PROCEDURE:

1. Open the MAT Lab® software by double clicking its icon.
2. MATLAB logo will appear and after few moments command prompt will appear.
3. Go to the File Menu and select a New M-file.(File_New_M-file) or in the left hand corner a blank white paper icon will be there. Click it once.
4. A blank M-file will appear with a title 'untitled'
5. Now start typing your program. After completing, save the M-file with appropriate name. To execute the program Press F5 or go to Debug Menu and select Run.
6. After execution, output will appear in the command window. If there is an error then with alarm, type of error will appear in red colour.
7. Rectify the error if any go to Debug Menu and select Run**.**

BLOCK DIAGRAM:

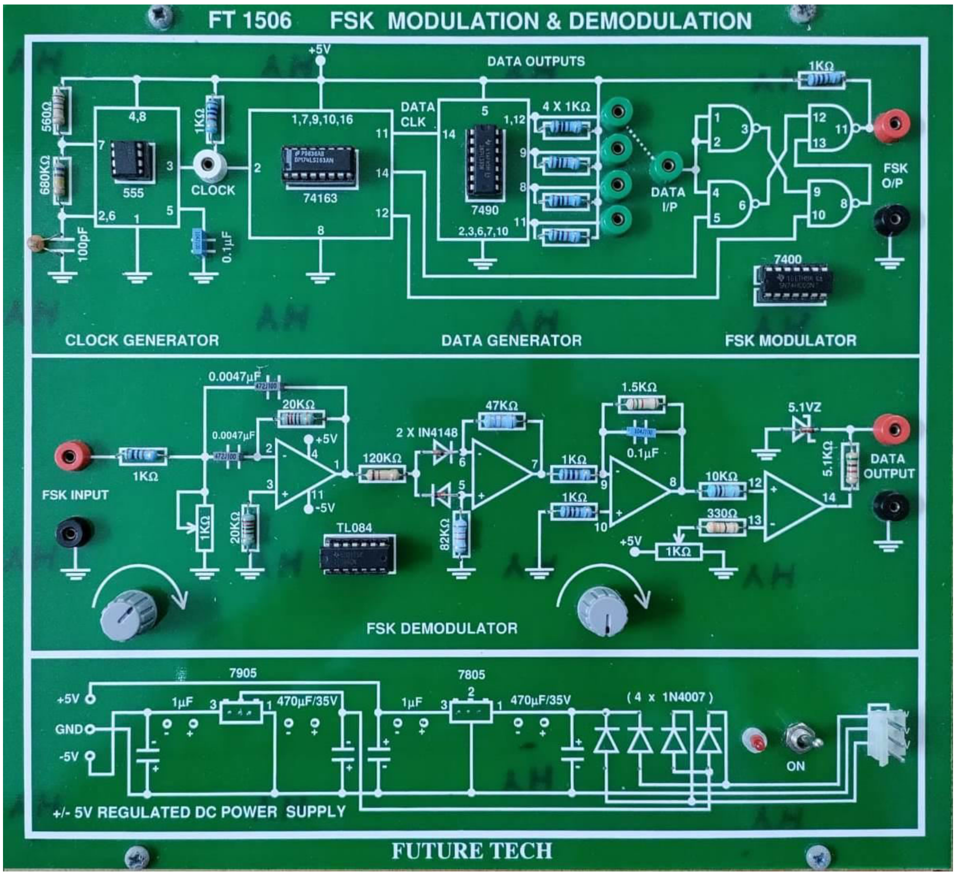


(a)



(b)

CIRCUIT DIAGRAM:

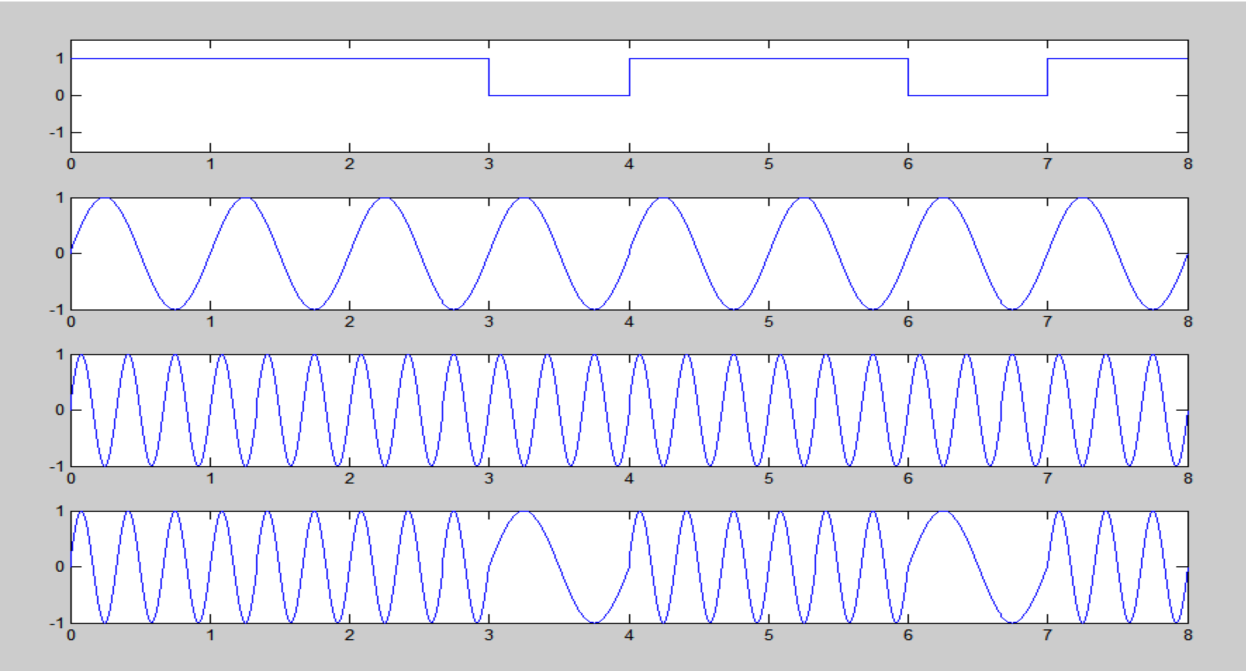


MATLAB CODE:

```
clc;
clearall;
closeall;
N=8;
Bit_stream=round(rand(1,N));
fs=100;
t=0:(1/fs):1;
fm=1;
fc1=1;
fc2=3;

datastream =[];
time=[];
carrier_signal1=[];
carrier_signal2=[];
fsk_signal=[];
fori= 1:1:length(Bit_stream);
datastream=[datastream ((Bit_stream(i)==0)*zeros(1,length(t))+
```

```
(Bit_stream(i)==1)*ones(1,length(t)))];
carrier_signal1=[carrier_signal1 (sin(2*pi*fc1*t))];
carrier_signal2=[carrier_signal2 (sin(2*pi*fc2*t))];
fsk_signal=[fsk_signal ((Bit_stream(i)==0)* sin(2*pi*fc1*t) +
(Bit_stream(i)==1)*sin(2*pi*fc2*t))];
time=[time,t];
t=t+1;
end

subplot(4,1,1);
plot(time,datastream);
axis([0 time(end) -1.5 1.5])
subplot(4,1,2);
plot(time,carrier_signal1);
subplot(4,1,3);
plot(time,carrier_signal2);
subplot(4,1,4);
plot(time,fsk_signal);
```

WAVE FORM:



THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

INFERENCE:

PRE-EXPERIMENT VIVA-VIOCE:

1. Define FSK modulation?
2. What are the advantages of FSK system over ASK system?
3. Draw the block diagram of coherent and Non-Coherant FSK system?

POST-EXPERIMENT VIVA-VIOCE:

1. Given a bandwidth of 5000Hz for an FSK signal, what are the baud rate and bit rate?
2. Find the minimum bandwidth for an FSK signal transmitting at 2000bps?

EXPERIMENT: 14
PHASE SHIFT KEYING

AIM:

1. To write and simulate the MATLab code for Phase Shift Keying Technique
2. To plot the CorrespondingWaveforms on the Graph Sheets

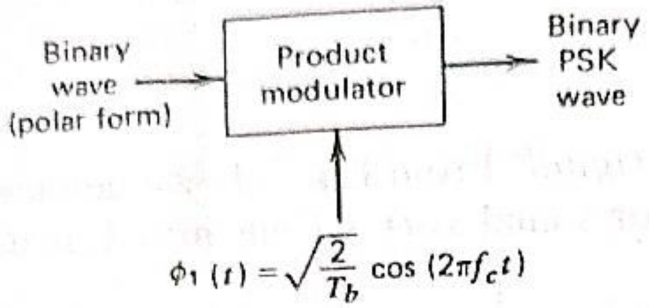
APPARATUS:

- PC Installed with Windows XP or higher Version andMATLab Software
- Power Supply.

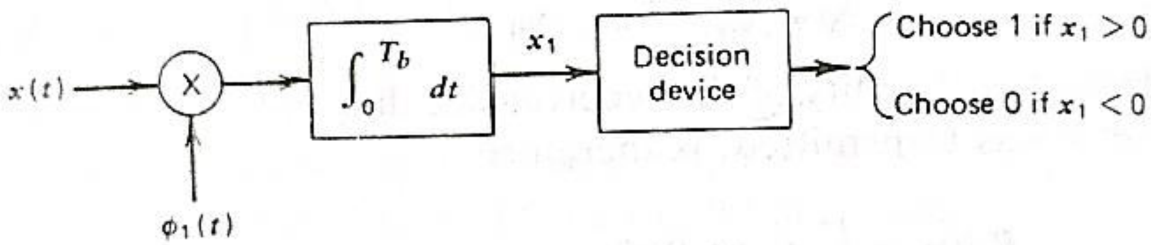
PROCEDURE:

1. Open the MATLAB® software by double clicking its icon.
2. MATLAB® logo will appear and after few moments Command Prompt will appear.
3. Go to the File Menu and select a New M- file. (File_New_M-file) or in the left hand corner a blank white paper icon will be there. Click it once.
4. A blank M-file will appear with a title "untitled'
5. Now start typing your program. After completing, save the M- file with appropriate name. To execute the program Press F5 or go to Debug Menu and select Run.
6. After execution, output will appear in the Command window.If there is an error then with an alarm, type of error will appear in red color.
7. Rectify the error if any and go to Debug Menu and select Run.

BLOCK DIAGRAM:

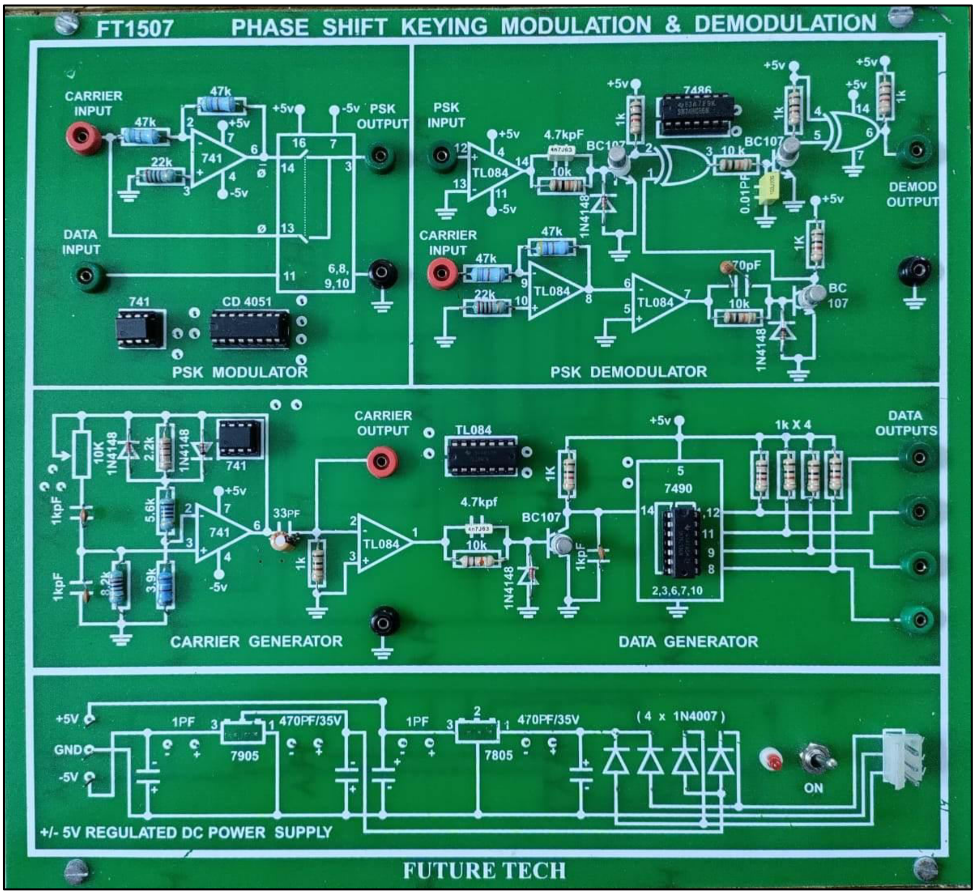


(a)



(b)

CIRCUIT DIAGRAM:

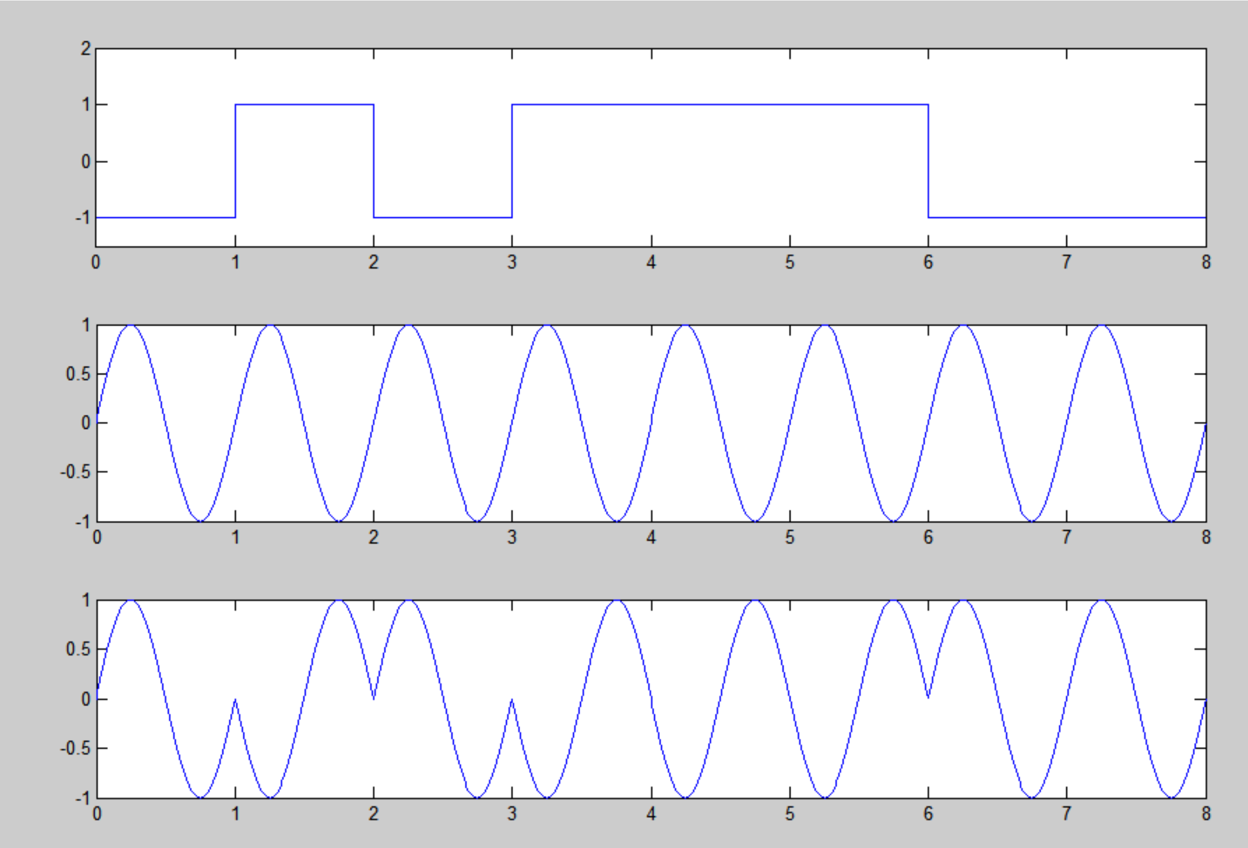


MATLab CODE:

```
clc;
clearall;
closeall;
N=8;
Bit_stream=round(rand(1,N));
fs=100;
t=0:(1/fs):1;
fm=1;
fc=1;

datastream =[];
time=[];
carrier_signal=[];
psk_signal=[];
fori= 1:1:length(Bit_stream);
datastream=[datastream (-(Bit_stream(i)==0)*ones(1,length(t))+
(Bit_stream(i)==1)*ones(1,length(t)))];
carrier_signal=[carrier_signal (sin(2*pi*fc*t))];
psk_signal=[psk_signal -((Bit_stream(i)==0)*sin(2*pi*fc*t+pi)+
(Bit_stream(i)==1)*sin(2*pi*fc*t))];
time=[time,t];
```

```
t=t+1;
end

subplot(3,1,1);
plot(time,datastream);
axis([0 time(end) -1.5 2])
subplot(3,1,2);
plot(time,carrier_signal);

subplot(3,1,3);
plot(time,psk_signal);
```

WAVEFORMS:



THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLISION:

INFERENCE:

PRE-EXPERIMENT VIVA-VOICE:

1. Define PSK Modulation.
2. What are advantages of PSK System over ASK and PSK Systems?
3. Draw the Block Diagrams of Coherent and Non-Coherent PSK Systems.

POST-EXPERIMENT VIVA-VOICE:

1. Why do we make 180 degree phase shift in PSK and Why not90 or 270? Comment on this.
2. Given a bandwidth of 5000 Hz for a PSK signal,what are the baud rate and bit rate?
3. Find the minimum bandwidth for a PSK signal transmitting at 2000bps.

EXPERIMENT: 15
DIFFERENTIAL PHASE SHIFT KEYING

AIM:

1. To write and simulate the MATLabcode for Differential Phase Shift Keying Technique.
2. To plot the Corresponding Waveforms on the Graph Sheet.

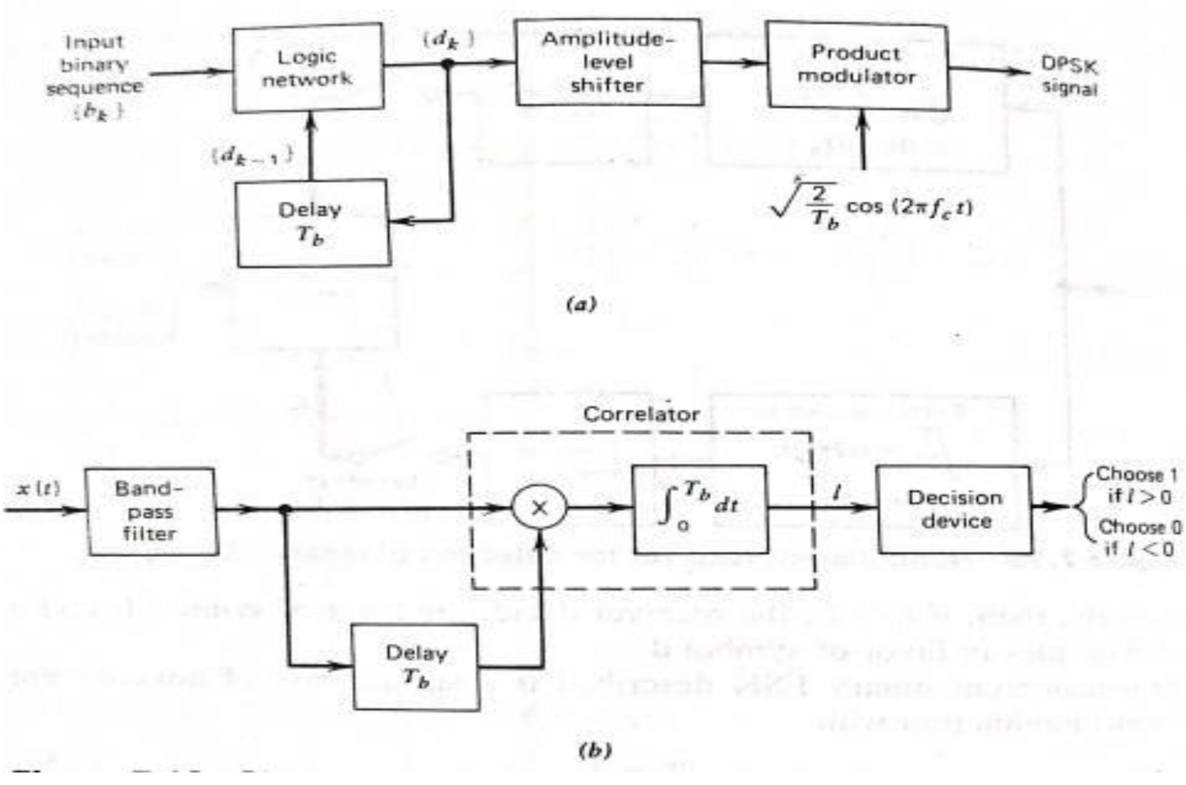
APPARATUS:

- PC Installed with Windows XP or higher Version and MATLab Software.
- Power Supply.

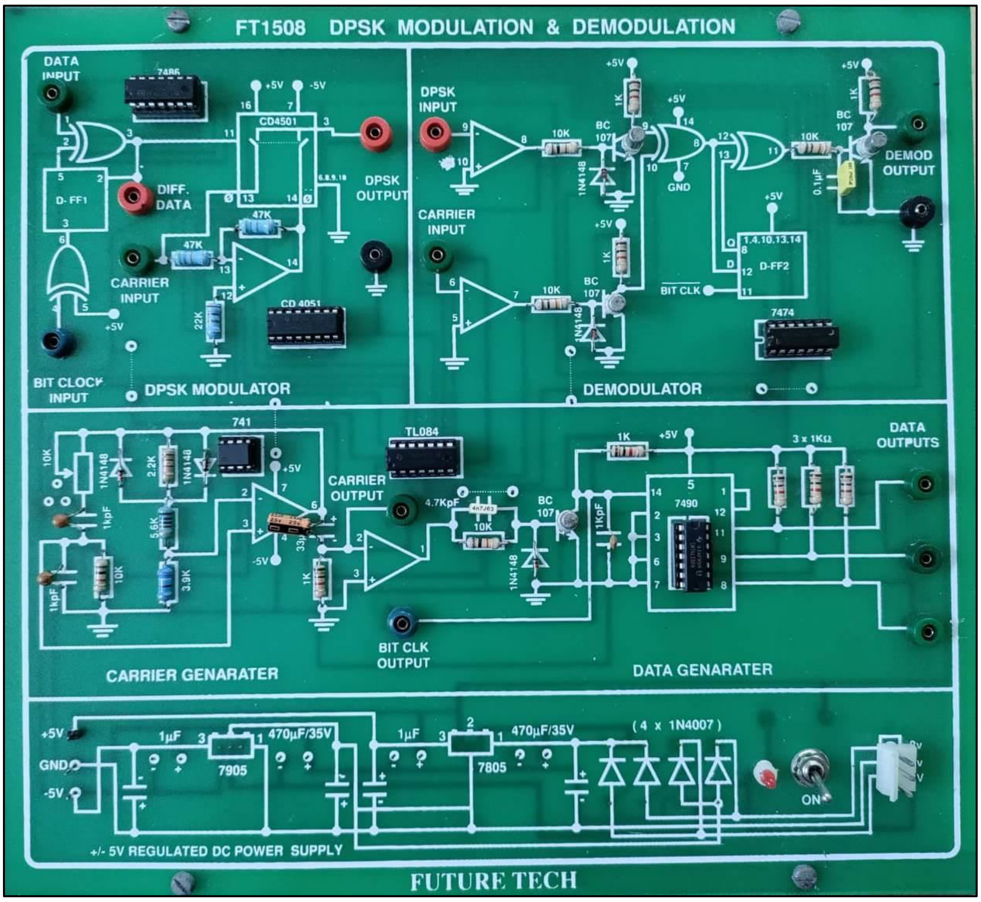
PROCEDURE:

1) Open the MATLab software by double clicking its icon.
2) MATLAB logo will appear and after few moments Commands Prompt will appear.
3) Go to the File Menu and select a New M-file. Or in the left hand corner a blank white paper icon will be there. Click it once.
4) A blank M-file will appear with a title 'untiled'
5) Now start typing your program. After completing, save the M-file with appropriate name. To execute the program Press F5 or go to Debug Menu and select Run.
6) After execution, output will appear in the Command window. If there is an error then with an alarm. Type of error will appear in red color.
7) Rectify the error if any and go to Debug Menu and select Run.

