Course Name   : **Electronics Engineering Group**

Course Code   : **EJ/EX/ET/EN/DE/EV/ED/EI**

Semester   : **Fifth for EJ/EX/ET/EN/DE/EV and Sixth for ED/EI**

Subject Title   : **Digital Communication**

Subject Code   : **17535**

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	50#	--	25@	175

NOTE:

> ➢ **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
> ➢ **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

    "Digital communication" is a Core subject for the Electronics & Communication engineering student. Communication technologies have undergone radical changes, especially due to convergence of computers and communication. Digital communication offers data processing option and flexibility which is not available with analog communication. This subject will enable the student to comprehend facts, concept and working principles of Digital communication systems.