BLOCK DIAGRAM:



CIRCUIT DIAGRAM:

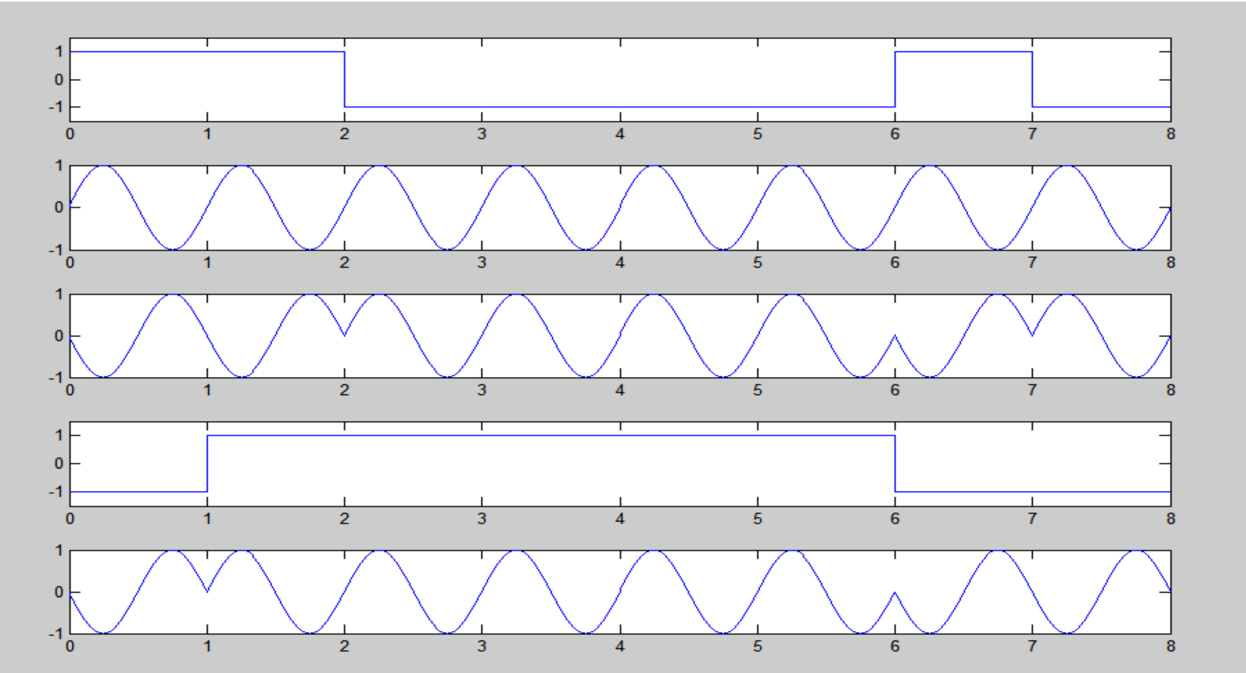


MATLab CODE:

```
clc;
clearall;
closeall;
N=8;
Bit_stream=round(rand(1,N));
fs=100;
t=0:(1/fs):1;
fm=1;
fc=1;

datastream =[];
time=[];
carrier_signal=[];
psk_signal=[];
diff_data=[];
dpsk_signal=[];
z=[];
y=xor(Bit_stream(1),0);

fori= 1:1:length(Bit_stream);
datastream=[datastream (-(Bit_stream(i)==0)*ones(1,length(t))+
(Bit_stream(i)==1)*ones(1,length(t)))];
```

```
carrier_signal=[carrier_signal (sin(2*pi*fc*t))];
z=[z xor(Bit_stream(i),y)];
y=z(i);
psk_signal=[psk_signal -((Bit_stream(i)==0)*sin(2*pi*fc*t+pi)+
(Bit_stream(i)==1)*sin(2*pi*fc*t))];
diff_data=[diff_data (-(z(i)==0)*ones(1,length(t)))+(z(i)==1)*ones(1,length(t))];
dpsk_signal=[dpsk_signal (z(i)==0)*sin(2*pi*fc*t+pi)+(z(i)==1)*sin(2*pi*fc*t)]
time=[time,t];
t=t+1;
end

subplot(5,1,1);
plot(time,datastream);
axis([0 time(end) -1.5 1.5])
subplot(5,1,2);
plot(time,carrier_signal);

subplot(5,1,3);
plot(time,psk_signal);
subplot(5,1,4);
plot(time,diff_data);
axis([0 time(end) -1.5 1.5])
subplot(5,1,5);
plot(time,dpsk_signal);
```

WAVEFORMS:



THEORY:

CALCULATIONS:

DISCUSIION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

INFERENCE:

PRE-EXPERIMENT VIVA-VOCE:

1. Define DPSK MODULATION.
2. What are advantages of DPSK System over ASK and FSK System?
3. Draw the Block Diagram of Coherent and Non-Coherent DPSK Systems.

POST-EXPERIMENT VIVA-VOCE:

1. Why do we make 180 degree phase shift in DPSK and why not 90 or 270? Comment on this.
2. Given a bandwidth of 5000 Hz for a DPSK signal, what are the baud rate and bit rate?
3. Find the minimum bandwidth for a DPSK signal transmitting at 200bps.

EXPERIMENT: 16

QUADRATURE PHASE SHIFT KEYING

AIM:

1) Towrite and simulate the MATLab code for Quadrature Phase Shift Keying Technique.
2) To plot the corresponding waveforms on the graph sheets.

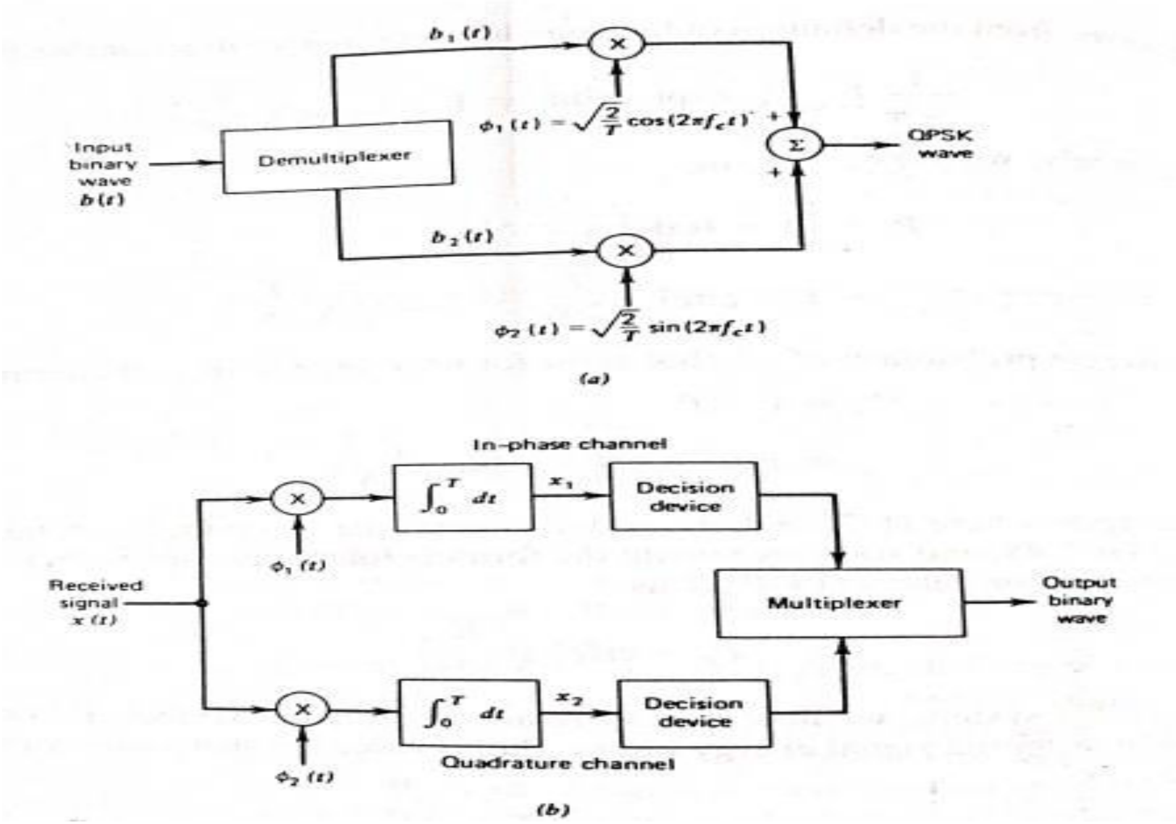
APPARATUS:

- PC Installed with windows XP or higher Version and MATLab Software.
- Power Supply.

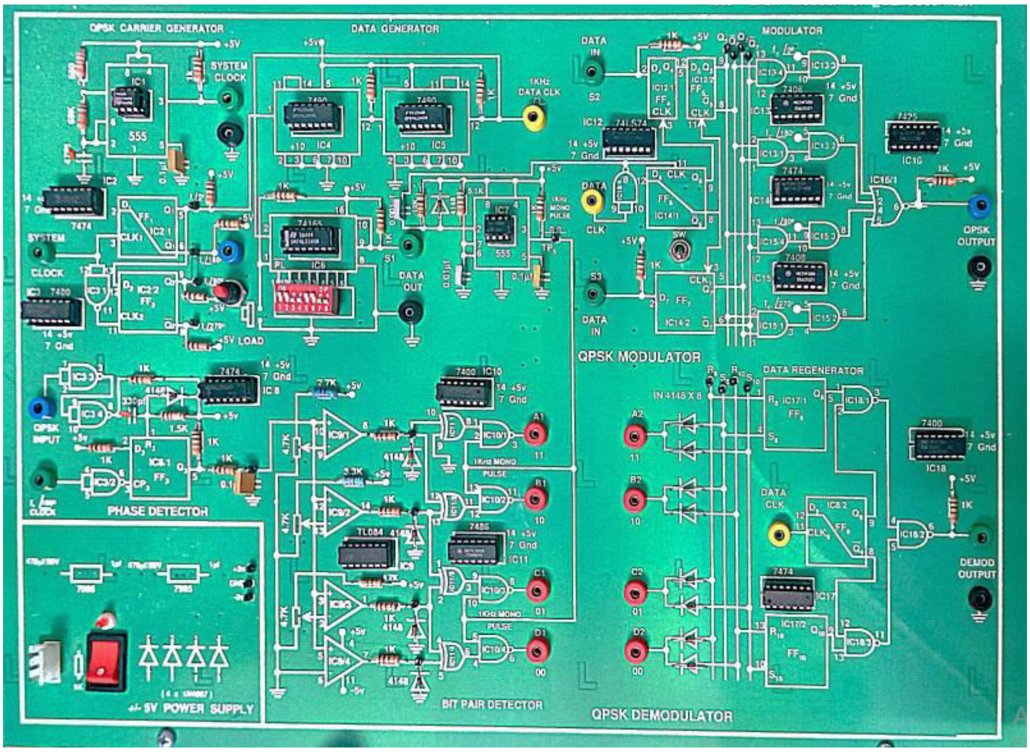
PROCEDURE:

1) Open the MATLAB software by double clicking its icon.
2) MATLAB® logo will appear and after few moments Command Prompt will appear.
3) Go to the File Menu and select a New M-file (file_ New_ M-file) or in the left hand corner a blank white paper icon will be there. Click it once.
4) A blank M-file will appear with a title 'untitled'.
5) Now start typing your program. After completing save the M-file with appropriate name. To execute the program Press F5 or go to Debug Menu and select Run.
6) After execution, output will appear in the Command window. If there is an error then with an alarm, of error will appear in red color.
7) Rectify the error if any and go to Debug Menu and select Run.

BLOCK DIAGRAM:



CIRCUIT DIAGRAM:



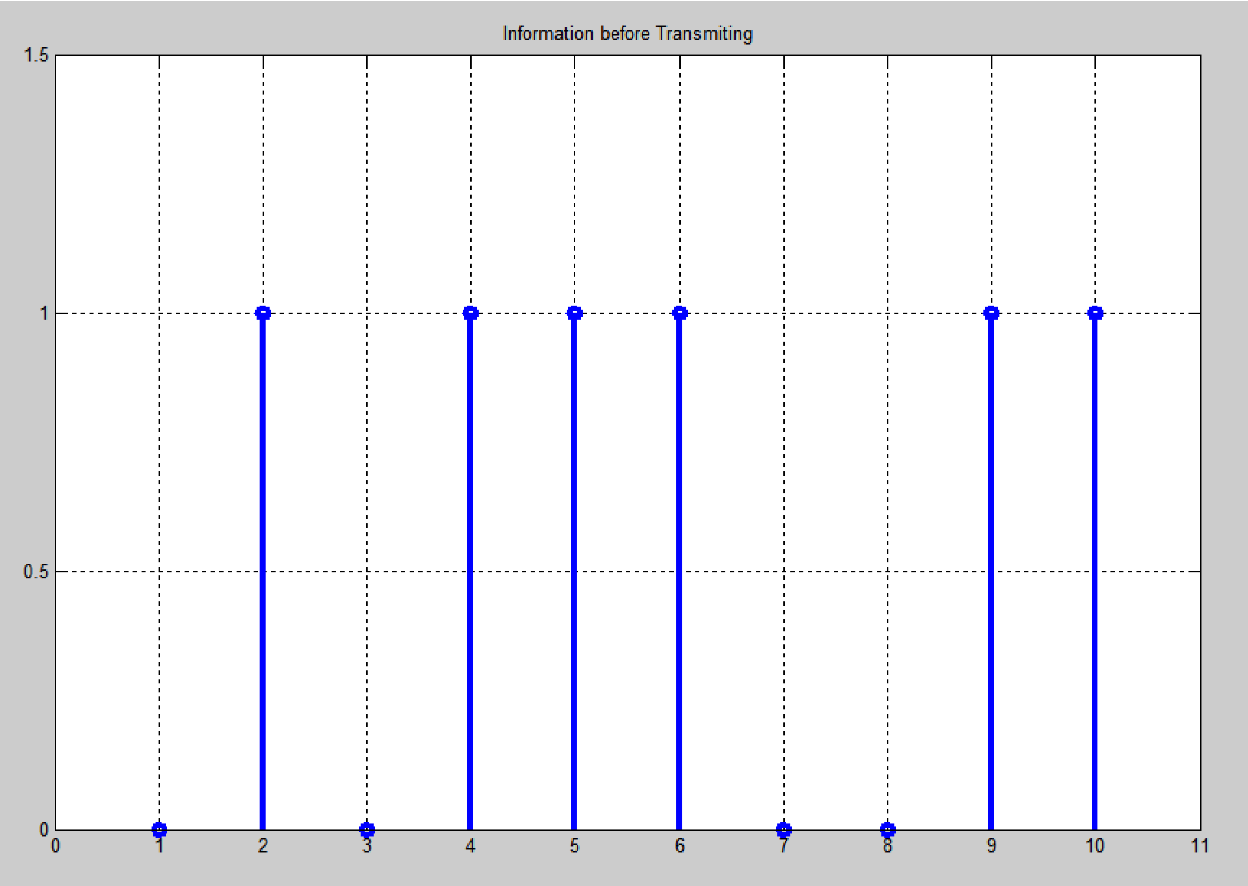
MATLAB CODE:

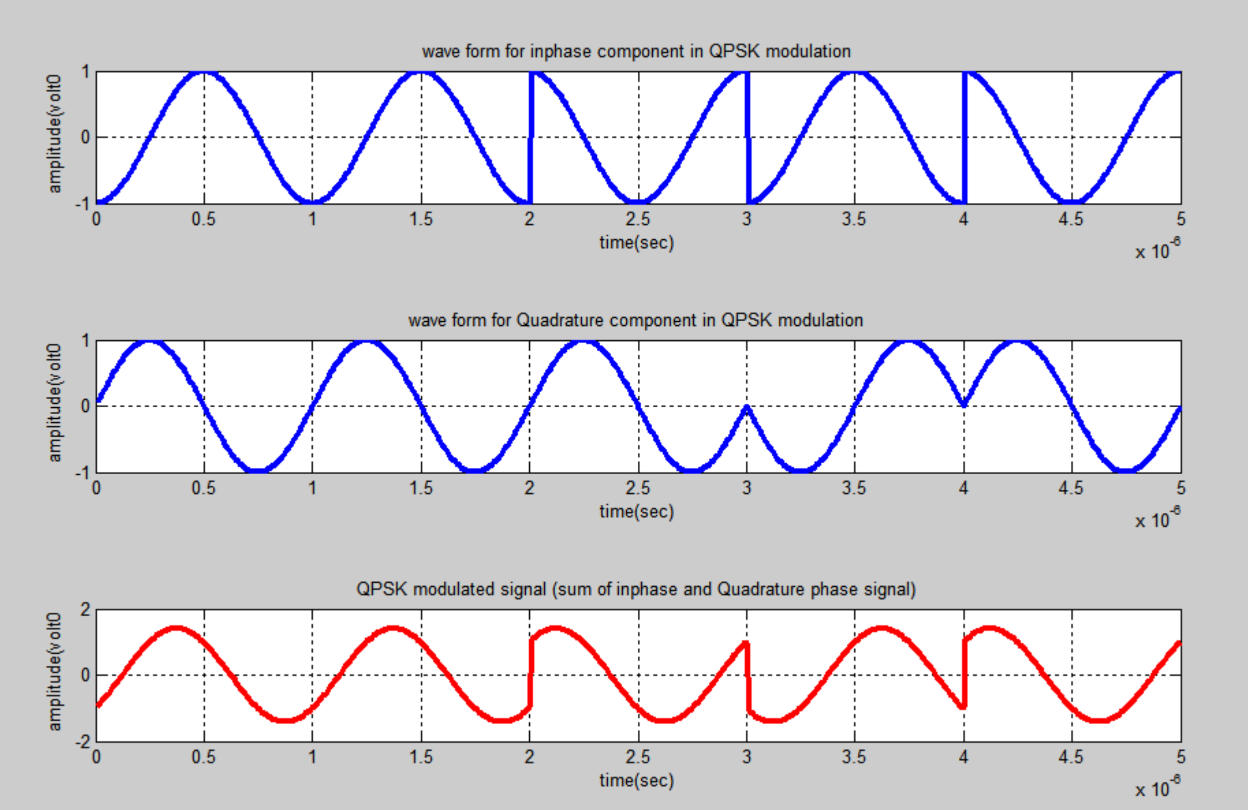
```
clearall;
closeall;
data=[0  1 0 1 1 1 0 0 1 1]; % information
%Number_of_bit=1024;
%data=randint(Number_of_bit,1);
figure(1)
stem(data, 'linewidth',3), grid on;
title('  Information before Transmiting ');
axis([ 0 11 0 1.5]);
data_NZR=2*data-1; % Data Represented at NZR form for QPSK modulation
s_p_data=reshape(data_NZR,2,length(data)/2);  % S/P convertion of data
br=10.^6; %Let us transmission bit rate  1000000
f=br; % minimum carrier frequency
T=1/br; % bit duration
t=T/99:T/99:T; % Time vector for one bit information
% XXXXXXXXXXXXXXXXXXXXXXX QPSK modulatio
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
y=[];
y_in=[];
y_qd=[];
for(i=1:length(data)/2)
```

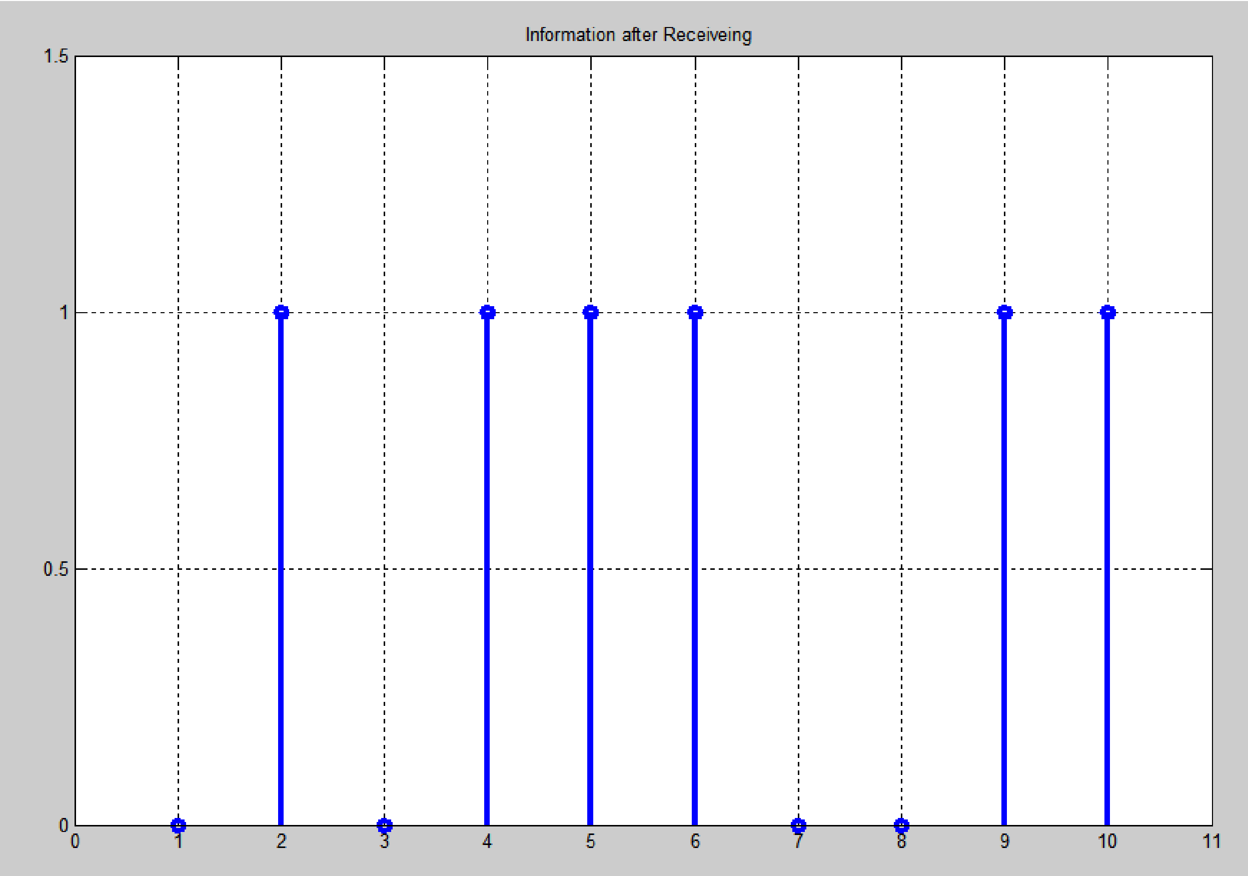
```
    y1=s_p_data(1,i)*cos(2*pi*f*t); % inphase component
    y2=s_p_data(2,i)*sin(2*pi*f*t) ;% Quadrature component
y_in=[y_in y1]; % inphase signal vector
y_qd=[y_qd y2]; %quadrature signal vector
    y=[y y1+y2]; % modulated signal vector
end
Tx_sig=y; % transmitting signal after modulation
tt=T/99:T/99:(T*length(data))/2;
figure(2)
subplot(3,1,1);
plot(tt,y_in,'linewidth',3), grid on;
title(' wave form for inphase component in QPSK modulation ');
xlabel('time(sec)');
ylabel(' amplitude(volt0');
subplot(3,1,2);
plot(tt,y_qd,'linewidth',3), grid on;
title(' wave form for Quadrature component in QPSK modulation ');
xlabel('time(sec)');
ylabel(' amplitude(volt0');
subplot(3,1,3);
plot(tt,Tx_sig,'r','linewidth',3), grid on;
title('QPSK modulated signal (sum of inphase and Quadrature phase signal)');
xlabel('time(sec)');
ylabel(' amplitude(volt0');
% XXXXXXXXXXXXXXXXXXXXXXXXXXXXX QPSK demodulation
XXXXXXXXXXXXXXXXXXXXXXXXXX
Rx_data=[];
Rx_sig=Tx_sig; % Received signal
for(i=1:1:length(data)/2)
%%XXXXXX inphase coherent dector XXXXXXX
Z_in=Rx_sig((i-1)*length(t)+1:i*length(t)).*cos(2*pi*f*t);
% above line indicat multiplication of received &inphasecarred signal

Z_in_intg=(trapz(t,Z_in))*(2/T);% integration using trapizodialrull
if(Z_in_intg>0) % Decession Maker
Rx_in_data=1;
else
Rx_in_data=0;
end

%%XXXXXX Quadrature coherent dector XXXXXX
Z_qd=Rx_sig((i-1)*length(t)+1:i*length(t)).*sin(2*pi*f*t);
%above line indicat multiplication ofreceived&Quadphasecarred signal
```

```
Z_qd_intg=(trapz(t,Z_qd))*(2/T);%integration using trapizodialrull
if (Z_qd_intg>0)% Decession Maker
Rx_qd_data=1;
else
Rx_qd_data=0;
end

Rx_data=[Rx_dataRx_in_dataRx_qd_data]; % Received Data vector
end
figure(3)
stem(Rx_data,'linewidth',3)
title('Information after Receiveing ');
axis([ 0 11 0 1.5]), grid on;
% XXXXXXXXXXXXXXXXXXXXXXXXXXX    end of program
XXXXXXXXXXXXXXXXXXXXXXXXXXX
```

WAVEFORMS:




wave form for inphase component in QPSK modulation
amplitude(volt0
time(sec)
x 10^-6
wave form for Quadrature component in QPSK modulation
amplitude(volt0
time(sec)
x 10^-6
QPSK modulated signal (sum of inphase and Quadrature phase signal)
amplitude(volt0
time(sec)
x 10^-6


Information after Receiveing

THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

INFERENCE:

PRE-EXPERIMENT VIVA-VOICE:

1. Define QPSK Modulation.
2. What are advantages of QPSK System?
3. Draw the block diagram of coherent and non-coherent QPSK System.

POST-EXPERIMENT VIVA-VOICE:

1. Given a bandwidth of 5000hz for a QPSK signal,what are the baud rate and bit rate?
2. Find the minimum bandwidth for a QPSK signal transmitting at 2000bps.
3. What is the practical value of the Symbol errer probability of the generated QPSK signal?

EXPERIMENT: 17
CHANNEL AND ITS CHARACTERISTICS

AIM:

1. To write and simulate the MATLab code for a Discrete MemorylessChannel.
2. To plot the corresponding waveforms on the graph sheets.

APPARATUS:

- PC Installed with Windows XP or higher Version and MATLAB Software.
- Power Supply

PROCEDURE:

1. Open the MATLAB Software by double clicking its icon.
2. MATLAB logo will appear and after few moments Command Prompt will appear.
3. Go to the File Menu and select a New M-file. (File_New_M-file) or in the left hand corner a blank white paper icon will be there. Click it once.
4. A blank M-file will appear with a title 'untitled'.
5. Now start typing your program. After completing, save the M=-file with appropriate name. To execute the program press F5 or go to Debug Menu and Select run.
6. After execution, output will appear in the Command Window. If there is an error then with an alarm, type of error will appear in red color.
7. Rectify the error if any and go to debug Menu and Select Run.

MATLAB CODE:

```
%C=B*log(1+S/eta*B)bits/s.
clc;
clear all;
close all;
s=15;
n=10;
i=1;
for B=0.01:0.1:50
        c(1, i)=B*log(1+(s/(n*B)));
        i=i+1;
end
plot(c); grid;                    %plots channel capacity versus bandwidth
title('Channel capacity vs Bandwidth')
xlabel('B/(s/n)');
ylabel('Cs');
```

THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLUSION:

INTERFERENCE:

PRE-EXPERIMENT VIVA-VOCE:

1. State Channel Capacity Theorem.
2. What does the Channel Capacity Theorem state?

POST-EXPERIMENT VIVA-VOCE:

1. What is the practical value of the Channel Capacity?
2. What is the Average Information Rate of the Channel you have considered?
3. What is the rate of channel usage for the channel you have considered?

EXPERIMENT: 18
AMPLITUDE SHIFT KEYING

AIM:

1) To write and simulate the MAT Lab code for Phase Shift Keying Technique
2) To plot the Corresponding Waveforms on the Graph Sheets

APPARATUS:

- PC Installed with Windows XP or higher Version and MAT Lab Software
- Power Supply.

PROCEDURE:

1) Open the MATLAB software by double clicking its icon.
2) MATLAB logo will appear and after few moments Command Prompt will appear.
3) Go to the File Menu and select a New M- file. (File_New_M-file) or in the left hand corner a blank white paper icon will be there. Click it once.
4) A blank M-file will appear with a title "untitled'
5) Now start typing your program. After completing, save the M- file with appropriate name. To execute the program Press F5 or go to Debug Menu and select Run.
6) After execution, output will appear in the Command window .If there is an error then with an alarm, type of error will appear in red color.
7) Rectify the error if any and go to Debug Menu and select Run.

BLOCK DIAGRAM:

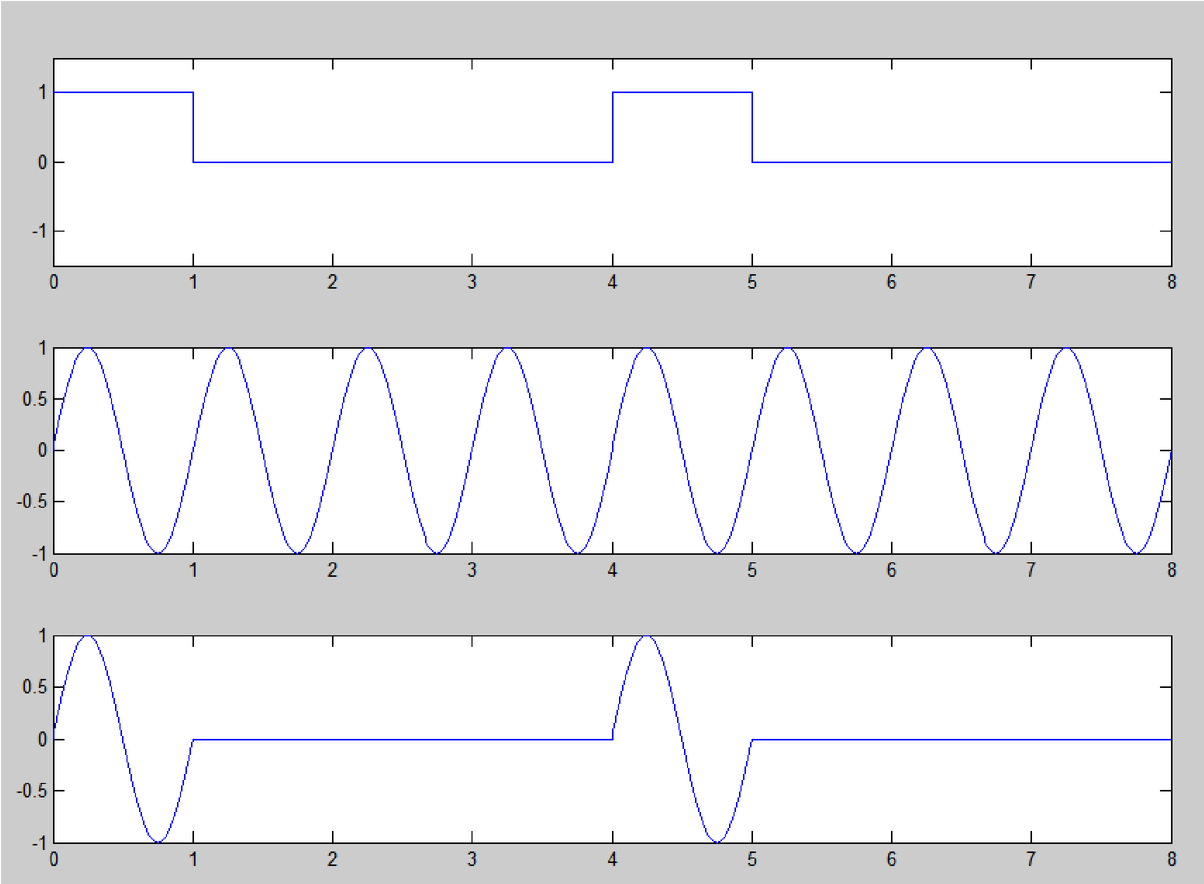
CIRCUIT DIAGRAM:

MAT Lab CODE:

```
clc;
clearall;
closeall;
N=8;
Bit_stream=round(rand(1,N));
fs=100;
t=0:(1/fs):1;
fm=1;
fc=1;

datastream =[];
time=[];
carrier_signal=[];
psk_signal=[];
fori= 1:1:length(Bit_stream);
datastream=[datastream (-(Bit_stream(i)==0)*ones(1,length(t))+
(Bit_stream(i)==1)*ones(1,length(t)))];
carrier_signal=[carrier_signal (sin(2*pi*fc*t))];
```

```
psk_signal=[psk_signal -((Bit_stream(i)==0)*sin(2*pi*fc*t+pi)+
(Bit_stream(i)==1)*sin(2*pi*fc*t))];
time=[time,t];
t=t+1;
end

subplot(3,1,1);
plot(time,datastream);
axis([0 time(end) -1.5 2])
subplot(3,1,2);
plot(time,carrier_signal);

subplot(3,1,3);
plot(time,psk_signal);
```

WAVEFORMS:



THEORY:

CALCULATIONS:

DISCUSSION:

ADVANTAGES:

DISADVANTAGES:

APPLICATIONS:

CONCLISION:

INFERENCE:

PRE-EXPERIMENT VIVA-VOCE:

1. Define PSK Modulation.
2. What are advantages of ASK System over FSK and PSK Systems?
3. Draw the Block Diagram of Coherent and Non-Coherent ASK Systems.

POST-EXPERIMENT VIVA-VOCE:

1. Given a bandwidth of 500 Hz for a ASK signal, what are the baud rate and bit rate?
2. Find the minimum bandwidth for a ASK signal transmitting at 1000bps.

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LABORATORY CERTIFICATE

This is certify that Mr. / Miss....M. praharshini....

Regd. No. 20091A04C5 of ....III.... year ....2nd.... has successfully completed the experiments in Digital communication lab of the ....ECE.... Branch prescribed by the RGMCET (Autonomous), Nandyal. for the academic year....2022-23....

Signature of the Staff Member

Signature of the HOD

Date 24/6/2023....

Signature of the Internal Examiner

Signature of the External Examiner

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(ESTD-1995)

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2.	06/03/23	Delta Modulation and Demodulation.	06-10	9	MAb 27/3/23
3.	06/03/23	psk Modulation & De-modulation.	11-15	9½	MAb 6/4/23
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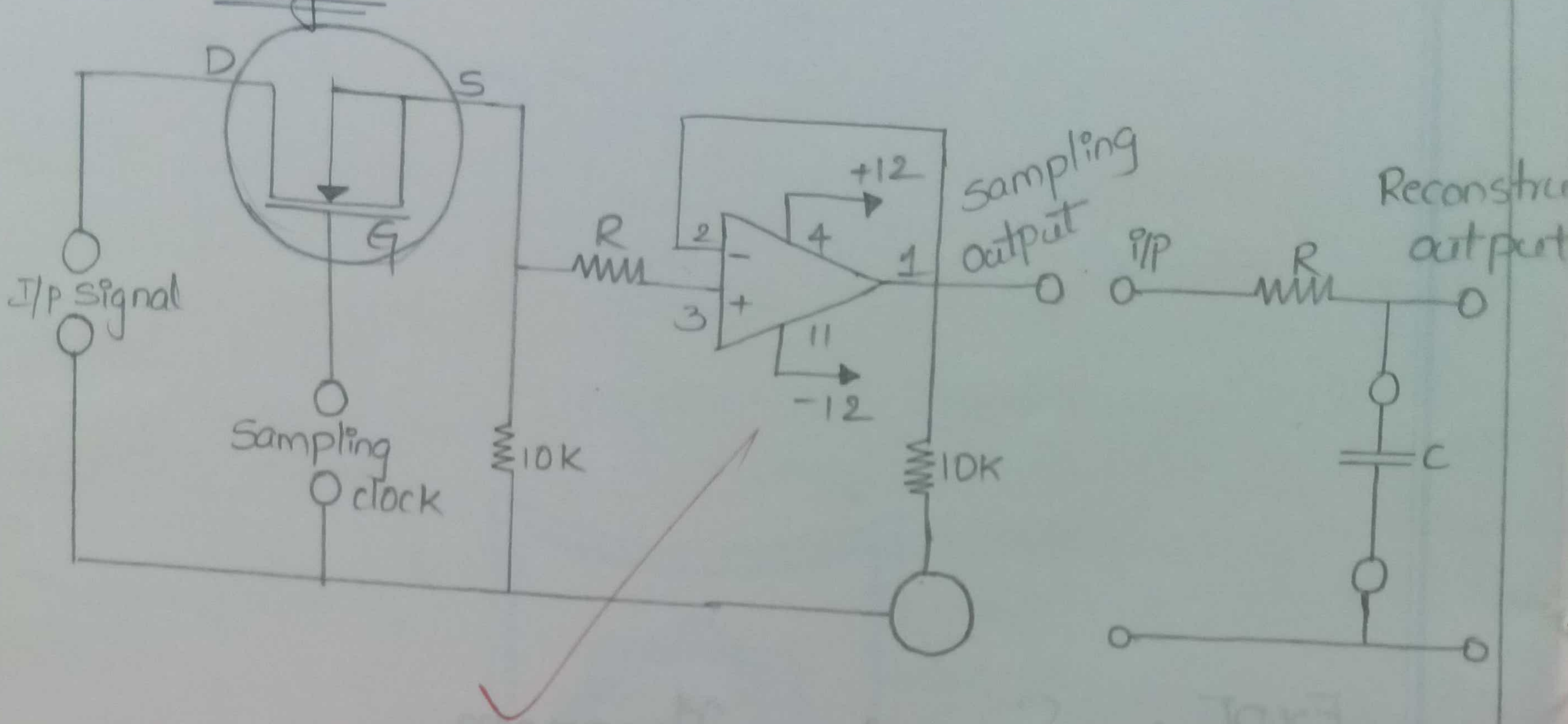
Expt No. 01 :- Sampling Theorem

Circuit Diagram:-



Expt No:(01)	Sampling Theorem	Date: 06/03/23

Aim: To Study and verify the Sampling theorem and reconstruction of sampled wave form.

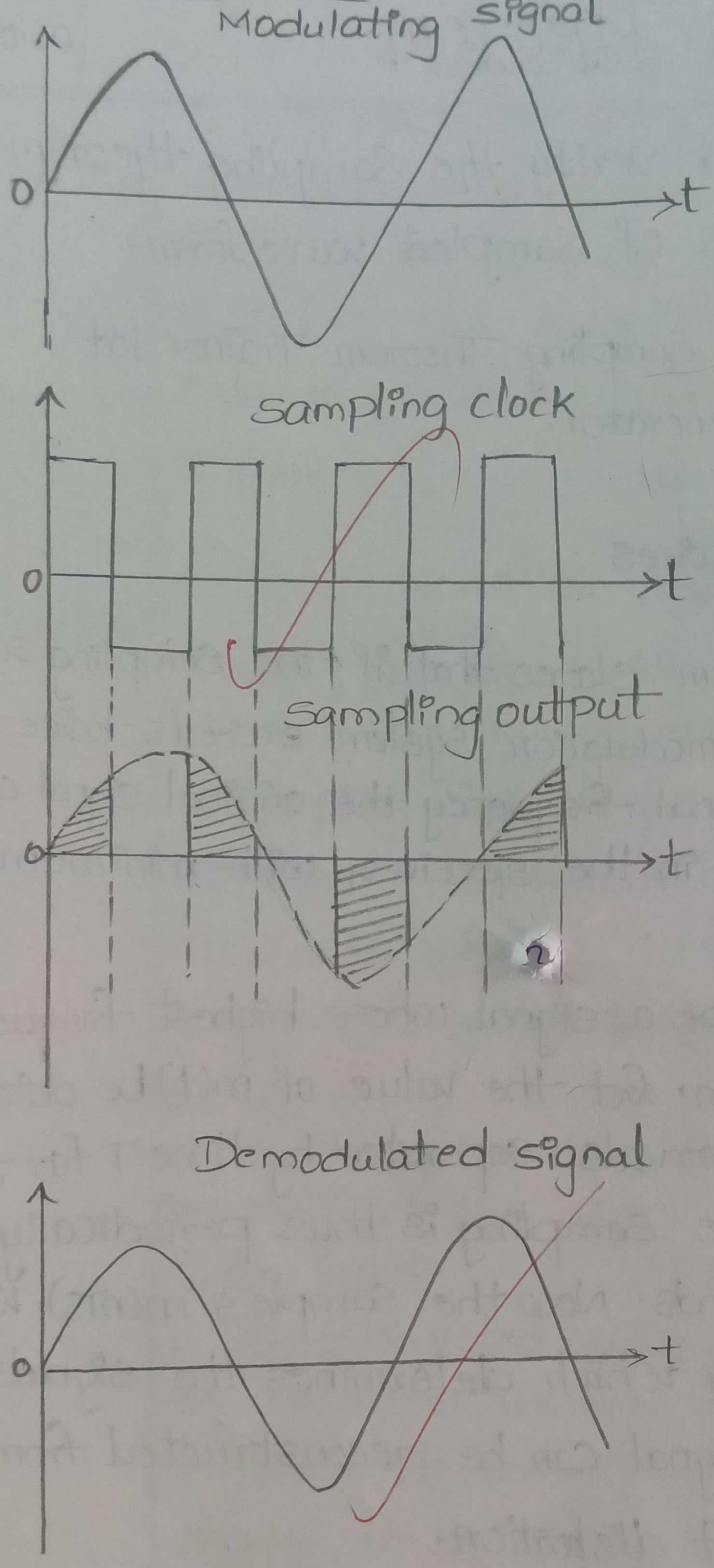
Apparatus:
1. physitech's Sampling Theorem Trainer kit
2. Function Generator.
3. CRO
4. connecting wires

Theory: Sampling theorem states that if the sampling rate in any pulse modulation system exceeds twice the maximum signal frequency the original signal can be reconstructed in the receiver with minimum distortion.

Let m(t) be a signal whose highest frequency component is fm. Let the value of m(t) be obtained at regular intervals seperated by time T far farless than (1/2 fm). The sampling is thus periodically done at each Ts seconds. Now the samples m(nTs). Where n is an integer which determines the signals uniquely. The signal can be reconstructed from these samples without distortion.

Time (Ts) is called the sampling Time. The minimum sampling rate is called NYQUIST RATE.

Expected Wave form:-



The validity of sampling theorem requires rapid sampling rate such that atleast two samples are obtained during the course of the interval corresponding to the highest frequency of the signal under analysis.

Over standard telephone channels the frequency range of A.F is from 300Hz to 3400Hz. For this application the sampling rate taken is 8000 samples per second. This is an international standard.

Procedure

1. Connections are made as per the circuit diagram
2. Apply the input signal with a frequency of 1KHz using a function generator.
3. Sampling clock frequency which is variable of 500Hz to 5KHz should be connected across the terminals which is indicated.
4. Now observe the sampling output of the circuit at the o/p.
5. By using the capacitors provided on the trainer, reconstruct the signal and verify it with the given input.
6. Reconstructed signal voltage will be depends on capacitor value.
7. Vary the sampling frequency and study the change in reconstructed signal.

Observation $f_s < 2f_m$:-

Message signal :-

Amplitude = 1×2V = 2V

Time period = 1×50 μs

Frequency = 20KHZ

clock signal :-

Amplitude = 1.2×2V = 2.4V

Time period = 0.8×1ms

Frequency = 1.25 KHZ

Sample output :-

Amplitude = 2×2ms

Time period = 2×1V = 2V

Frequency = 250HZ

Demodulated signal :-

Amplitude = 1.2×5.6V

Time period = 3×1ms

Frequency = 333.3Hz

$f_s > 2f_m$:-

Message signal :-

Amplitude = 1×2V = 2V

Time period = 1×50 μs

Frequency = 20KHz

clock signal :-

Amplitude = 1.2×2V = 2.4V

Time period = 0.8×1ms

Frequency = 1.25KHz

Sample output:-

Amplitude = 1.8 × 1V

Time period = 1.2 × 1ms

Frequency = 833.3HZ

Demodulated signal:-

Amplitude = 0.5 × 5V = 2.5V

Time period = 1.2 × 1mS

Frequency = 833.3HZ

$f_s = 2f_m$:-

Sample output:-

Amplitude = 2 × 1V = 2V

Time period = 3 × 0.5mS
1.5 × 10^{-3}S

Frequency = 666.66Hz

Demodulated signal:-

Amplitude = 1.6 × 1V = 1.6V

Time period = 3 × 0.5mS = 1.5 × 10

Frequency = 666.66Hz

Result:- Hence conducted the sampling Theorem and obtained the corresponding waveforms.

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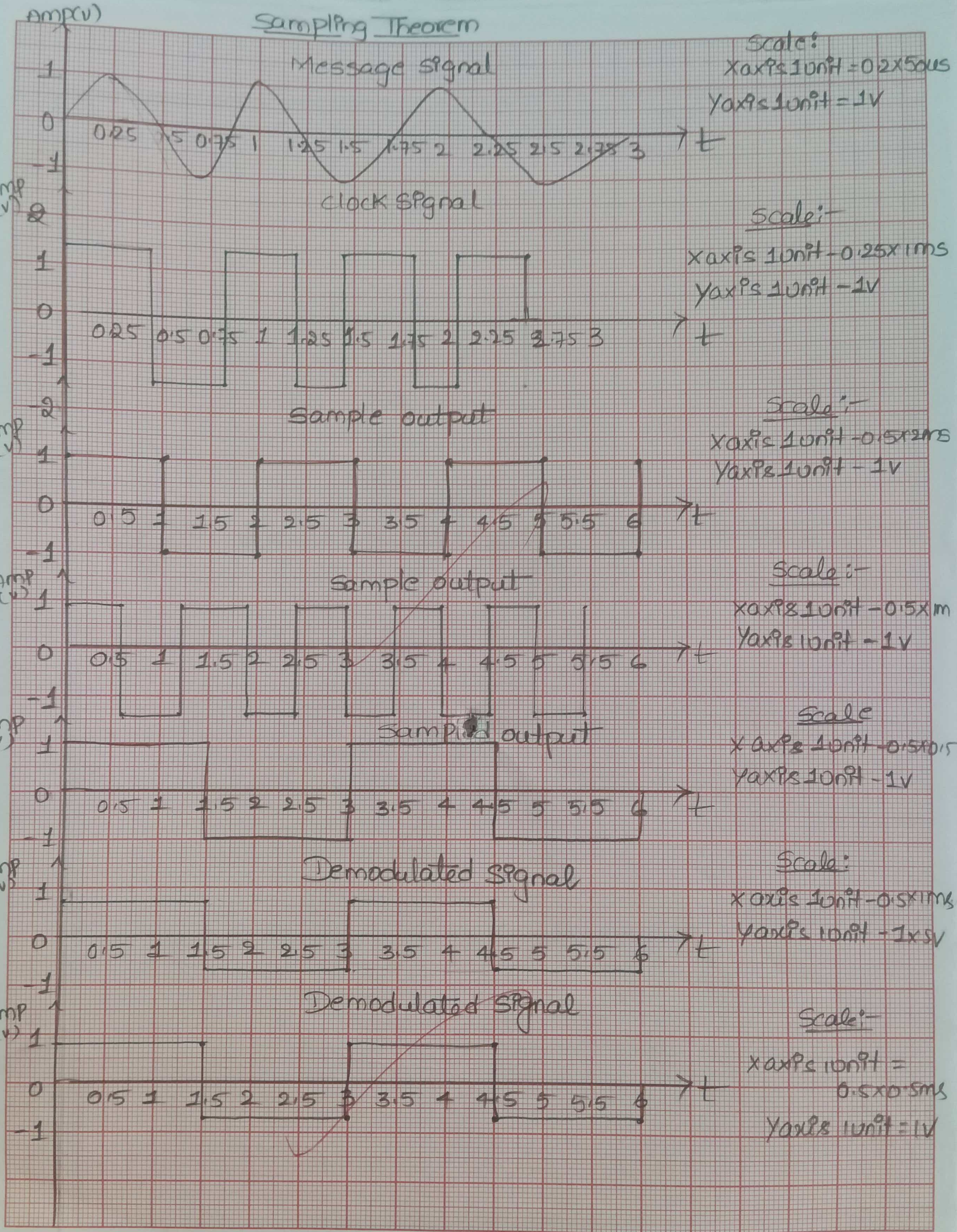
M.A 6/3/23

Sampling Theorem



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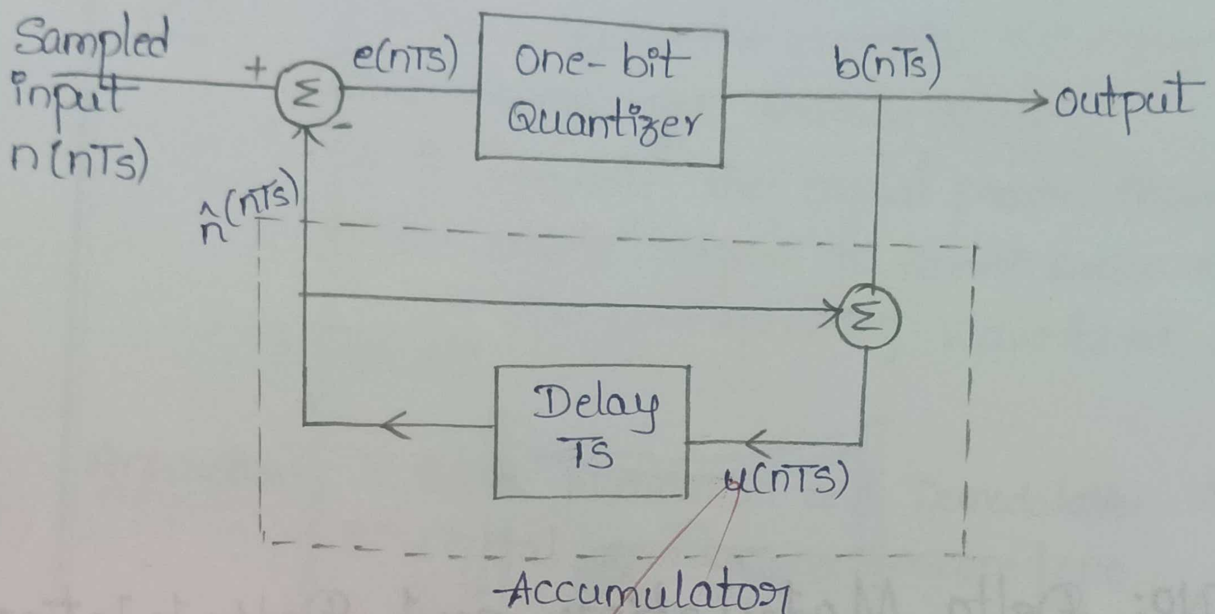
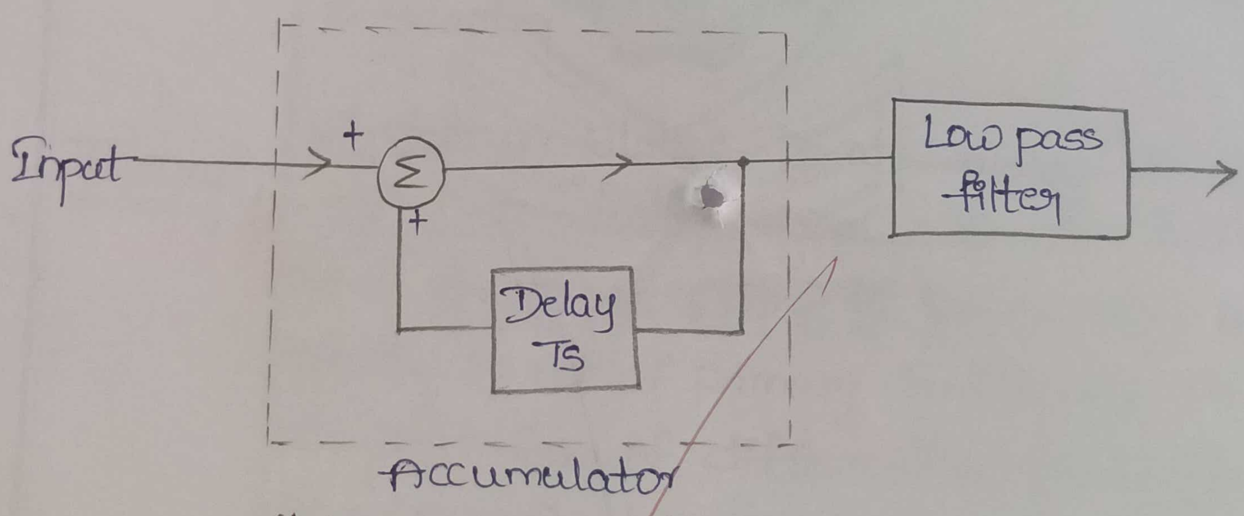
Expt No: Delta Modulation and DeModulation
(02)

Block diagrams:-



(a) Transmitter (DM)



(b) Receiver (DM)

EXPT NO (02)	Delta Modulation and Demodulation	Date 06/03/23

Aim:-

1. To accquire the practical knowledge of delta modulation and demodulation.
2. To calculate the signal power, Quantization Noise power, signal to Quantization Noise power.
3. plot the corresponding waveforms on the graph sheets.

Apparatus:-

1. Delta Modulation and Demodulation kit
2. Digital storage oscilloscope | CRO
3. CRO probes
4. patch chords
5. Adapter

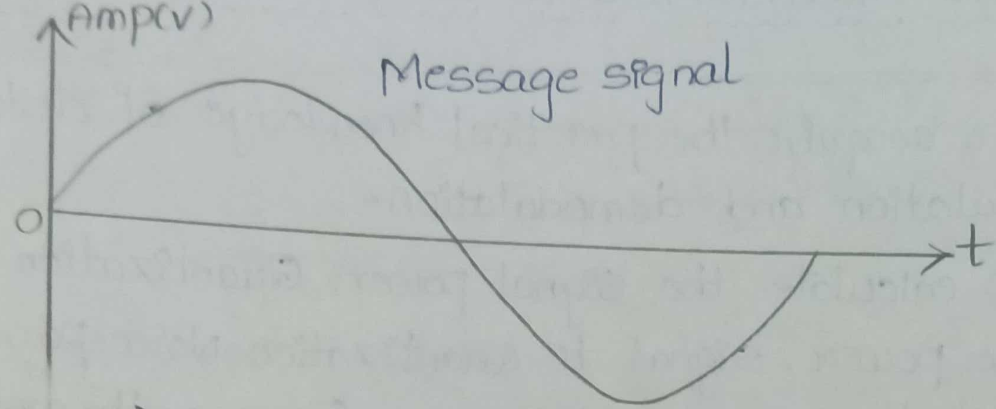
Theory:-

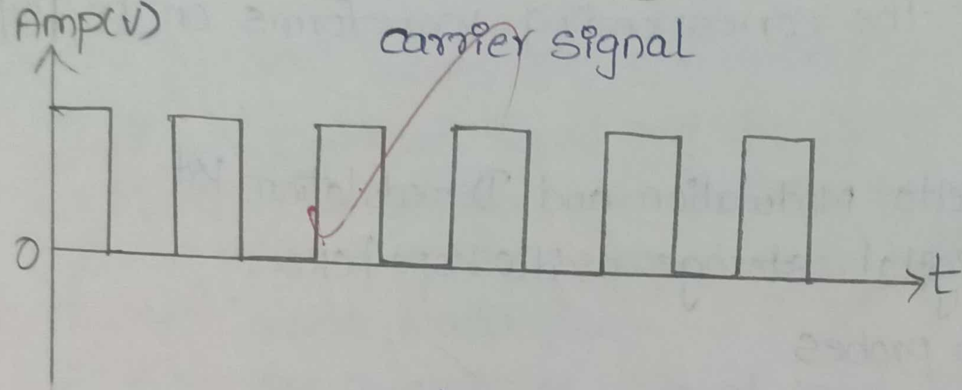
A deltamodulation is an analog-to-digital and digital-to-analog signal conversion technique used for transmission of information, where quality is not of primary importance. DM is the simplest form of differential pulse code modulation (DPCM) where the difference between sucessive samples is encoded into n-bit data streams.

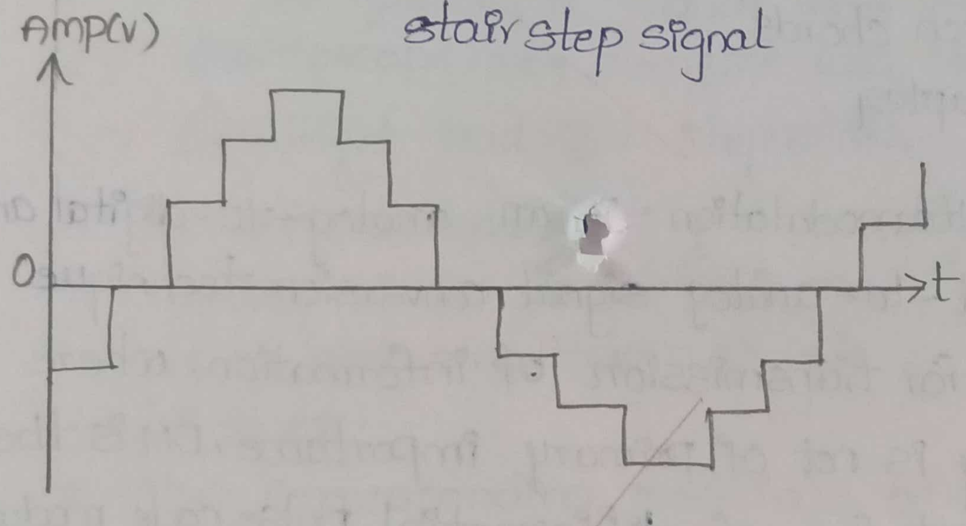
The delta Modulation includes a one-bit quantizer & a delay circuit along with two summer circuits. The output of delta modulator will be a staircase approximated wave form. The step size of this wave

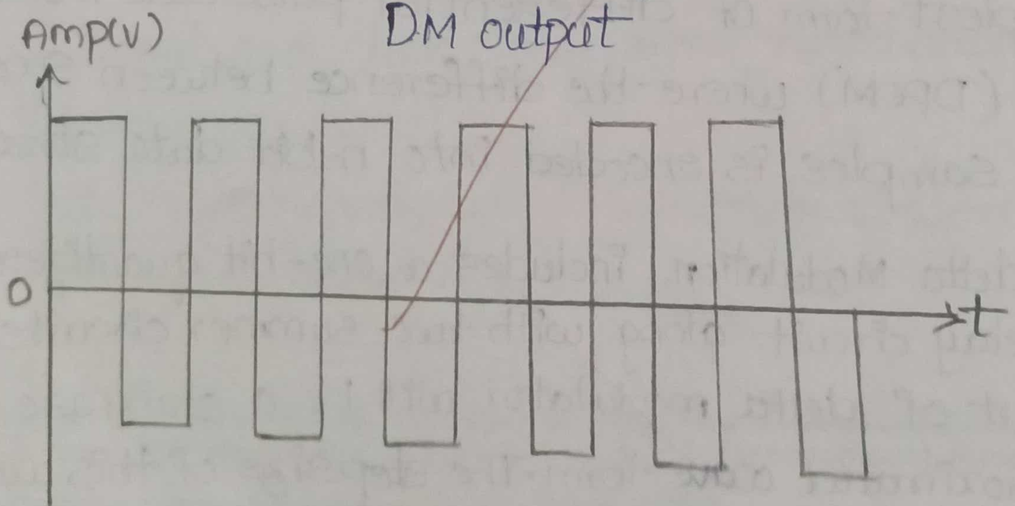
4C5

Expected waveforms:-







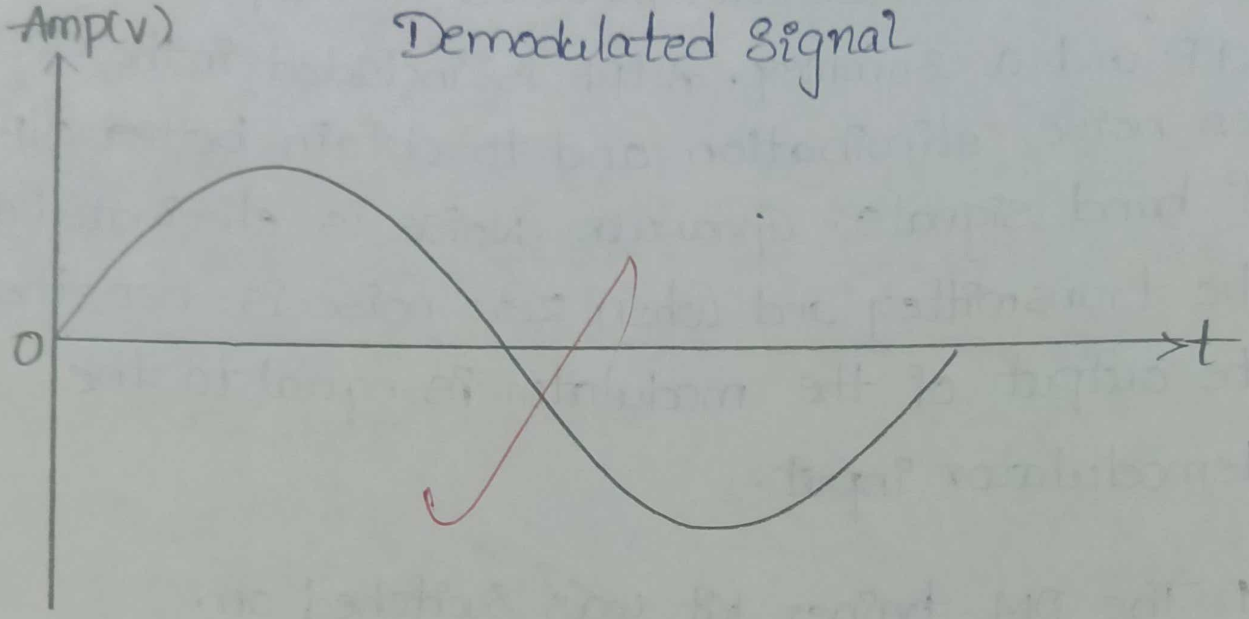


form is delta(Δ).
The delta demodulator includes a delay circuit a LPF and a summer. A LPF is included in the ckt. For noise elimination and to obtain better o/p of band signals. Granular Noise is eliminated at the transmitter and when zero noise is seen, then the output of the modulator is equal to the demodulator input.

Procedure:

1. The DM trainer kit was switched on.
2. The Modulated signal and the clock signal were observed on oscilloscope and the modulating signal and the clock signal were applied as i/p to the delta modulator.
3. Then the quantized signal was observed on the oscilloscope, the stepsize was calculated. i.e., stepheight and the stepwidth.
4. The delta modulated signal was observed at the output of DM circuit and the bit duration sequence and amplitude of the DM o/p were noted down.
5. The corresponding readings of modulating signal and clock signal were noted down (amplitude Frequency time).
6. The corresponding waveforms were plotted on graph sheet.

Demodulated Signal



Observations:-

Modulating signal:

Amplitude = 1 x 10V = 10V

Time period = 2 x 0.5ms = 1ms

Frequency = 1KHz

clock:-

Amplitude = 1 x 5V = 5V

Time period = 2 x 5μs = 10μs

Frequency = 200KHz

Quantized (stair case):-

stepwidth = 0.8

step height = 0.3

DM output:-

Amplitude = 2.2 x 2V = 4.4V

Time period = 2 x 0.5ms = 1ms

Frequency = 1KHz

Demodulated signal:-

Amplitude = 2 x 5V = 10V

Time period = 2 x 0.5ms = 1ms

Frequency = 1KHz

Calculation

1. step width (T_S) = 0.8 x 1ms
2. step height (δ) = 0.3 x 1V

f_m = 1KHz

Signal to Quantization Noise ratio $= \frac{3}{8\pi^2 f_m^2 T_s^2}$

$$= \frac{3}{8\pi^2(1K)^2(0.8\times 1m)^2}$$

$$= 59.36$$

Result:- Hence we conducted the experiment of delta Modulation and demodulation and obtained the corresponding wave form.

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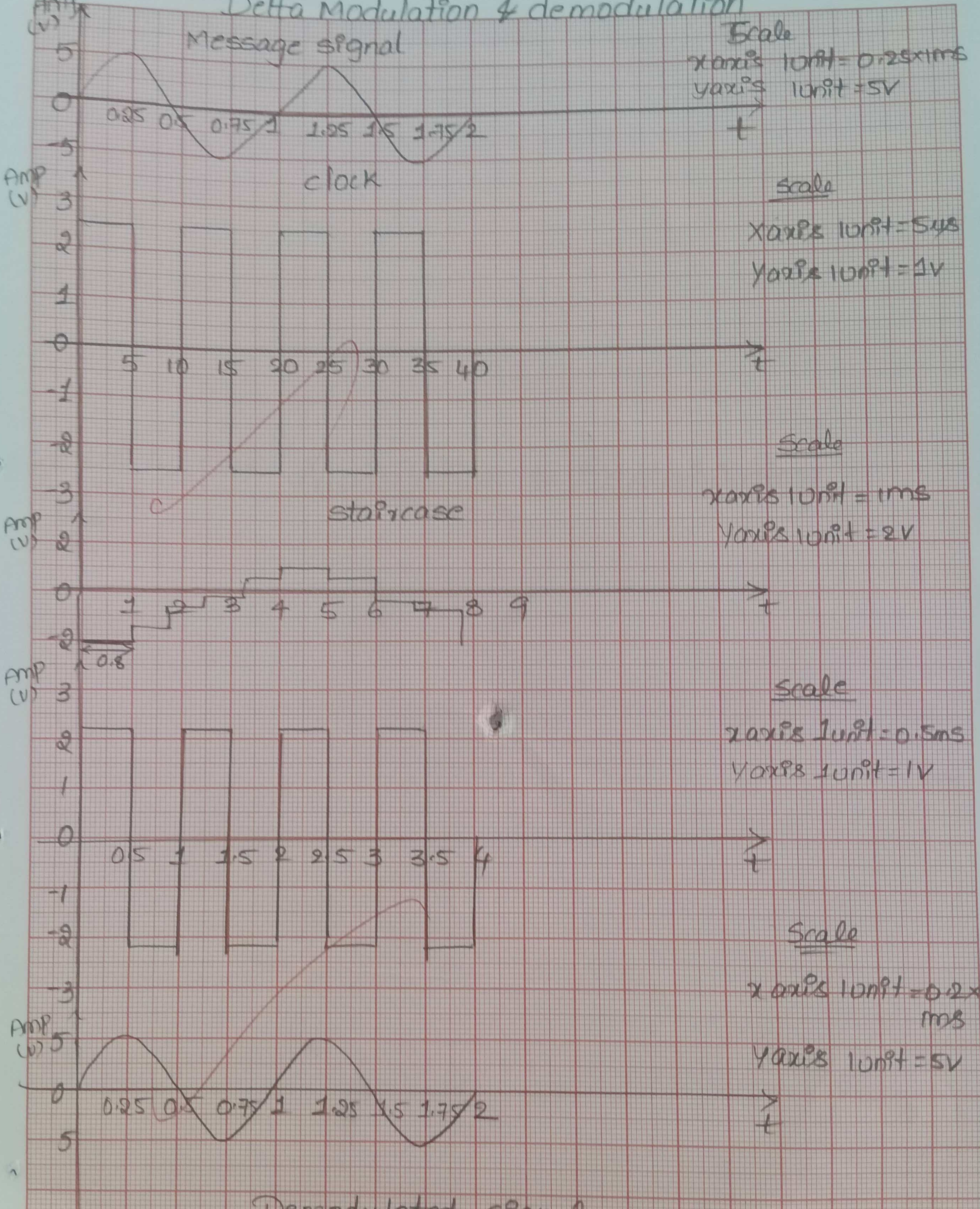
6/3/24

Delta Modulation & demodulation

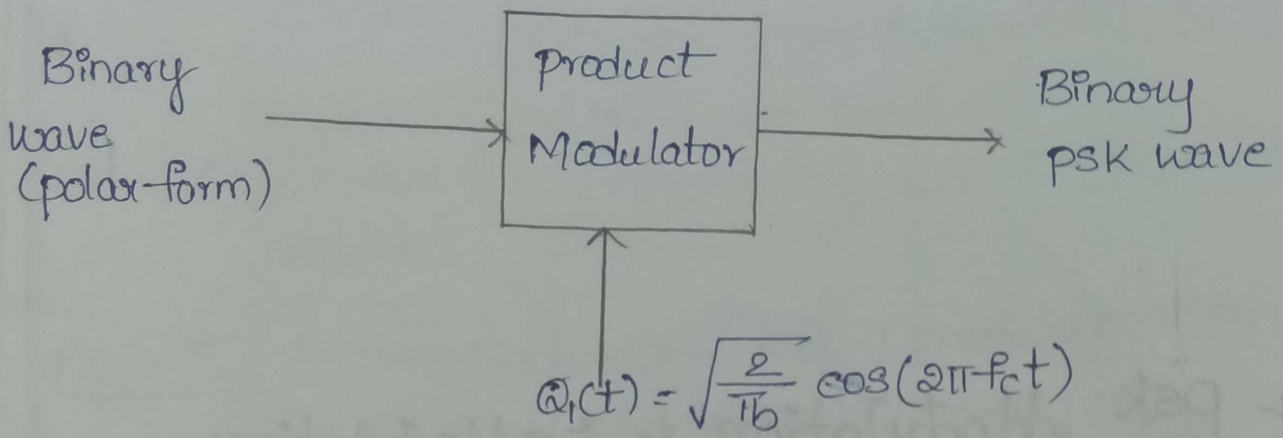


Demodulated signal

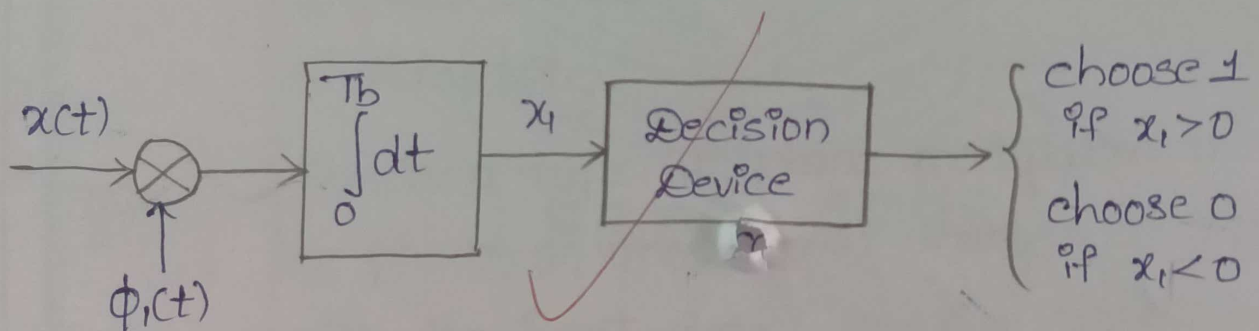
Expt No: 03 :- PSK Modulation & DeModulation

Block Diagrams:-

(a) PSK Transmitter:-



(b) PSK Receiver:-



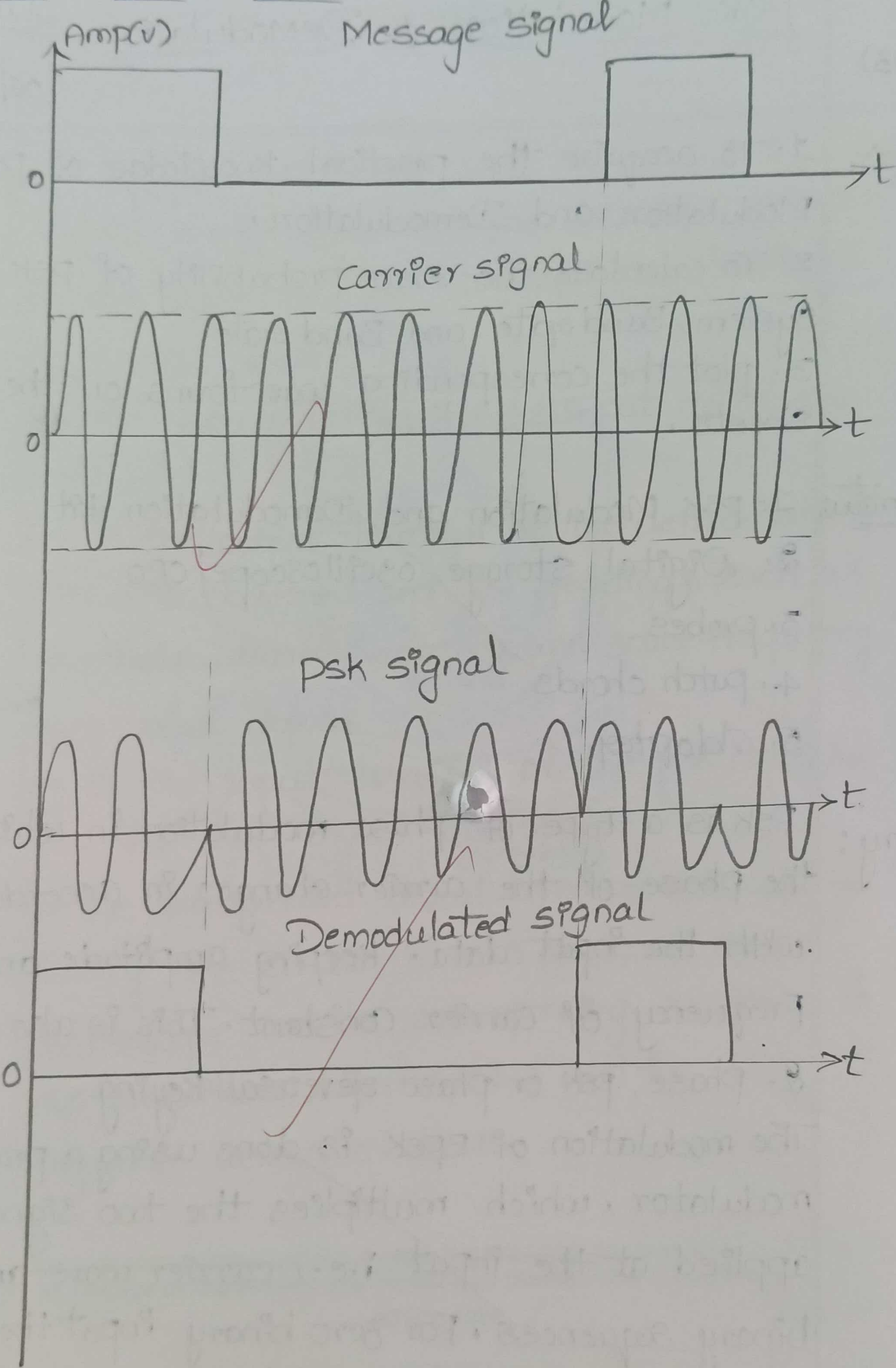
Expt No:(03)	PSK Modulation & Demodulation	Date 06/8/23

Aim:- 1. To acquire the practical knowledge of psk Modulation and Demodulation.
2. To calculate the error probability of psk system, Baud rate and Band rate.
3. plot the corresponding waveforms on the graph sheets.

Apparatus 1. psk Modulation and Demodulation kit
2. Digital storage oscilloscope/CRO
3. probes
4. patch chords
5. Adapter

Theory: Psk is a type of phase modulation in which the phase of the carrier changes in accordance with the input data. Keeping amplitude and Frequency of carrier constant. This is also called 2-phase psk or phase reversal keying.
The modulation of BPSK is done using a product modulator, which multiplies the two signals. applied at the input i.e., carrier wave and binary sequences. For zero binary input the phase will be 0 and for high input, the phase reverse

Expected Wave Forms:-



of 180°. To detect the original binary sequence of zeros and ones, we apply the noisy psk signal to a correlator. The correlator output is connected and compared with a threshold of zero volts.

Procedure:-

1. The psk trainer kit was switched on.
2. The carrier signal and the data was observed on the CRO/DSO, their corresponding readings were noted down.
3. The data was applied as input to the psk Modulator.
4. At the output terminal of the demodulator the psk was observed and its readings such as amplitude, mark frequency and space frequency were noted down.
5. At the input terminal of the psk demodulator the psk signal was applied.
6. The demodulated signal could be obtained by tuning the circuit it was observed on the oscilloscope and its corresponding readings such as amplitude, bit duration and the data sequence were noted down.

7. The error probability, baud rate and the band width of the psk signal were calculated.
8. The corresponding wave forms were plotted on graph sheets.

Data:

Observation:- Amplitude = 1x5V = 5V

Bit duration, t_b = 1 → 1x50µs = 50µs
0 → 1x 50µs = 50µs

Carrier Signal:

Amplitude = 3x2V = 6V
time period = 1.2 x50 µs = 60µs
Frequency = 16.66KHz

PSK Signal:

Amplitude = 2.9x 2V = 5.8V
time period = 1.2 x 50µs = 60µs
Frequency = 16.66 KHz

Demodulated o/p:-

Amplitude = 2x2V = 4V
Bit duration, t_b = 1 → 1x50µs = 50µs
0 → 1 x 50µs = 50µs

Result:- Hence conducted the psk modulation and demodulation and obtained the corresponding wave-forms.

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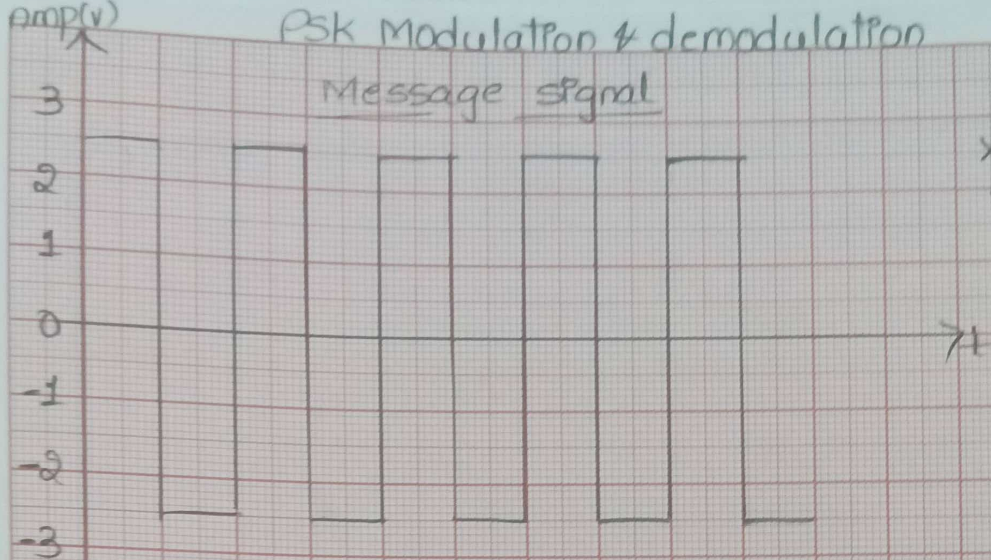
4.C5

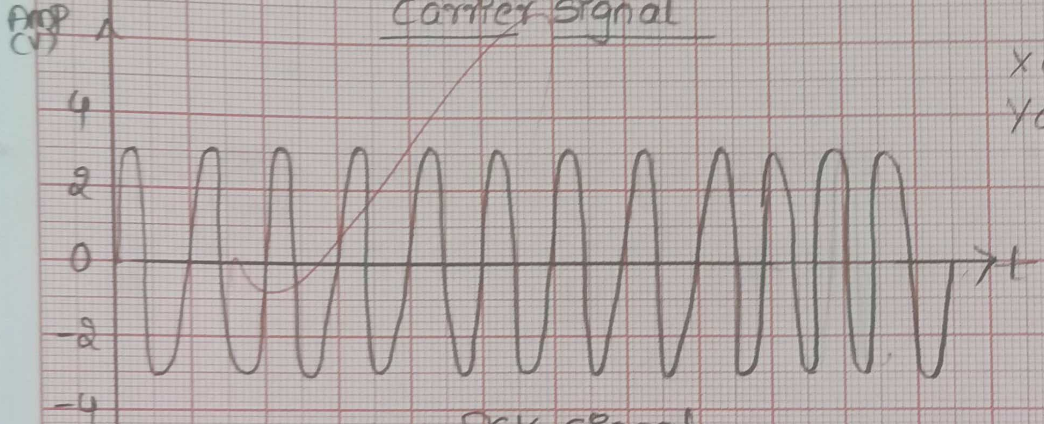
PSK Modulation & demodulation

Message signal



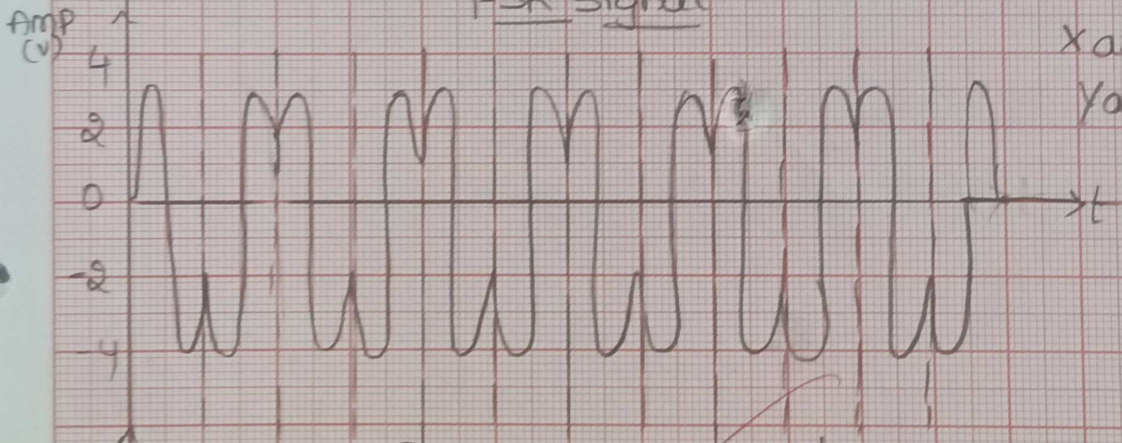
Scale:-
X axis 1 unit → 1x50 µs
Y axis 1 unit → 1V

Carrier signal



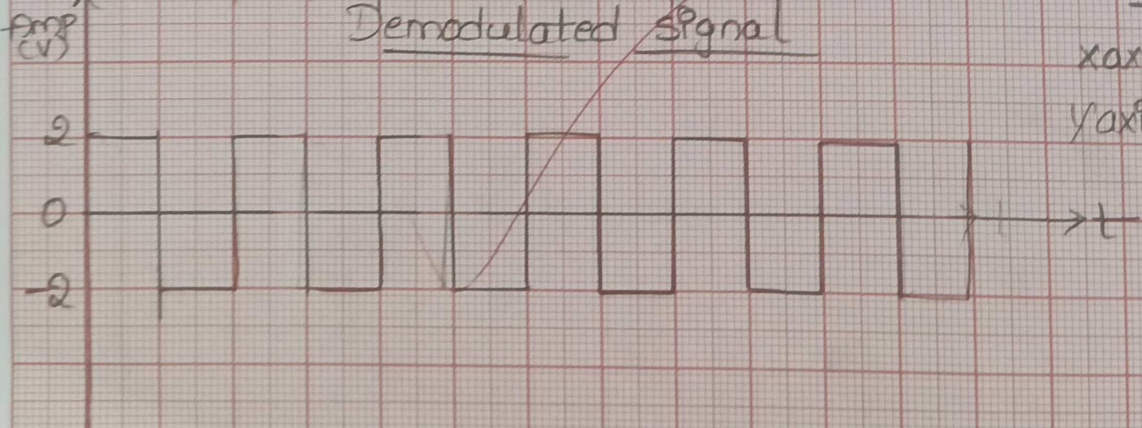
Scale:-
X axis 1 unit → 1.2x50 µs
Y axis 1 unit → 2V

PSK signal



Scale:-
X axis 1 unit → 1x50 µs
Y axis 1 unit → 2V

Demodulated signal

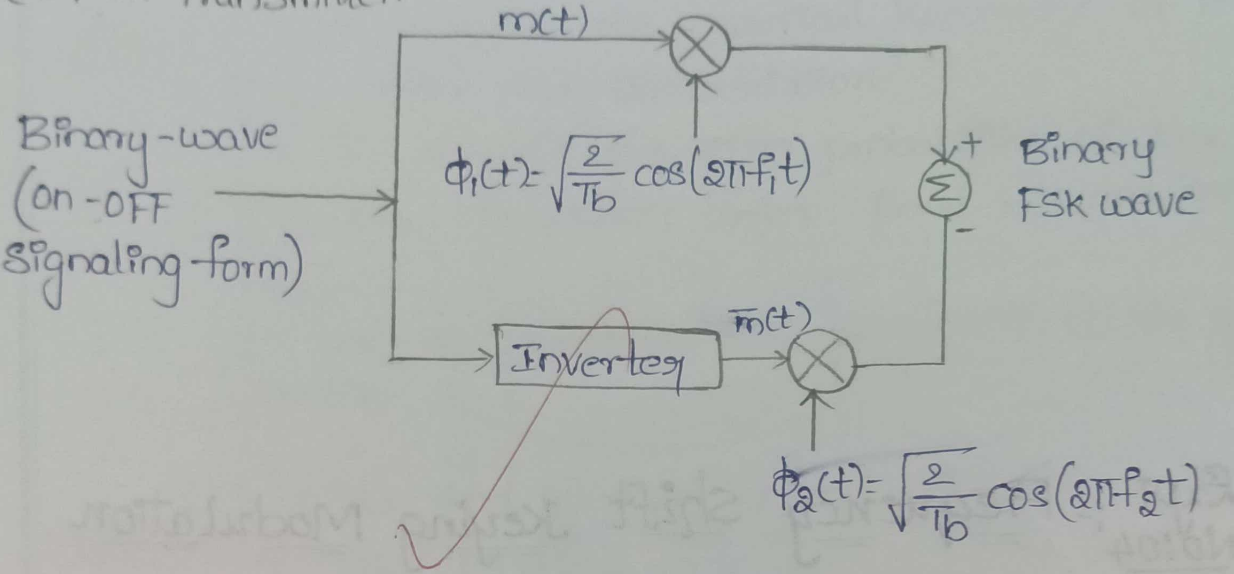


Scale:
X axis 1 unit → 1x50 µs
Y axis 1 unit → 2V

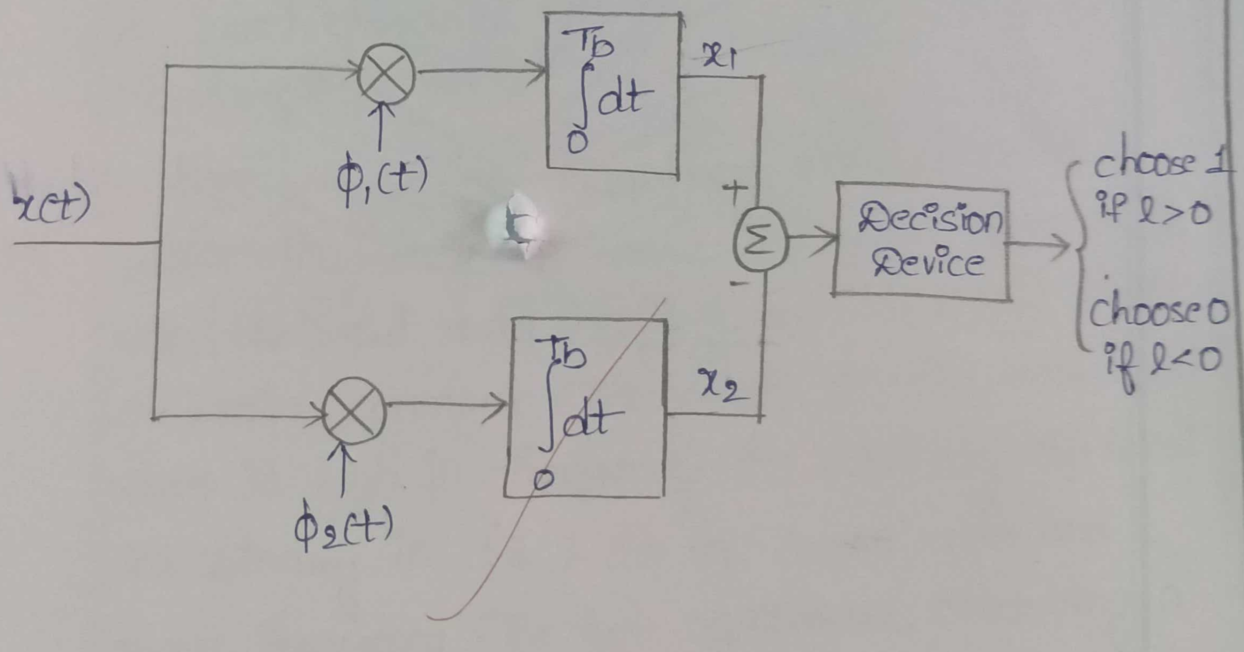
Expt No:04 :- Frequency Shift Keying Modulation and Demodulation

Block diagram:-

(a) FSK Transmitter:-



(b) FSK Receiver:-



Expt No:(4)	Frequency Shift Keying Modulation & DeModulation	Date: 06/3/23

Aim:

1. To acquire the practical knowledge of FSK modulation and demodulation.
2. To calculate the error probability of FSK system, Modulation Index, Baud rate and Band rate.
3. plot the corresponding waveforms on the graph sheets.

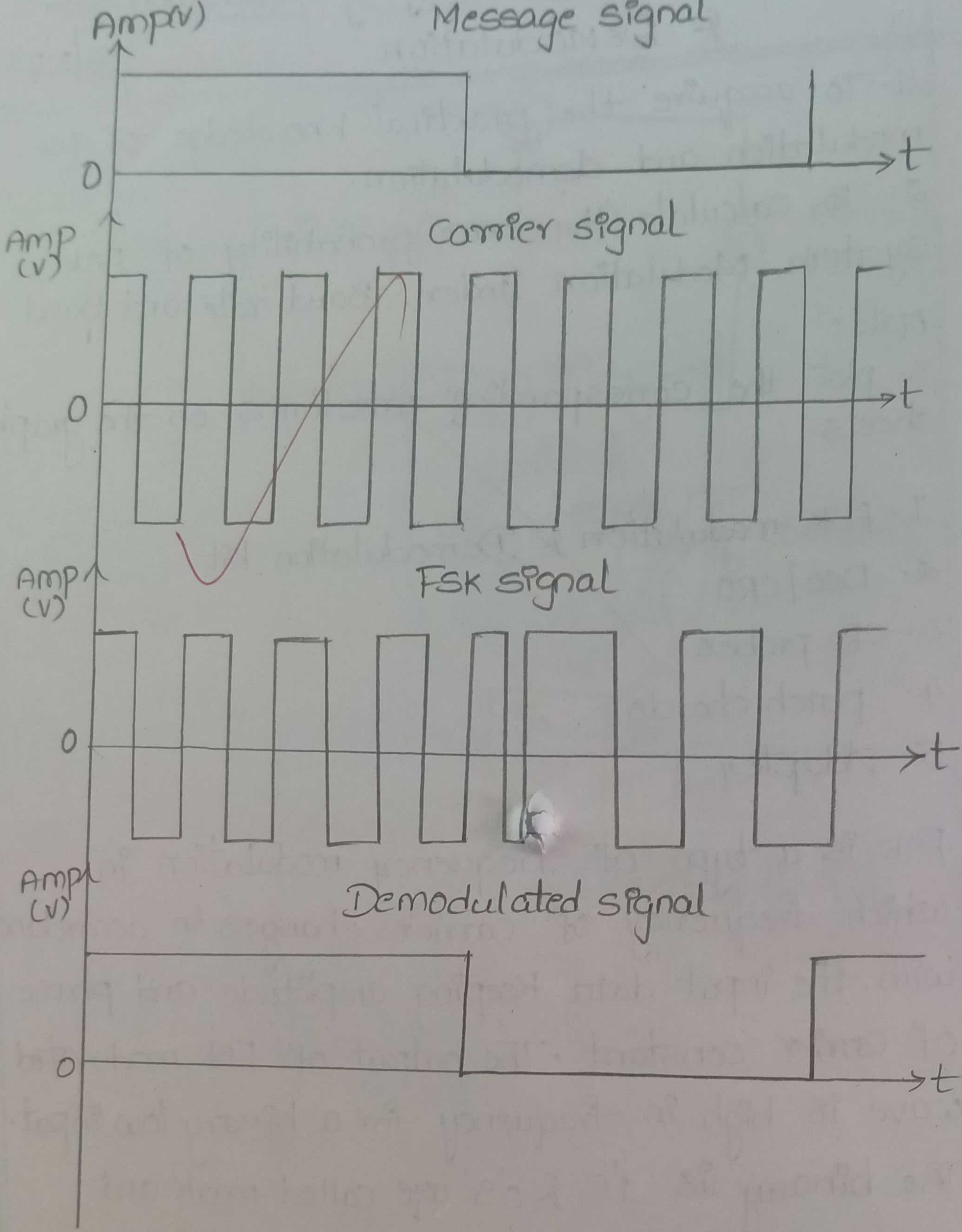
Apparatus:-

1. FSK modulation & Demodulation kit
2. DSO/CRO
3. CRO probes
4. patch chords
5. Adapter.

Theory:-

FSK is a type of frequency modulation in which frequency of carrier changes in accordance with the input data keeping amplitude and phase of carrier constant. The output of FSK modulated wave is high in frequency for a binary low input. The binary is 1'S & 0'S are called mark and space frequency. The two oscillators, producing a higher and a lower frequency, signals are connected to a switch along with an internal clock to avoid the abrupt phase discontinuous of the

Expected WaveForms:-



output waveform during transmission of the message.

In order to detect the original binary sequence given the noisy received wave x(t). we may use the receiver. It consists of two correlators with a common input which are supplied with locally generated coherant refrence signals $Q_1(t)$ and $Q_2(t)$. The correlator outputs are then subtracted, one from other and the resulting difference, Q_1 is compared with a threshold of 0 volts.

Procedure:

1. The FSK trainer kit was switched on.
2. The carrier signal and the data was observed on the CRO/DSO, their correspondings readings were noted down.
3. The data was applied as input to the FSK modulator.
4. At the output terminal of the modulator the FSK output was observed and its readings such as amplitude, frequency time period were noted down.
5. At the input terminal of FSK demodulator the FSK signal were applied.
6. The demodulated signal could be obtained by tuning the circuit. It was observed on the oscilloscope and its corresponding readings such

4CS

as amplitude, bit duration and the data sequence were noted down.

7. The Error probability, baud rate, modulation index, and the band width of the signal were calculated.

8. The corresponding wave-forms were plotted on graph sheets.

Observations:-

Data:

Amplitude = 2.2 × 2V = 4.4V

Frequency = 869.565

Time period = 2.3 × 0.5ms = 1.15×10^{-3}

Clock:

Amplitude = 2 × 1V = 2V

Frequency = 16.66×10^{-3}

Time period = 0.6 × 0.1 ms

FSK Signal:

Amplitude = 2.5 × 2V = 5V

Mark time period = 0.2 × 0.5ms = 1×10^{-4} s

Mark frequency = 10KHz

Space time period = 0.8 × 0.5ms = 4×10^{-4} s

Space frequency = 2.5×10^{-3}

Demodulated Signal:

Amplitude = 1.6x5V = 8V

Time period = 8x0.5mS

Frequency = 1×10^{3} HZ

Result:- Hence conducted the FSK Modulation & demodulation and obtained corresponding wave forms

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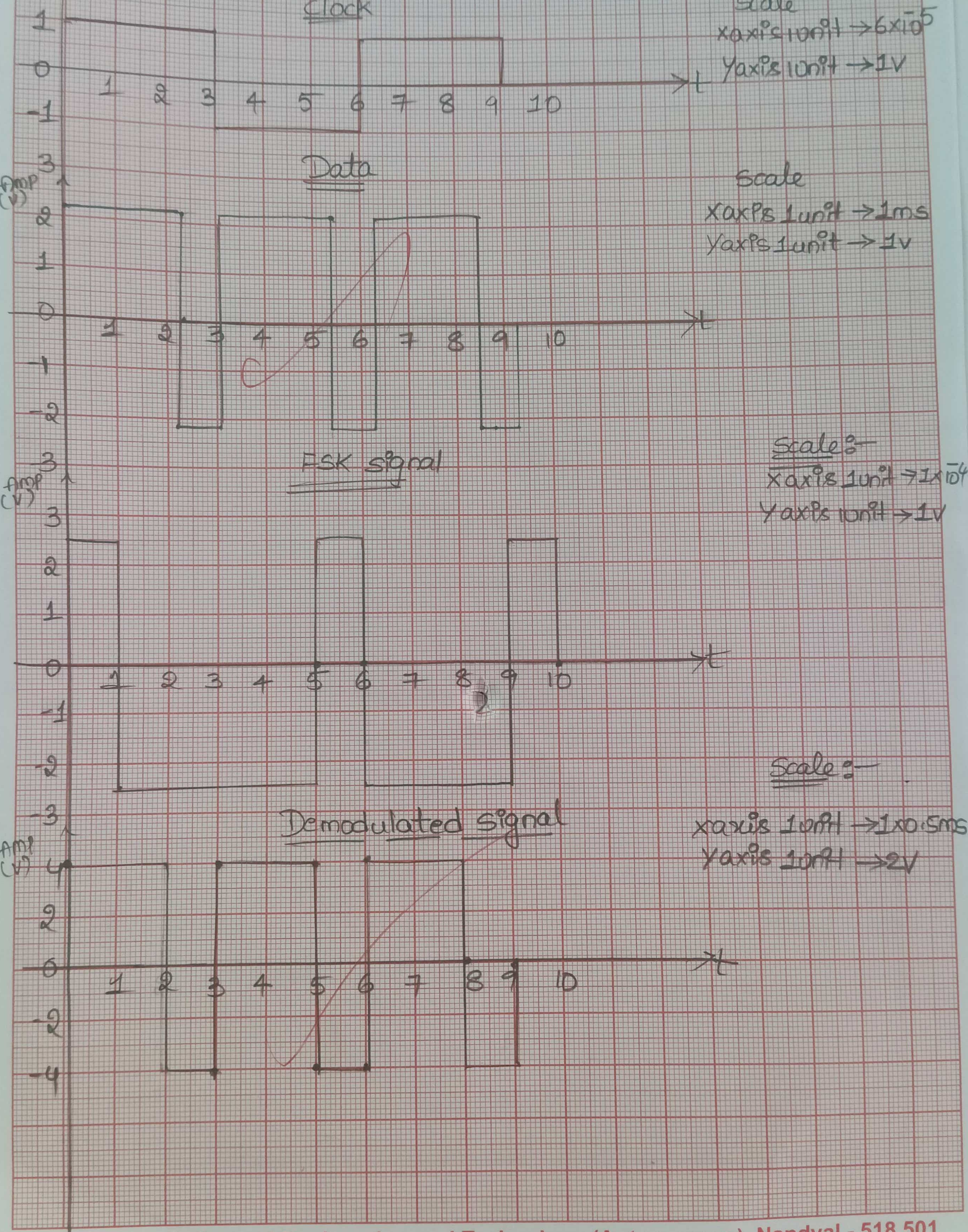
FSK Modulation & demodulation



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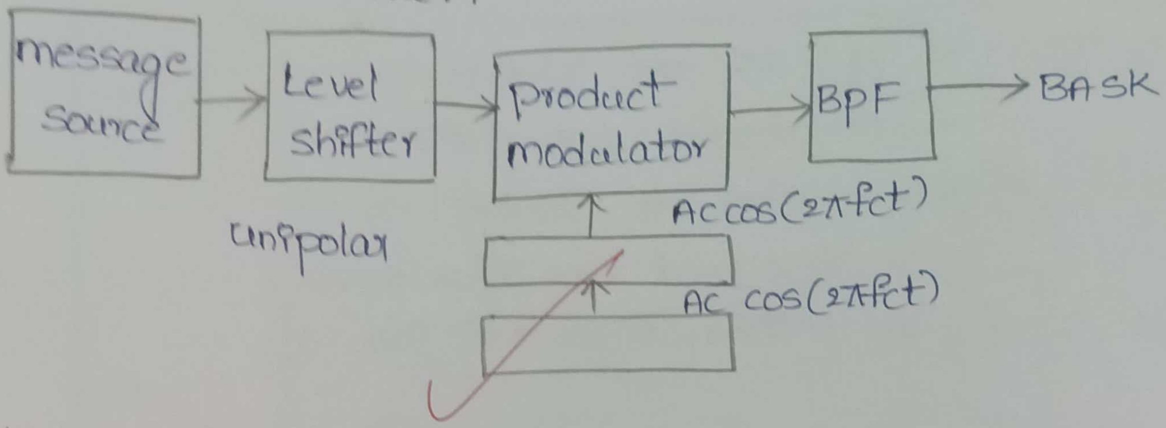
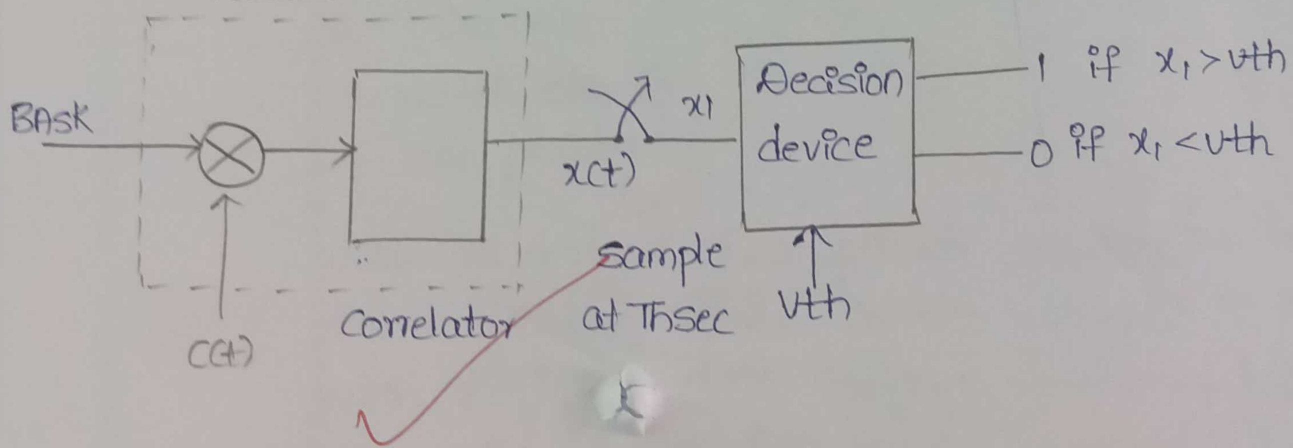
Block diagram:-

(a) ASK Transmitter:



(b) ASK Receiver:



Expt No (05)	Ask Modulation and Demodulation	Date 20/3/23

Aim:- 1. To acquire the practical knowledge of Ask modulation and demodulation
2. To calculate the error probability of Ask system Baud rate and band rate.
3. plot the corresponding wave forms on graphsheet

Apparatus
1. Ask Modulation and demodulation kit
2. DSO/CRO
3. patch chords
4. CRO probes

Theory

Ask is a type of amplitude modulation in which the amplitude of the carrier changes in accordance with the input data keeping frequency & phase at carrier input for carrier constant. The binary signal when Ask modulated gives the zero value for low input while it gives the carrier input for high input.

In the generation, the base band signal $F_b(t)$ is multiplied by any periodic signal $s(t)$. so that result is as follows.

$$x(t) = F_b(t)S(t)$$

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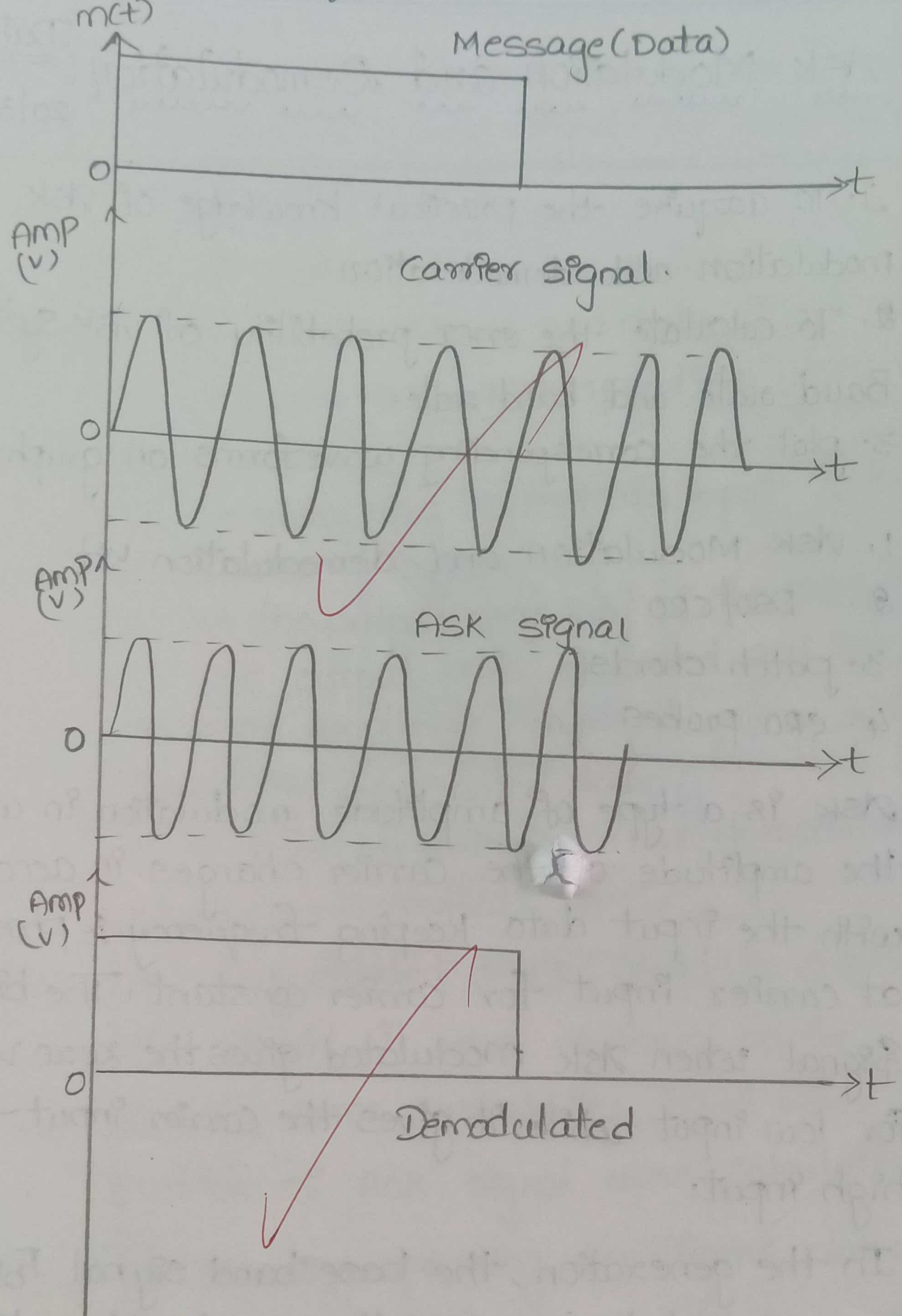
Expected waveforms:



The product x(t) contains a series of AM waves with carrier frequencies that are harmonic multiples of the fundamental frequency fc. A BPF is used to extract any of the harmonics, thus generating ASK signal. The attenuation can be recovered.

Procedure

1. ASK trainer kit was switched on.
2. The carrier signal and data signal was observed on CRO/DSO, their corresponding readings were noted down.
3. The data was applied as input to the ASK modulation.
4. At the output terminal of the modulator to the ASK output was observed and its readings such as amplitude, mark frequency and space frequency were noted down.
5. At input terminal of ASK demodulator the ASK signal was applied.
6. demodulated signal could be obtained by tuning the circuit it was observed on the oscilloscope
7. The error probability baud rate & the band width of ASK signal were calculated.
8. The corresponding waveforms plotted on the graph sheet.

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Observation Data:

frequency = 156.25 Hz

Amplitude = 1.6×2V = 3.2V

Bit duration = 3.2×2ms = 6.4ms

Carrier signal:

Amplitude = 3.6×2V = 7.2V

Time period = 2×1ms = 2ms

Frequency = 500 Hz

ASK signal:

Amplitude = 1.6×2V = 3.2V

Time period = 1.2×2ms = 2.4ms

Frequency = 416.66 Hz

Demodulated o/p:

Amplitude = 3.2V

Bit duration = 3.2×2ms = 6.4ms

Result:- Hence conducted the ASK modulation and demodulation and obtained corresponding waveforms.

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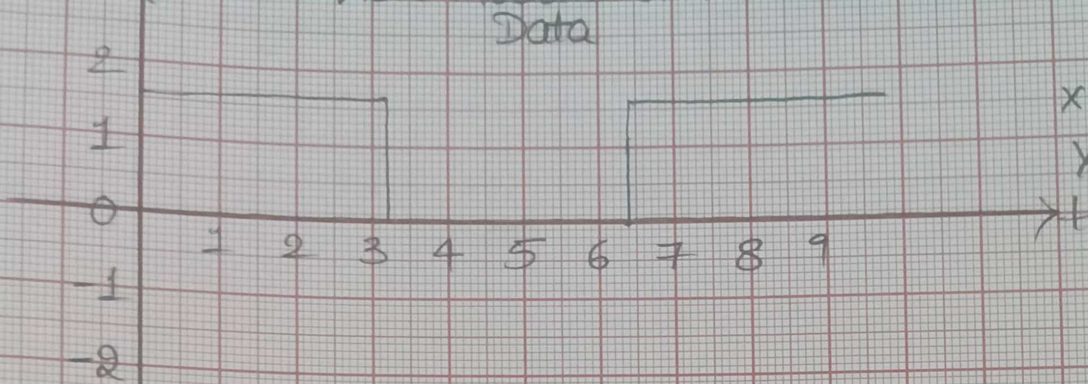
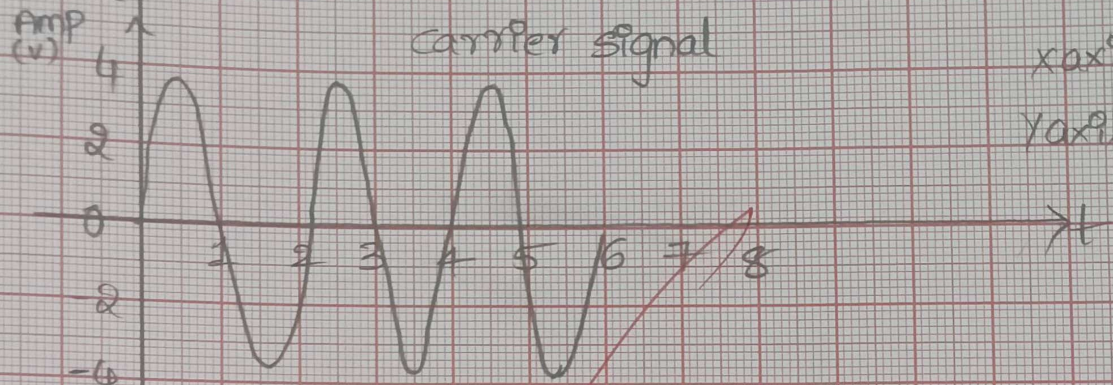
ASK Modulation & Demodulation



Scale

x axis 1unit = 1x2ms

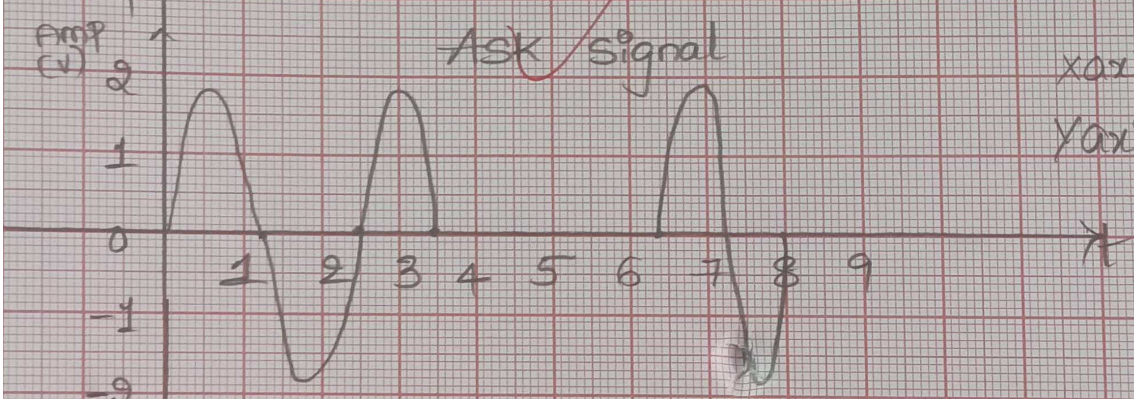
Y axis 1unit = 1v



Scale :-

x axis 1unit = 1x2ms

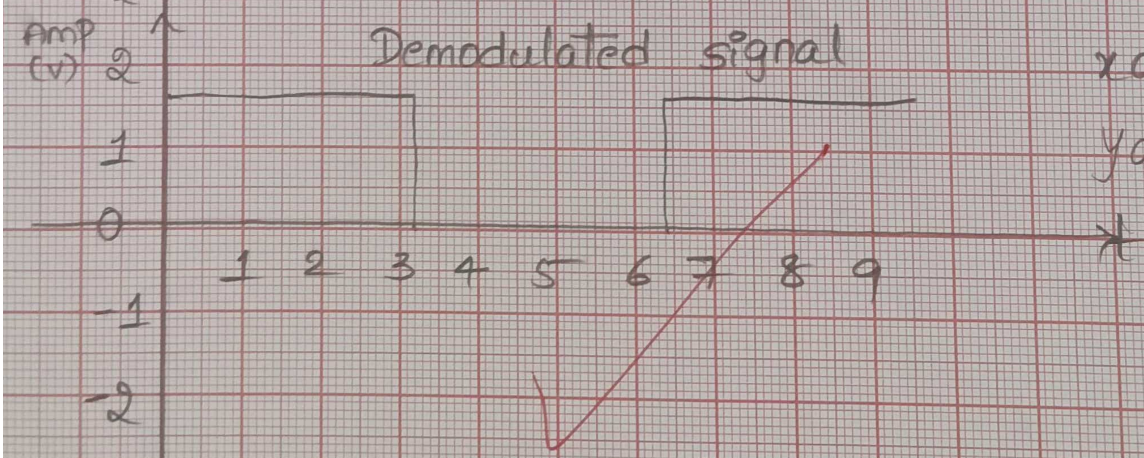
Y axis 1unit = 2v



Scale :-

x axis 1unit = 1x2ms

Y axis 1unit = 1v



Scale

x axis 1unit = 1x2ms

Y axis 1unit = 1v

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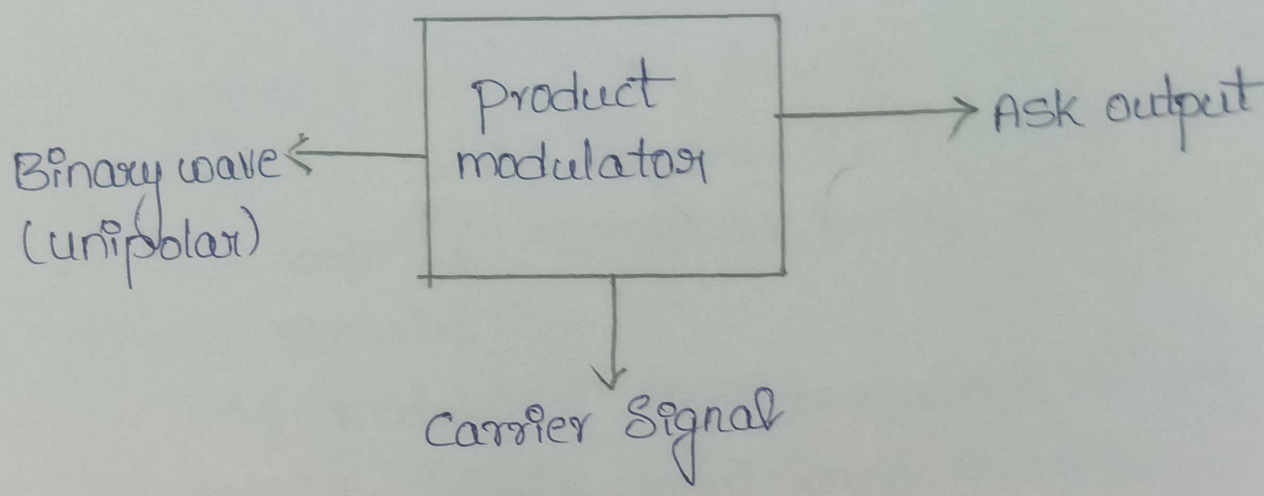
Block diagram:-

ASK Modulator:-



EXPT NO (01)	Amplitude Shift Keying	Date:- 10/4/23

Aim:- To write a MATLAB code for Amplitude shift keying.

Apparatus 1. Computer system

Software:- MATLAB 7.0.4

Theory:- Amplitude shift keying is a type of Amplitude Modulation which represents the binary data in the form of variations in the amplitude of the signal.

Any modulated signal has a high frequency carrier. The binary signal when ASK modulated gives a "zero" value for "Low" input while it gives a carrier output for high input.

The Ask modulator block diagram comprises of the carrier signal generator, the binary sequence From the message signal and the band-limited filter. The carrier generator, sends a continuous high-frequency carrier. The binary sequence from the message signal makes the unipolar input to be either High (or) Low.

Hence the output will be the carrier signal at high input. When there is low input the switch opens, allowing no voltage to appear. Hence the output will be low.

Procedure

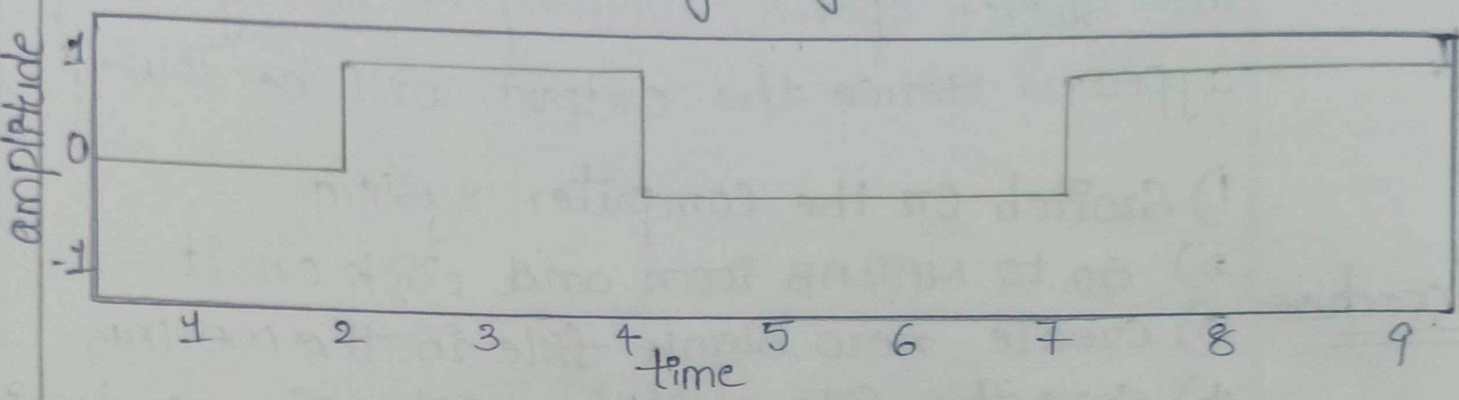
1) Switch on the computer system
2) Go to MATLAB icon and click on it
3) Create new blank file in the MATLAB
4) Save the file with .m Extension and write the MATLab code for the corresponding Experiment.
5) Then save the code & run the code.
6) if there is any errors, rectify it
7) observe the corresponding waveforms on figure window, draw it.

CODE:-

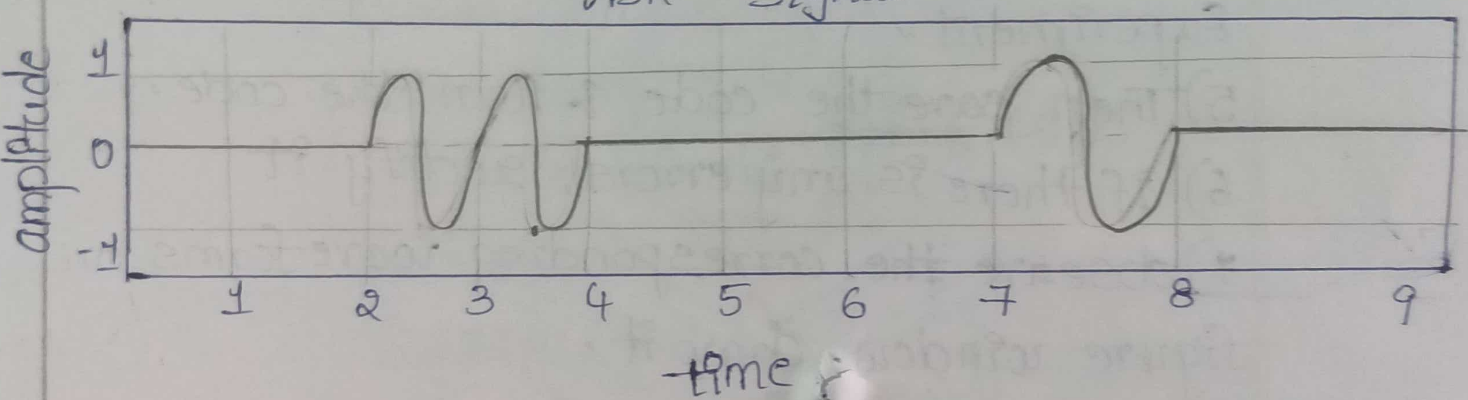
```
clc;
clear all;
close all;
n=8;
bit stream = round(rand(1,n));
fs = 1000;
t = 0:1/fs:1;
f1 = 1;
data stream = [];
time = [];
ask signal = [];
```

Waveforms:-

Message signal



ASK signal



```
for i= 1: length (bit stream)
data stream = [datastream ( bitstream (i)= =0)*
        zeros (1, length (t))+( bit stream (i)= =1)*
              ones (1, length (t))];
ask signal = [ask signal (bitstream (i)= =0)*
        zeros (1, length (t)) + (bitstream (i)==1)
        * sin (2* pi*f1 *t);
time = [time ,t]
  t = t+1;
end
subplot (2,1,1);
plot (time, datastream);
xlabel ('time');
ylabel ('amplitude');
axis ([0 time(end) -1.5 1.5]);
grid on;
subplot (2,1,2);
plot (time, ask signal);
xlabel ('time');
ylabel ('amplitude');
title ('Amplitude shift keying');
axis ([0 time (end) -1.5 1.5]);
grid on;
```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Result:- Hence MATLAB code for Amplitude shift keying was performed by using matlab software and obtained the wave forms.

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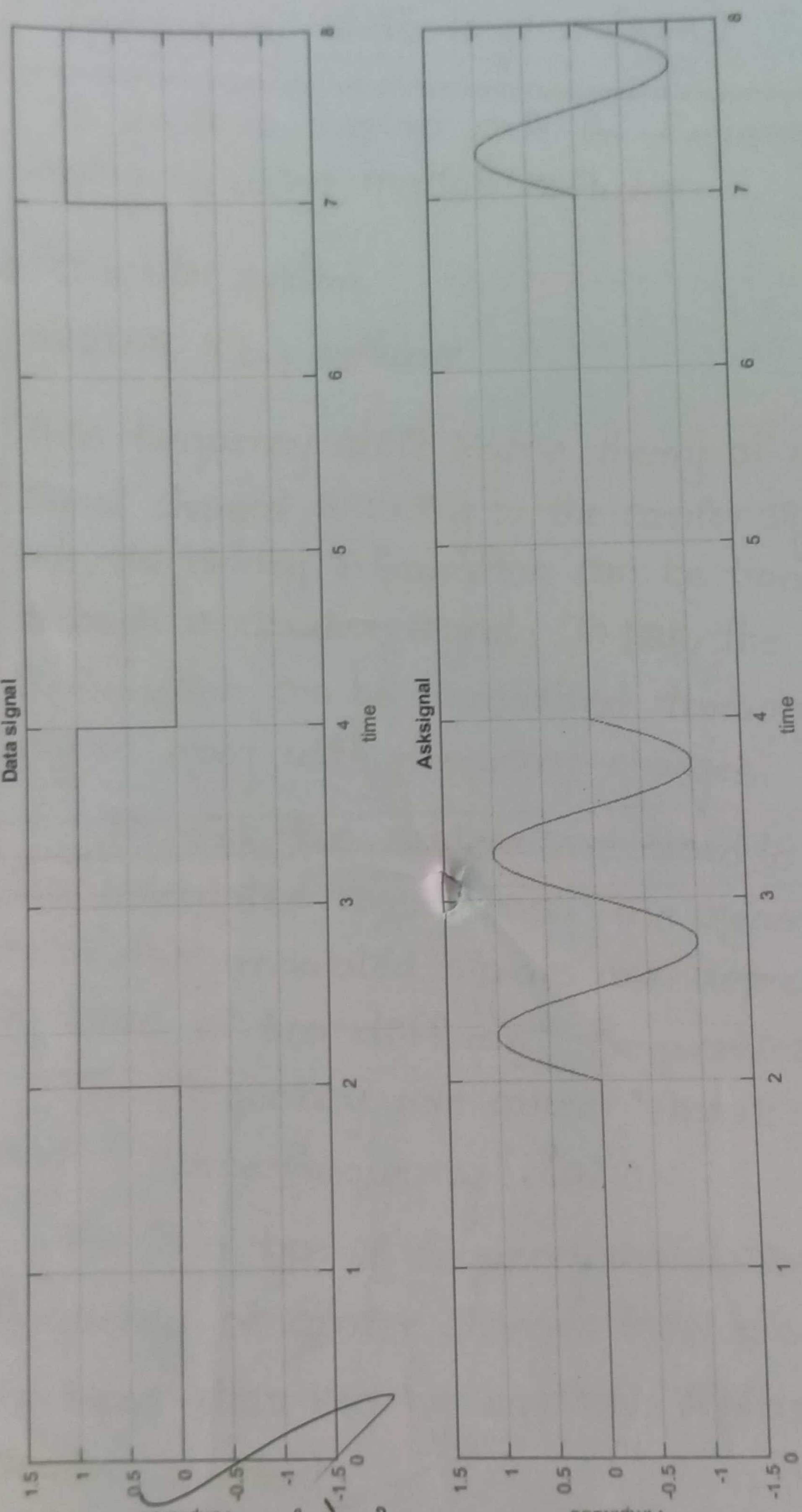
Amplitude shift Keying (ASK)



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Expt No:(02)	Frequency shift keying (FSK)	Date 17/4/23

Aim:- To write a matlab code for frequency shift keying by using matlab software.

Apparatus: computer system

Software: MATLAB 7.0.4 software

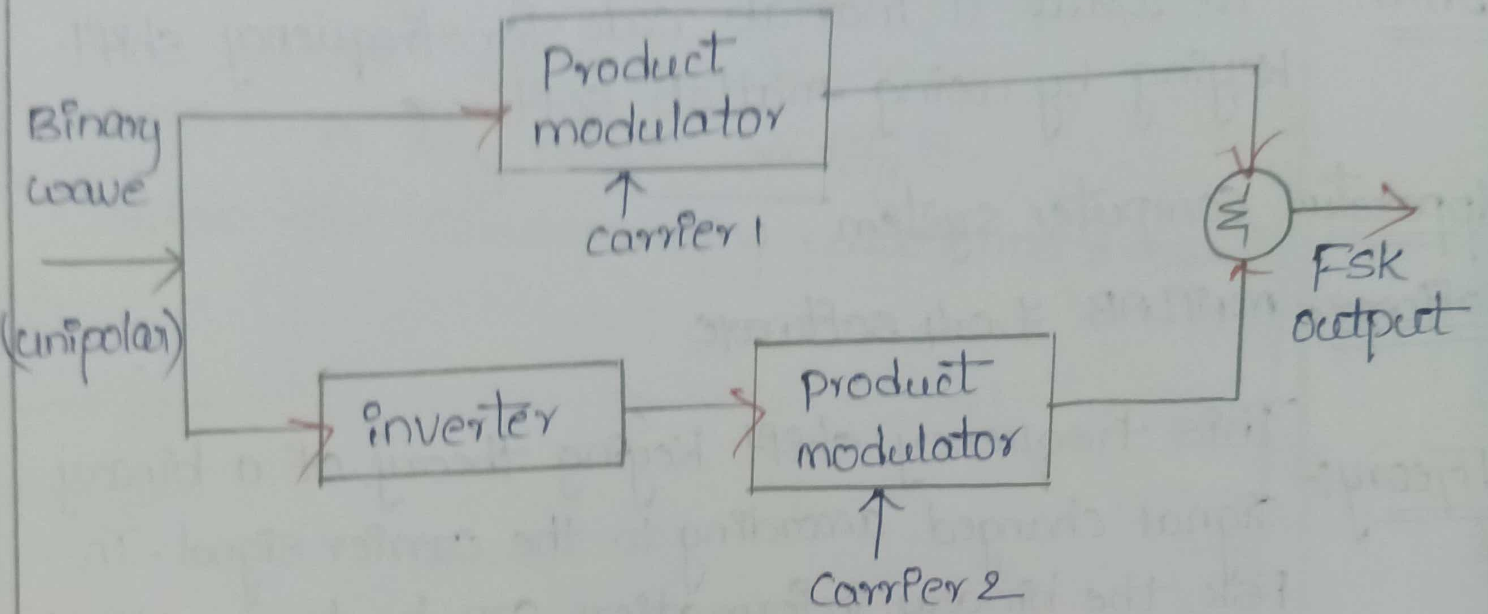
Theory:- This frequency shift keying theory of a binary signal changed according to the carrier signal. In FSK, the binary information can be transmitted through a carrier signal. In FSK, the binary information can be transmitted through a carrier signal along with frequency changes.

In fsk, two carriers are used to produce fsk modulated waveforms. The reason behind this, fsk modulated signals are represented in terms of two different frequencies.

The frequency are called "mark frequency" and "space frequency". (0)

fsk is a type of frequency modulation in which frequency of carrier changes inaccordance with the input data keeping amplitude & phase of carrier constant.

Block diagram:-



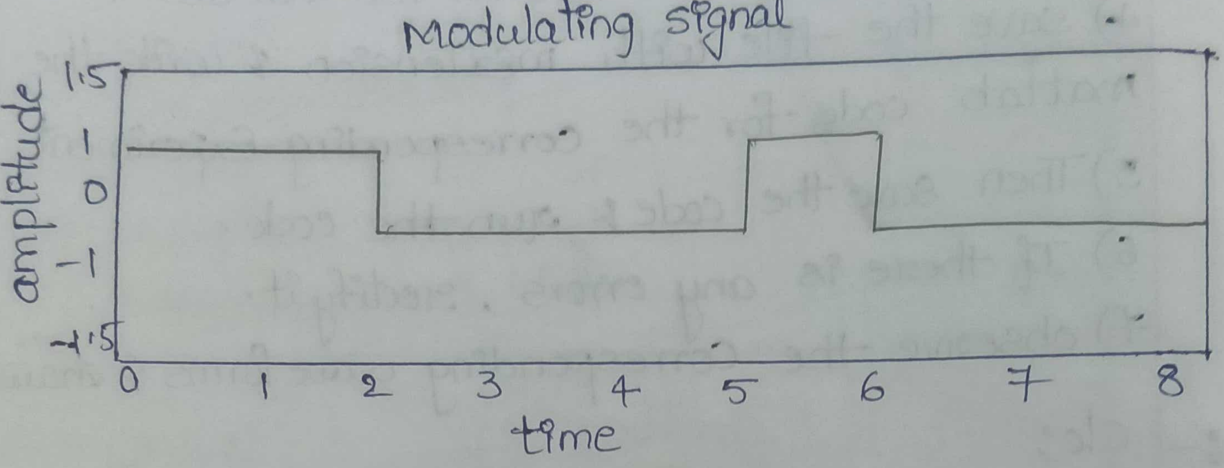
Procedure

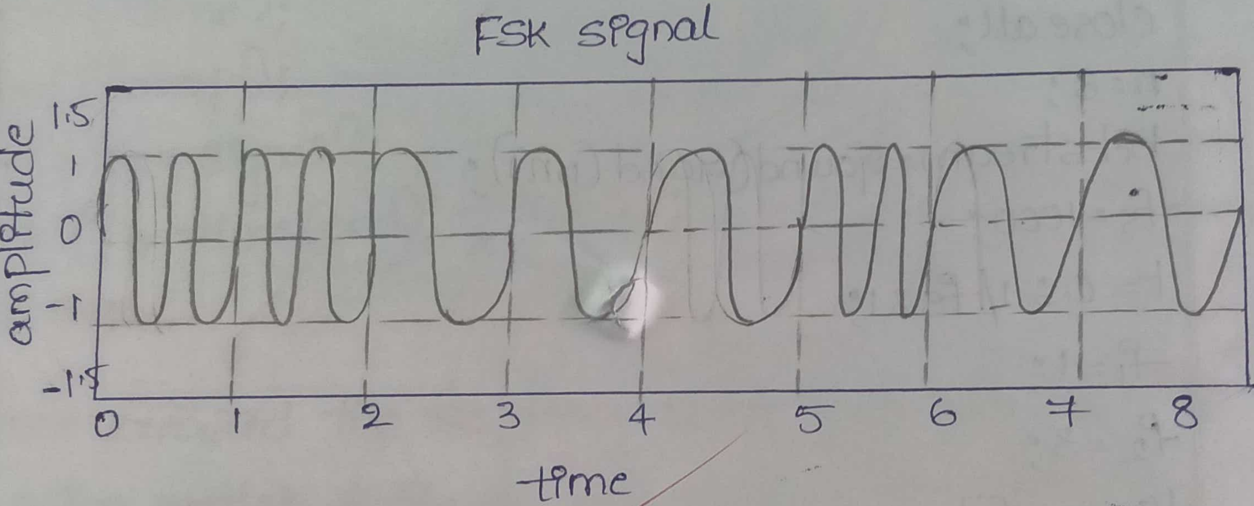
1) switch on the computer system.
2) Go to mattlab icon & click on it.
3) create new bank file on the matlab.
4) save the file with m extension & write the mattlab code for the corresponding Experiment
5) Then save the code & run the code.
6) If there is any errors, rectify it.
7) observe the corresponding waveforms & draw it

Code:-

```
clc;
clear all;
close all;
n=8;
bitstream=round(rand(1,n));
fs=1000;
t=0:1/fs:1;
f1=1;
f2=3;
time=[];
fsk signal=[];
data stream=[];
for i=1:length(bitstream);
datastream=[datastream (bitstream(i)==0)*
    zeros(1,length(t))+(bitstream(i)==1)*
        ones(1,length(t))];
```

Expected waveforms:-





```
fsk signal = [fsksignal (bitstream(i)==0)*sin(2*pi
        *f1*t)) + (bitstream(i)==1)*sin
                         (2*pi*f2*t))];
time = [time, t];
 t = t+1;
end
 subplot(2,1,1)
 plot (time, datastream);
xlabel('time');
ylabel('Amp');
axis([0 time(end) -1.5 1.5]);
grid on;
subplot(2,1,2)
plot(time, fsksignal);
xlabel('time');
ylabel('Amp');
title('Fsk signal');
axis([0 time(end) -1.5 1.5]);
grid on;
```

Result Hence executed the frequency shift keying (FSK) by using matlab software and obtained the wave-forms.

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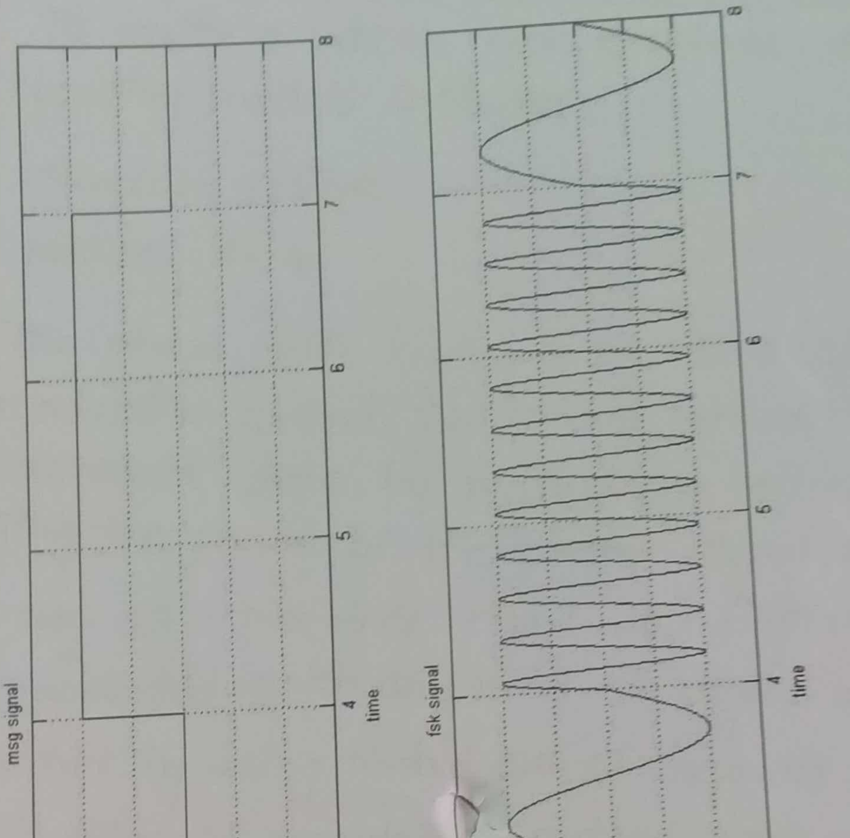
Frequency Shift Keying (FSK)



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EXPT NO (03)	Phase Shift Keying [PSK]	Date 17/4/23

Aim:- To write a MATLAB code for phase shift keying by using matlab software.

Apparatus computer system

software MATLAB 7.0.4

Theory:- The phase shift keying is one kind of digital modulation method. This kind of method is used to transmit data by modulating otherwise changing the phase of the carrier signal, which is known as a refrence signal. The digital data can be represented with any kind of digital modulation method by using limited no. of seperate signals. This kind of modulation method uses a limited no. of phase where each phase can be assigned with binary digits.

Generally, Every phase Encodes an equivalent no. of bits. Every bits pattern form the symbol that is denoted by the Exact phase.

Procedure

1) Switch on the computer system.
2) Go to matlab icon & click on it.
3) create new bank file on the matlab.
4) Save the file with .m Extension & write the

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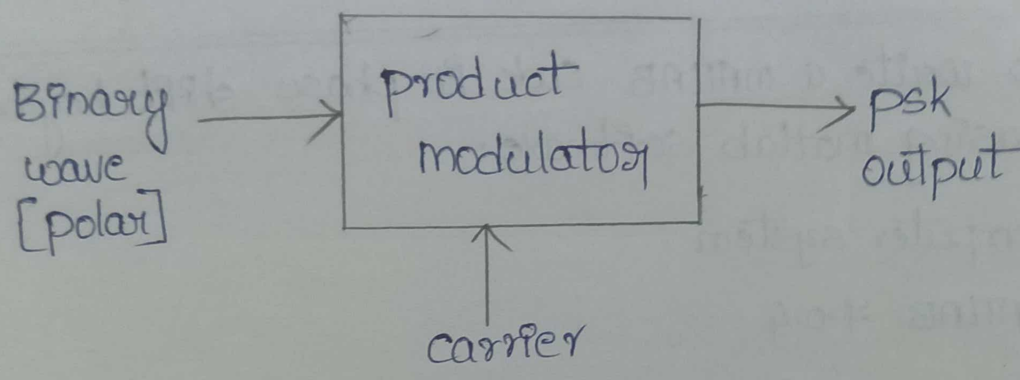
Block diagram:-



matlab code for the corresponding experiment

5) Then save the code & run the code.

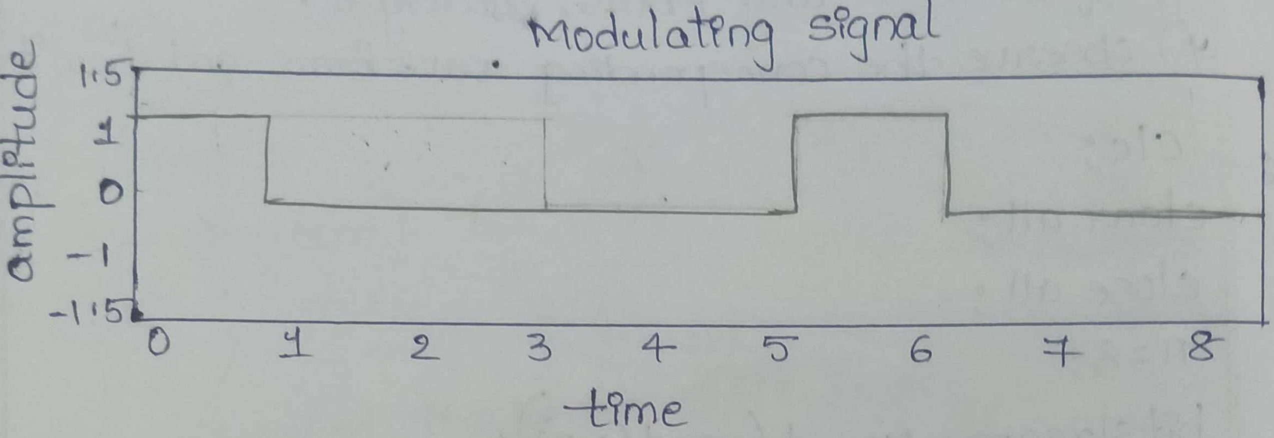
6) If there is any errors, rectify it.

7) observe the corresponding wave forms and draw it

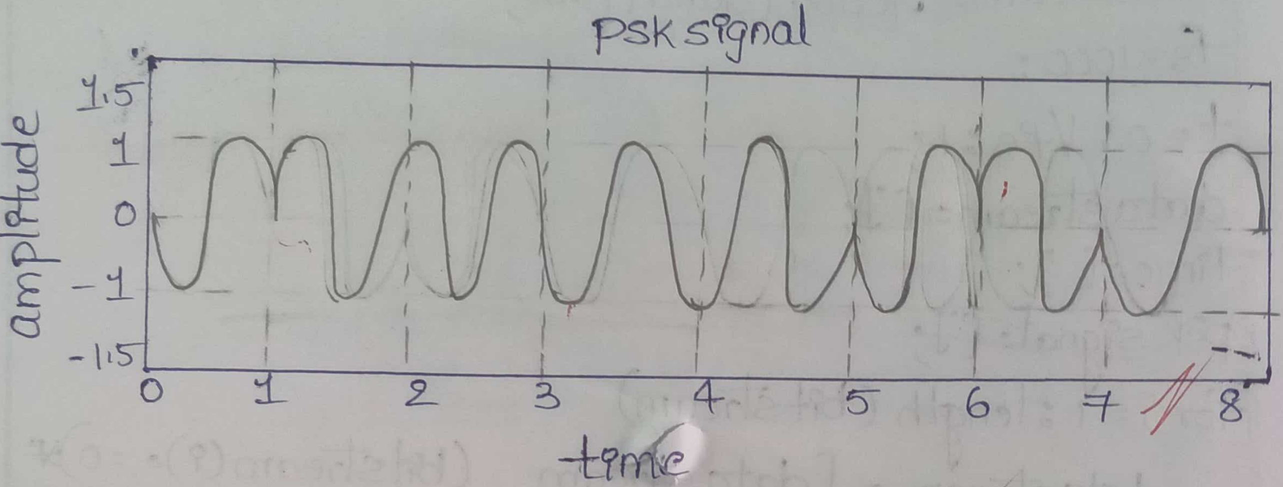
Code:-

```
clc;
clear all;
close all;
n=8;
bitstream= round (rand(1,n));
fs=1000;
t=0:1/fs:1;
datastream=[];
time=[ ];
psk signal=[];
for i=1:length (bitstream)
    datastream=[datastream (bitstream(i)==0)*
        zeros (1, length(t))+(bitstream(i)==1)*ones
                                (1, Length (t))];
    Psk signal=[psk signal ((bitstream(i)==0)*
           sin(2*pi*f*t)+(bitstream (i)==1)*
                          sin (2* pi*f * t+pi))];
    time=[time,t];
    t=t+1;
end
  Subplot(2,1,1)
  plot (time, datastream);
```

Waveforms:-



Modulating signal
amplitude
1.5
1
0
-1
-1.5
0
1
2
3
4
5
6
7
8
time



PSK signal
amplitude
1.5
1
0
-1
-1.5
0
1
2
3
4
5
6
7
8
time

```
xlabel ('time');
ylabel ('Amp');
axis ([0 time(end) -1.5 1.5]);
grid on;
subplot (2,1,2)
plot (time, psksignal);
xlabel ('time');
ylabel ('Amp');
axis ([0 time(end) -1.5 1.5]);
grid on;
```

Result:- Hence, executed the phase shift keying (psk) by using matlab software and obtained the waveforms.

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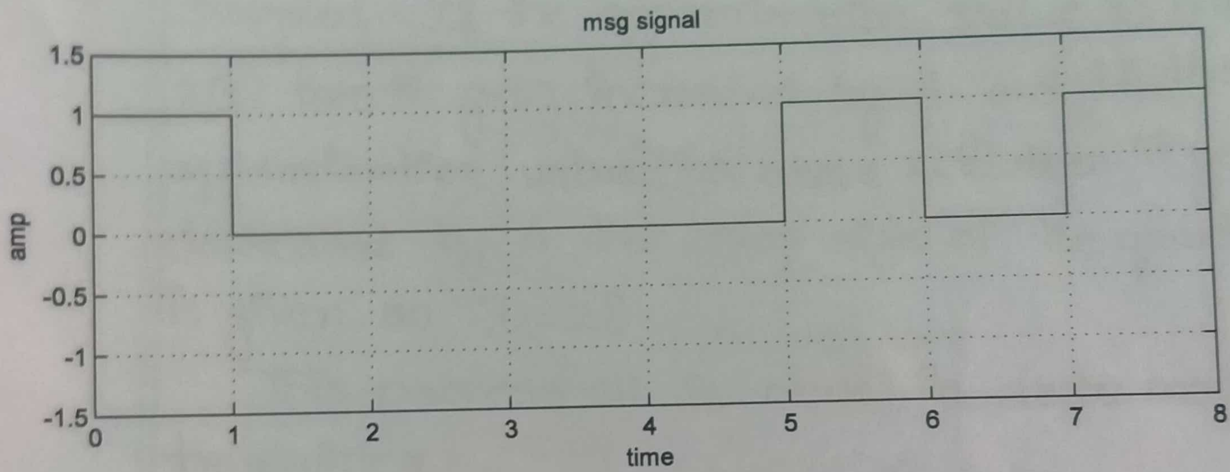
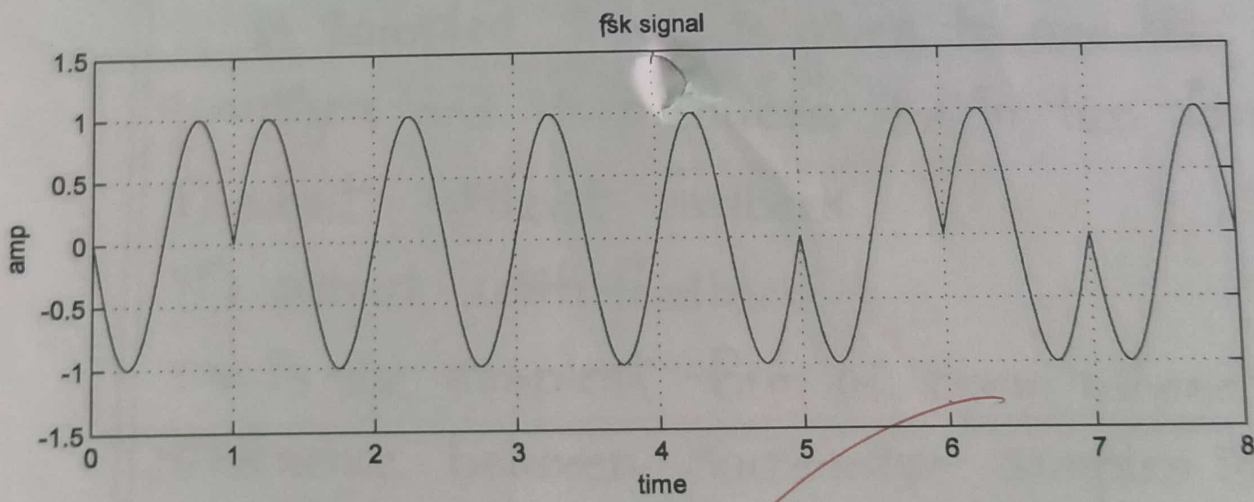
Phase shift keying (PSK)





Expt No	Delta Modulation & Demodulation	Date 24/4/23

Aim:- To write a MATLAB code for delta modulation and draw the waveforms.

Apparatus Computer system with MATLAB Software.

Theory In delta modulation the base band signal is over sampled. If the approximation value in below to x(t) then it gets increased by Δ and if the approximation value is above x(t) then it gets decreased by Δ One step size of the quantizer is given an D=2δ.

This process all is done in delta modulation transmitter.

A sampled input is given to one bit quantizer and it produces the in two forms

i) output without feedback

ii) output with feedback

DM is the simplest form of DPCM where the difference between successive samples is encoded into n-bit data streams. In delta modulation, the transmitted data are reduced to a 1-bit data stream.

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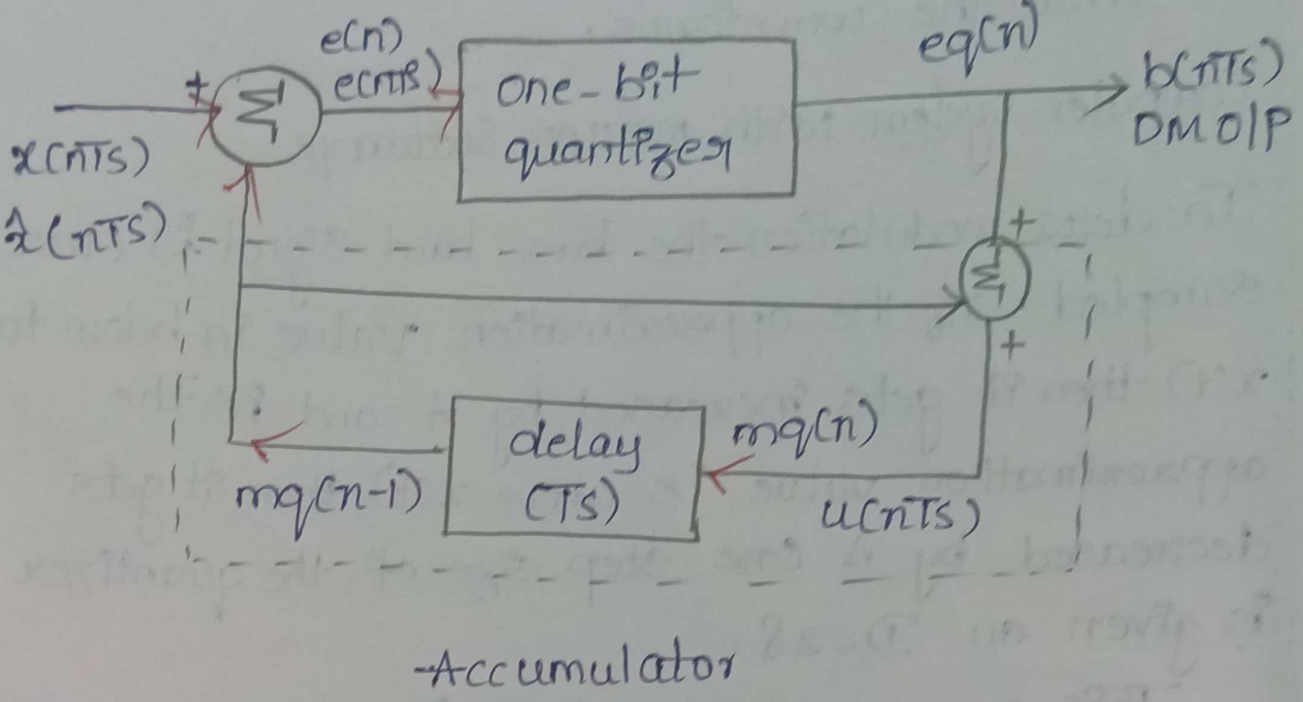
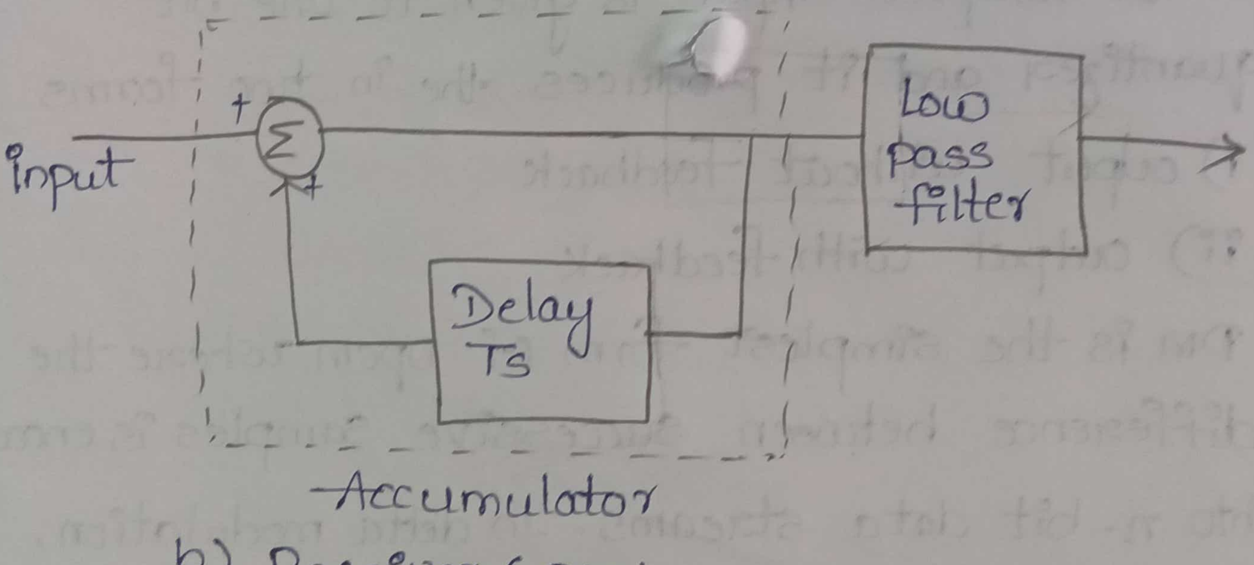
Block Diagram:-



a) Transmitter (DM)



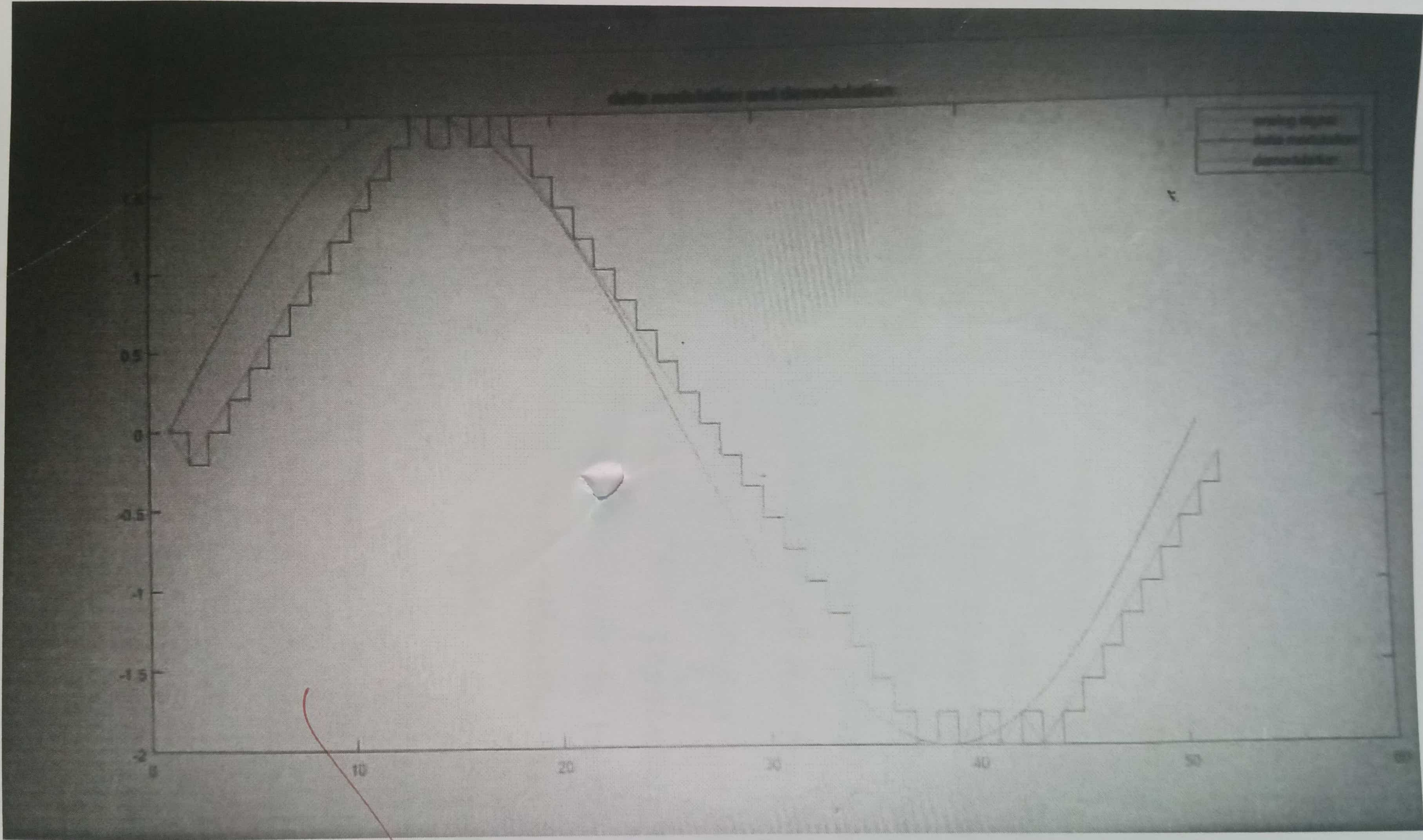
b) Receiver (DM)

Procedure

1) Switch on the computer system
2) Go to matlab icon → Go to file → select blank m-file.
3) Now Enter MATLAB code in the New file.
4) Then save the file with m Extension.
5) Now debug the code and run the code if any errors occurs rectify the error
6) observe the waveforms in figure.
7) Note down the corresponding waveforms.

Program code:-

```
clc;
clear all;
close all;
a=2;
t=0:2*pi/50:2*pi;
x=a*sin(t);
l=length(x);
plot(x,'r');
delta=0.2;
hold on;
xn=0;
for i=1:l;
    if x(i)>xn(i)
        d(i)=1;
    xn(i+1)=xn(i)+delta;
else
    d(i)=0;
    xn(i+1) = xn(i)-delta;
```


1.5
1
0.5
0
-0.5
-1
-1.5
-2
0
10
20
30
40
50
60

Expt No: (4)	Sampling Theorem	Date 24/4/23

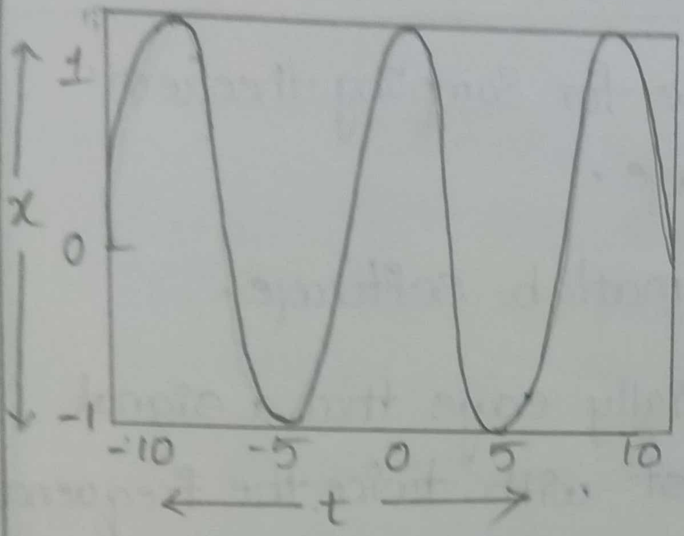
Aim:- To write a MATLAB code for Sampling theorem by using matlab software.

Apparatus: personal computer with matlab software.

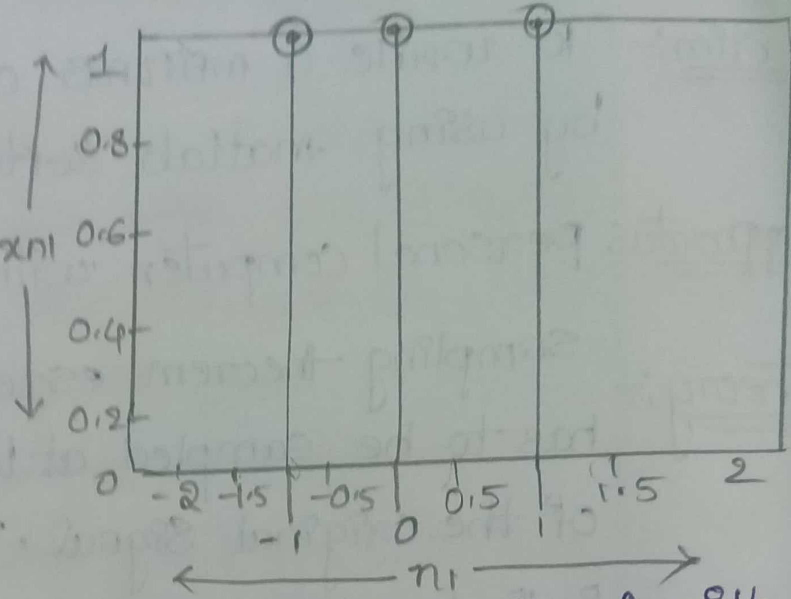
Theory:- sampling theorem essentially says that a signal has to be sampled at least with twice the frequency of the original signal. The sampling theorem indicates that a continuous signal can be properly sampled, only if it does not contain frequency components above one-half of the sampling rate.

It retains accuracy in bringing out the correct statistical information. The population tree is a huge set and it returns out to be exhausting for the actual study and estimation process.

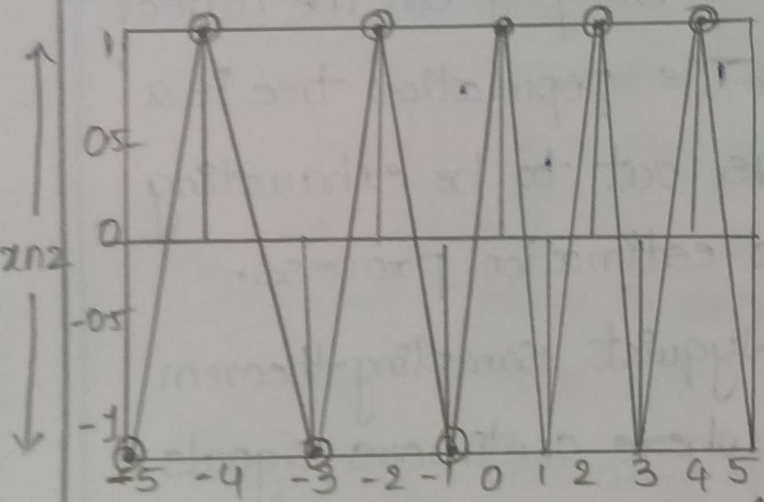
In sampling theorem Nyquist sampling theorem underlies all situations where continuous signals are sampled and is especially important where pattern are to be digitized and analyzed by computers. Analog information must be transformed into a digital format. process starts with sampling the waveform to produce a discrete pulse - amp-modulated waveform.



continuous time signal

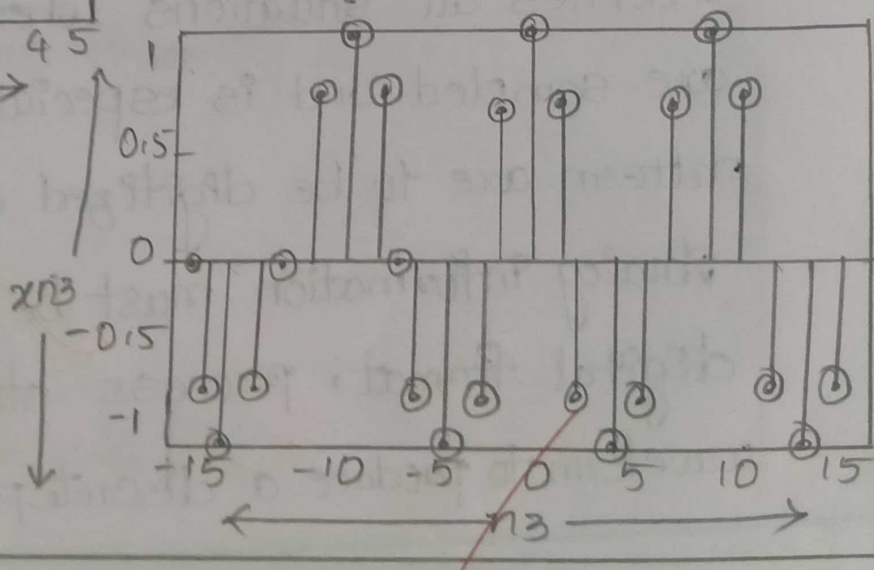


Discrete time signal with ($f_s < 2f_m$).



Discrete time signal with ($f_s = 2f_m$)

Discrete time signal with ($f_s > 2f_m$)



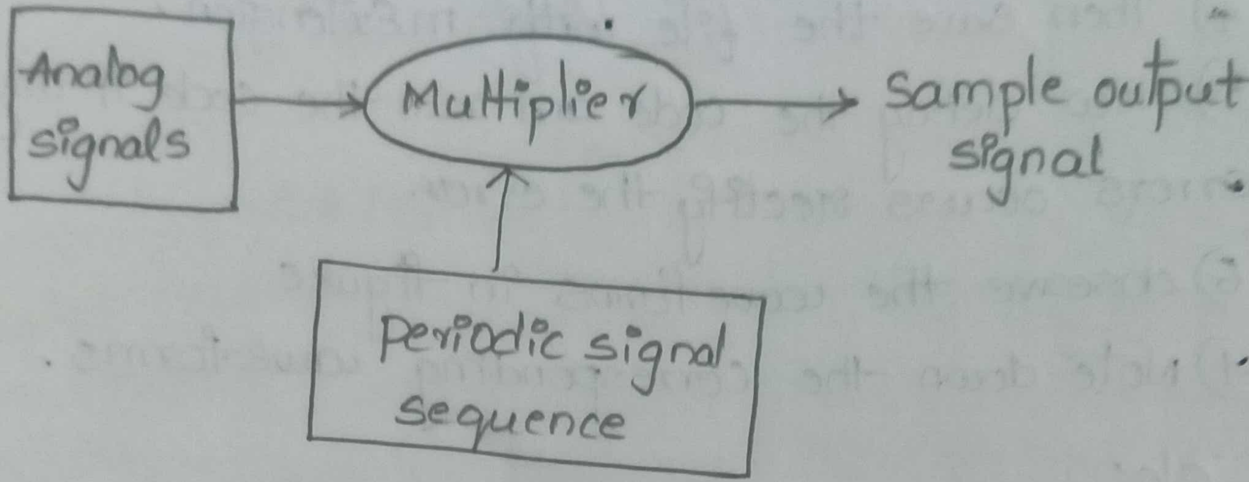
Procedure

1) switch on the computer system
2) Go to matlab icon → Go to file → select blank M File.
3) Now Enter MATLAB code in the New file
4) Then save the file with m Extension.
5) Now debug the code and run the code if any errors occurs rectify the error
6) observe the waveforms in figure
7) Note down the corresponding waveforms.

Program Code:-

```
clc;
clear all;
close all;
t=-10:0.01:10;
fm=0.125;
x=cos(2*pi*fm*t);
Subplot (2,2,1);
plot (t,x);
xlabel ('Time in seconds');
ylabel ('x(t)');
title ('continuous time signal');
fs1=1*fm;
fs2=2*fm;
fs3=8*fm;
n1=-2:1:2
xn1=cos(2*pi*n1*fm/fs1);
Subplot (2,2,2);
```

Block diagram :-



```
stem (n,xn1);
hold on;
plot (x1,xn1);
xlabel ('n');
ylabel ('x(n)');
title ('Discrete time signal with fs<2fm);
n2 = -5:1:5;
xn2 = cos(2*pi*n2*fm/fs2);
subplot (2,2,3);
stem (n,xn2);
hold on;
plot (n2,xn2);
xlabel ('n');
ylabel('x(n)');
title ('Discrete time signal with fs=2fm);
n3=-15:1:15;
xn3 = cos (2*pi*n3*fm/fs3);
subplot (2,2,4);
stem (n,xn3);
hold on;
plot (n3,xn3);
xlabel ('n');
ylabel ('x(n)');
title (' Discrete time signal with fs>2fm);
```

Result:- Hence verified the sampling theorem by using matlab software and obtained the wave forms.

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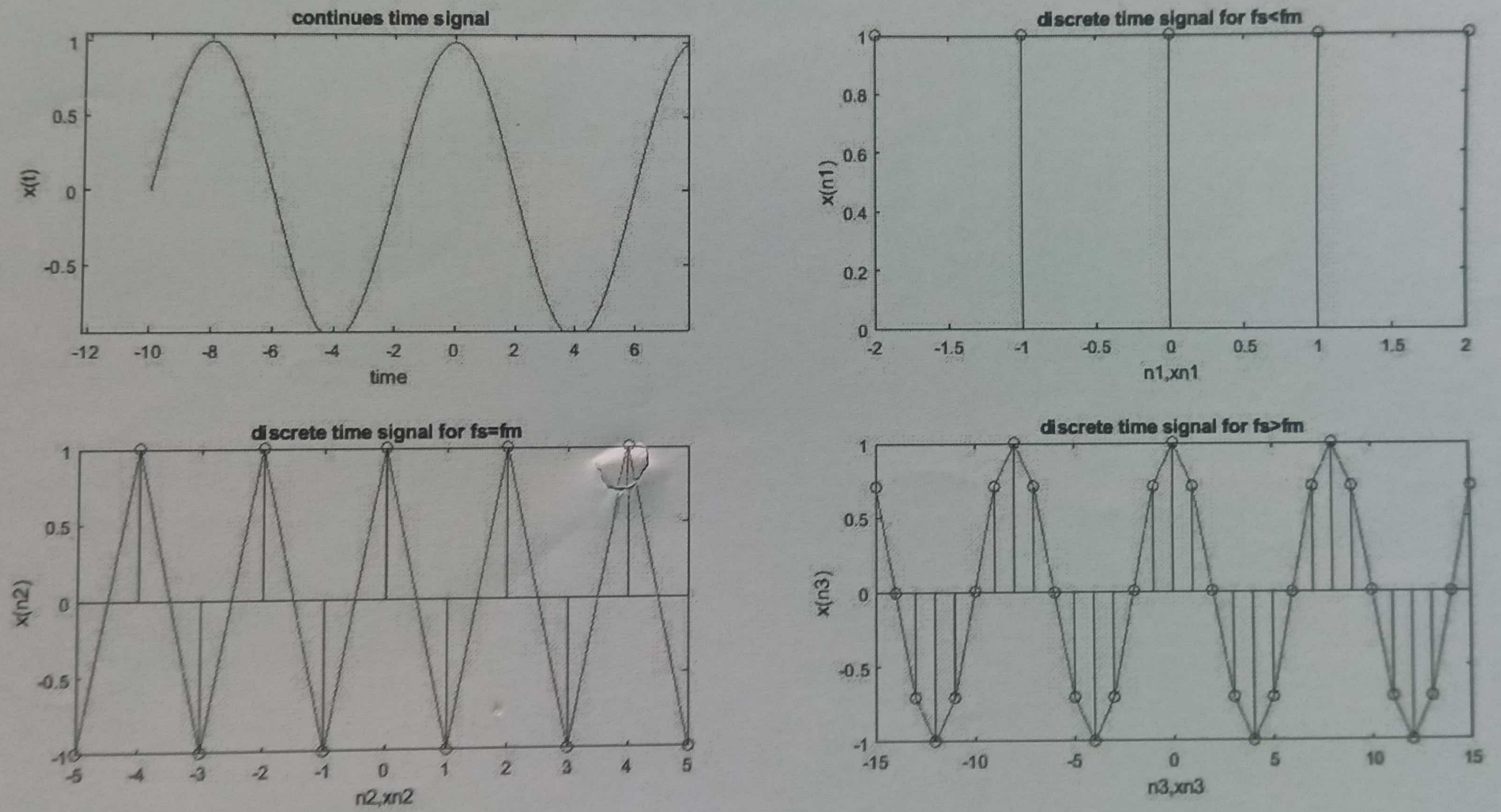
continues time signal
x(t)
time
discrete time signal for fs<fm
x(n1)
n1,xn1
discrete time signal for fs=fm
x(n2)
n2,xn2
discrete time signal for fs>fm
x(n3)
n3,xn3

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CO- PO ATTAINMENT PROCESS

Academic Year	2022-23						
Regulations	R20						
Year	III	**Sem**	II				
Batch	20						
Branch	ECE						
Subject(Code)	DC LAB						
Name of the Faculty	MAHESWARI M						
Reg.No.	**Final Internal marks(25)**	**Total Final Marks(75)**	**External Marks(50)**	**N CO 1**	**N CO 2**	**N CO 3**	**N CO 4**
20091A0402	24	69	45	92	92	92	92
20091A0404	23	67	44	89.33333	89.33333	89.33333	89.33333
20091A0408	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A0419	24	64	40	85.33333	85.33333	85.33333	85.33333
20091A0435	23	69	46	92	92	92	92
20091A0436	23	68	45	90.66667	90.66667	90.66667	90.66667
20091A0437	23	67	44	89.33333	89.33333	89.33333	89.33333
20091A0439	24	69	45	92	92	92	92
20091A0450	24	70	46	93.33333	93.33333	93.33333	93.33333
20091A0466	24	72	48	96	96	96	96
20091A0469	24	71	47	94.66667	94.66667	94.66667	94.66667
20091A0470	24	71	47	94.66667	94.66667	94.66667	94.66667
20091A0471	24	71	47	94.66667	94.66667	94.66667	94.66667
20091A0472	23	71	48	94.66667	94.66667	94.66667	94.66667

20091A0475	24	72	48	96	96	96	96
20091A0478	24	73	49	97.33333	97.33333	97.33333	97.33333
20091A0479	22	69	47	92	92	92	92
20091A0480	22	56	34	74.66667	74.66667	74.66667	74.66667
20091A0488	24	69	45	92	92	92	92
20091A0490	22	65	43	86.66667	86.66667	86.66667	86.66667
20091A0497	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A04A3	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A04C1	22	65	43	86.66667	86.66667	86.66667	86.66667
20091A04C4	24	72	48	96	96	96	96
20091A04C9	24	73	49	97.33333	97.33333	97.33333	97.33333
20091A04D3	22	69	47	92	92	92	92
20091A04D7	19	67	48	89.33333	89.33333	89.33333	89.33333
20091A04D9	22	66	44	88	88	88	88
20091A04E0	24	71	47	94.66667	94.66667	94.66667	94.66667
20091A04E5	24	71	47	94.66667	94.66667	94.66667	94.66667
20091A04E6	22	66	44	88	88	88	88
20091A04E7	24	72	48	96	96	96	96
20091A04E8	23	66	43	88	88	88	88
20091A04E9	24	72	48	96	96	96	96
20091A04F1	24	70	46	93.33333	93.33333	93.33333	93.33333
20091A04F8	24	73	49	97.33333	97.33333	97.33333	97.33333
20091A04F9	23	67	44	89.33333	89.33333	89.33333	89.33333
20091A04G0	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A04G1	24	69	45	92	92	92	92
20091A04G2	23	68	45	90.66667	90.66667	90.66667	90.66667
20091A04G3	24	73	49	97.33333	97.33333	97.33333	97.33333
20091A04G5	23	69	46	92	92	92	92
20091A04H5	24	72	48	96	96	96	96
20091A04H7	24	68	44	90.666	90.6666	90.6666	90.6666

				67	7	7	7
20091A04H8	24	69	45	92	92	92	92
20091A04H9	24	73	49	97.33333	97.33333	97.33333	97.33333
20091A04J0	24	71	47	94.66667	94.66667	94.66667	94.66667
20091A04J3	24	67	43	89.33333	89.33333	89.33333	89.33333
20091A04J9	24	70	46	93.33333	93.33333	93.33333	93.33333
20091A04K1	24	73	49	97.33333	97.33333	97.33333	97.33333
20091A04K5	24	70	46	93.33333	93.33333	93.33333	93.33333
20091A04K6	24	72	48	96	96	96	96
20091A04M3	24	73	49	97.33333	97.33333	97.33333	97.33333
20091A04M7	24	68	44	90.66667	90.66667	90.66667	90.66667
20091A04M9	24	72	48	96	96	96	96
20091A04N6	22	67	45	89.33333	89.33333	89.33333	89.33333
20091A04N7	24	69	45	92	92	92	92
20091A04P0	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A04P8	23	71	48	94.66667	94.66667	94.66667	94.66667
21095A0404	24	72	48	96	96	96	96
21095A0412	24	71	47	94.66667	94.66667	94.66667	94.66667
21095A0417	24	70	46	93.33333	93.33333	93.33333	93.33333
21095A0430	24	73	49	97.33333	97.33333	97.33333	97.33333
21095A0432	23	68	45	90.66667	90.66667	90.66667	90.66667
20091A0401	22	69	47	92	92	92	92
20091A0406	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A0410	22	69	47	92	92	92	92
20091A0411	22	67	45	89.33333	89.33333	89.33333	89.33333
20091A0417	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A0418	22	70	48	93.33333	93.33333	93.33333	93.33333

20091A0426	22	68	46	90.66667	90.66667	90.66667	90.66667
20091A0427	22	68	46	90.66667	90.66667	90.66667	90.66667
20091A0438	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A0443	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A0444	21	70	49	93.33333	93.33333	93.33333	93.33333
20091A0447	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A0449	20	67	47	89.33333	89.33333	89.33333	89.33333
20091A0452	21	69	48	92	92	92	92
20091A0454	21	66	45	88	88	88	88
20091A0455	20	67	47	89.33333	89.33333	89.33333	89.33333
20091A0456	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A0459	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A0465	17	62	45	82.66667	82.66667	82.66667	82.66667
20091A0467	19	66	47	88	88	88	88
20091A0473	21	68	47	90.66667	90.66667	90.66667	90.66667
20091A0476	21	67	46	89.33333	89.33333	89.33333	89.33333
20091A0484	21	70	49	93.33333	93.33333	93.33333	93.33333
20091A0485	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A0489	21	66	45	88	88	88	88
20091A0494	21	66	45	88	88	88	88
20091A0495	21	68	47	90.66667	90.66667	90.66667	90.66667
20091A0496	20	64	44	85.33333	85.33333	85.33333	85.33333
20091A04A6	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A04B0	20	68	48	90.66667	90.66667	90.66667	90.66667
20091A04B5	22	66	44	88	88	88	88
20091A04B6	24	71	47	94.66667	94.66667	94.66667	94.66667

20091A04B7	20	68	48	90.66667	90.66667	90.66667	90.66667
20091A04B9	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A04C0	22	69	47	92	92	92	92
20091A04C3	22	68	46	90.66667	90.66667	90.66667	90.66667
20091A04D1	21	69	48	92	92	92	92
20091A04D8	23	70	47	93.33333	93.33333	93.33333	93.33333
20091A04F2	21	68	47	90.66667	90.66667	90.66667	90.66667
20091A04F7	21	69	48	92	92	92	92
20091A04G6	20	67	47	89.33333	89.33333	89.33333	89.33333
20091A04G8	24	72	48	96	96	96	96
20091A04G9	21	69	48	92	92	92	92
20091A04H3	20	66	46	88	88	88	88
20091A04J1	20	67	47	89.33333	89.33333	89.33333	89.33333
20091A04J2	21	69	48	92	92	92	92
20091A04J8	21	66	45	88	88	88	88
20091A04K4	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A04M1	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A04M5	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A04M6	23	69	46	92	92	92	92
20091A04M8	22	69	47	92	92	92	92
20091A04N0	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A04N3	22	68	46	90.66667	90.66667	90.66667	90.66667
20091A04N4	23	70	47	93.33333	93.33333	93.33333	93.33333
20091A04N9	22	70	48	93.33333	93.33333	93.33333	93.33333
20091A04P7	22	69	47	92	92	92	92
20091A04P9	23	72	49	96	96	96	96
21095A0411	23	71	48	94.66667	94.66667	94.66667	94.66667
21095A0415	20	68	48	90.66667	90.66667	90.66667	90.66667
21095A0416	23	71	48	94.66667	94.66667	94.66667	94.66667

21095A0425	23	70	47	93.33333	93.33333	93.33333	93.33333
21095A0427	21	67	46	89.33333	89.33333	89.33333	89.33333
19091A0412	22	52	30	69.33333	69.33333	69.33333	69.33333
20091A0405	23	68	45	90.66667	90.66667	90.66667	90.66667
20091A0407	23	65	42	86.66667	86.66667	86.66667	86.66667
20091A0415	24	68	44	90.66667	90.66667	90.66667	90.66667
20091A0416	22	67	45	89.33333	89.33333	89.33333	89.33333
20091A0422	23	69	46	92	92	92	92
20091A0423	23	68	45	90.66667	90.66667	90.66667	90.66667
20091A0424	23	71	48	94.66667	94.66667	94.66667	94.66667
20091A0428	23	68	45	90.66667	90.66667	90.66667	90.66667
20091A0433	23	68	45	90.66667	90.66667	90.66667	90.66667
20091A0441	23	63	40	84	84	84	84
20091A0442	23	63	40	84	84	84	84
20091A0448	24	68	44	90.66667	90.66667	90.66667	90.66667
20091A0451	23	67	44	89.33333	89.33333	89.33333	89.33333
20091A0453	23	68	45	90.66667	90.66667	90.66667	90.66667
20091A0457	23	69	46	92	92	92	92
20091A0458	23	64	41	85.33333	85.33333	85.33333	85.33333
20091A0460	23	64	41	85.33333	85.33333	85.33333	85.33333
20091A0462	22	63	41	84	84	84	84
20091A0463	23	66	43	88	88	88	88
20091A0492	23	65	42	86.66667	86.66667	86.66667	86.66667
20091A04A0	23	67	44	89.33333	89.33333	89.33333	89.33333
20091A04A4	23	65	42	86.66667	86.66667	86.66667	86.66667
20091A04A5	23	68	45	90.66667	90.66667	90.66667	90.66667

20091A04A7	22	62	40	82.66667	82.66667	82.66667	82.66667
20091A04A9	22	66	44	88	88	88	88
20091A04B2	20	60	40	80	80	80	80
20091A04B3	20	60	40	80	80	80	80
20091A04B4	20	62	42	82.66667	82.66667	82.66667	82.66667
20091A04B8	22	65	43	86.66667	86.66667	86.66667	86.66667
20091A04C2	22	66	44	88	88	88	88
20091A04C5	22	64	42	85.33333	85.33333	85.33333	85.33333
20091A04D2	24	68	44	90.66667	90.66667	90.66667	90.66667
20091A04D6	23	66	43	88	88	88	88
20091A04E3	22	62	40	82.66667	82.66667	82.66667	82.66667
20091A04G4	24	65	41	86.66667	86.66667	86.66667	86.66667
20091A04G7	23	66	43	88	88	88	88
20091A04H1	22	66	44	88	88	88	88
20091A04H4	23	65	42	86.66667	86.66667	86.66667	86.66667
20091A04H6	23	67	44	89.33333	89.33333	89.33333	89.33333
20091A04J4	23	67	44	89.33333	89.33333	89.33333	89.33333
20091A04J5	23	69	46	92	92	92	92
20091A04J6	23	70	47	93.33333	93.33333	93.33333	93.33333
20091A04J7	23	70	47	93.33333	93.33333	93.33333	93.33333
20091A04N5	23	67	44	89.33333	89.33333	89.33333	89.33333
20091A04P2	22	65	43	86.66667	86.66667	86.66667	86.66667
20091A04P4	23	68	45	90.66667	90.66667	90.66667	90.66667
20091A04Q0	24	73	49	97.33333	97.33333	97.33333	97.33333
21095A0401	24	73	49	97.33333	97.33333	97.33333	97.33333
21095A0402	23	69	46	92	92	92	92
21095A0403	23	72	49	96	96	96	96
21095A0405	23	70	47	93.33333	93.33333	93.33333	93.33333

21095A0406	22	69	47	92	92	92	92
21095A0407	23	71	48	94.66667	94.66667	94.66667	94.66667
21095A0409	23	70	47	93.33333	93.33333	93.33333	93.33333
21095A0418	23	71	48	94.66667	94.66667	94.66667	94.66667
21095A0421	23	72	49	96	96	96	96
21095A0422	23	71	48	94.66667	94.66667	94.66667	94.66667
21095A0428	22	65	43	86.66667	86.66667	86.66667	86.66667
21095A0433	23	71	48	94.66667	94.66667	94.66667	94.66667
19091A04B6	21	54	33	72	72	72	72
20091A0403	22	59	37	78.66667	78.66667	78.66667	78.66667
20091A0409	18	49	31	65.33333	65.33333	65.33333	65.33333
20091A0412	22	55	33	73.33333	73.33333	73.33333	73.33333
20091A0413	21	64	43	85.33333	85.33333	85.33333	85.33333
20091A0420	17	59	42	78.66667	78.66667	78.66667	78.66667
20091A0421	21	55	34	73.33333	73.33333	73.33333	73.33333
20091A0425	19	59	40	78.66667	78.66667	78.66667	78.66667
20091A0430	21	55	34	73.33333	73.33333	73.33333	73.33333
20091A0431	21	56	35	74.66667	74.66667	74.66667	74.66667
20091A0432	23	67	44	89.33333	89.33333	89.33333	89.33333
20091A0434	18	58	40	77.33333	77.33333	77.33333	77.33333
20091A0440	17	52	35	69.33333	69.33333	69.33333	69.33333
20091A0446	18	62	44	82.66667	82.66667	82.66667	82.66667
20091A0464	18	52	34	69.33333	69.33333	69.33333	69.33333
20091A0468	22	54	32	72	72	72	72
20091A0474	19	50	31	66.66667	66.66667	66.66667	66.66667

20091A0477	18	44	26	58.66667	58.66667	58.66667	58.66667
20091A0487	21	55	34	73.33333	73.33333	73.33333	73.33333
20091A0491	20	53	33	70.66667	70.66667	70.66667	70.66667
20091A0499	18	44	26	58.66667	58.66667	58.66667	58.66667
20091A04A8	21	56	35	74.66667	74.66667	74.66667	74.66667
20091A04B1	18	56	38	74.66667	74.66667	74.66667	74.66667
20091A04C7	18	50	32	66.66667	66.66667	66.66667	66.66667
20091A04D0	21	60	39	80	80	80	80
20091A04D4	18	50	32	66.66667	66.66667	66.66667	66.66667
20091A04D5	20	48	28	64	64	64	64
20091A04E2	19	53	34	70.66667	70.66667	70.66667	70.66667
20091A04E4	22	48	26	64	64	64	64
20091A04F4	17	55	38	73.33333	73.33333	73.33333	73.33333
20091A04F5	17	56	39	74.66667	74.66667	74.66667	74.66667
20091A04F6	21	59	38	78.66667	78.66667	78.66667	78.66667
20091A04H2	19	45	26	60	60	60	60
20091A04K0	15	31	16	41.33333	41.33333	41.33333	41.33333
20091A04K2	17	47	30	62.66667	62.66667	62.66667	62.66667
20091A04K3	17	59	42	78.66667	78.66667	78.66667	78.66667
20091A04K7	15	50	35	66.66667	66.66667	66.66667	66.66667
20091A04K8	21	56	35	74.66667	74.66667	74.66667	74.66667
20091A04M2	21	61	40	81.33333	81.33333	81.33333	81.33333
20091A04N1	23	57	34	76	76	76	76
20091A04N2	18	46	28	61.33333	61.33333	61.33333	61.33333
20091A04P1	17	46	29	61.33333	61.33333	61.33333	61.33333
20091A04P3	16	42	26	56	56	56	56

20091A04P6	19	51	32	68	68	68	68
21095A0408	16	40	24	53.33333	53.33333	53.33333	53.33333
21095A0410	22	57	35	76	76	76	76
21095A0413	24	61	37	81.33333	81.33333	81.33333	81.33333
21095A0414	17	51	34	68	68	68	68
21095A0419	19	58	39	77.33333	77.33333	77.33333	77.33333
21095A0420	20	59	39	78.66667	78.66667	78.66667	78.66667
21095A0423	21	60	39	80	80	80	80
21095A0424	22	56	34	74.66667	74.66667	74.66667	74.66667
21095A0426	18	58	40	77.33333	77.33333	77.33333	77.33333
21095A0429	22	61	39	81.33333	81.33333	81.33333	81.33333
21095A0431	18	54	36	72	72	72	72

CO-PO CALCULATION

	CO 1		CO 2		CO 3		CO 4	
	No. of students Attained	Weightage Points	No. of students Attained	Weightage Points	No. of students Attained	Weightage Points	No. of students Attained	Weightage Points
>60%	237	3	237	3	237	3	237	3
40% to 60%	5	2	5	2	5	2	5	2
<40%	0	1	0	1	0	1	0	1
Total No. of students	242		242		242		242	
Atainment value		2.98		2.98		2.98		2.98
% of Attainment		97.93		97.93		97.93		97.93
Attained or not		YES		YES		YES		YES

CO	CO Attainment Value	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2.98		2	1											1	
CO 2	2.98	3	3	2	1	1				1	2				2	
CO 3	2.98	1	3	3	2	1	1			2	1		2	3	1	
CO 4	2.98		2	2	1	3				2	1	1	2		1	3
CO 5																
CO 6																

DC LAB		2.98	2.98	2.98	2.98	2.98	2.98	-	-	2.98	2.98	2.98	2.98	2.98	2.98	2.98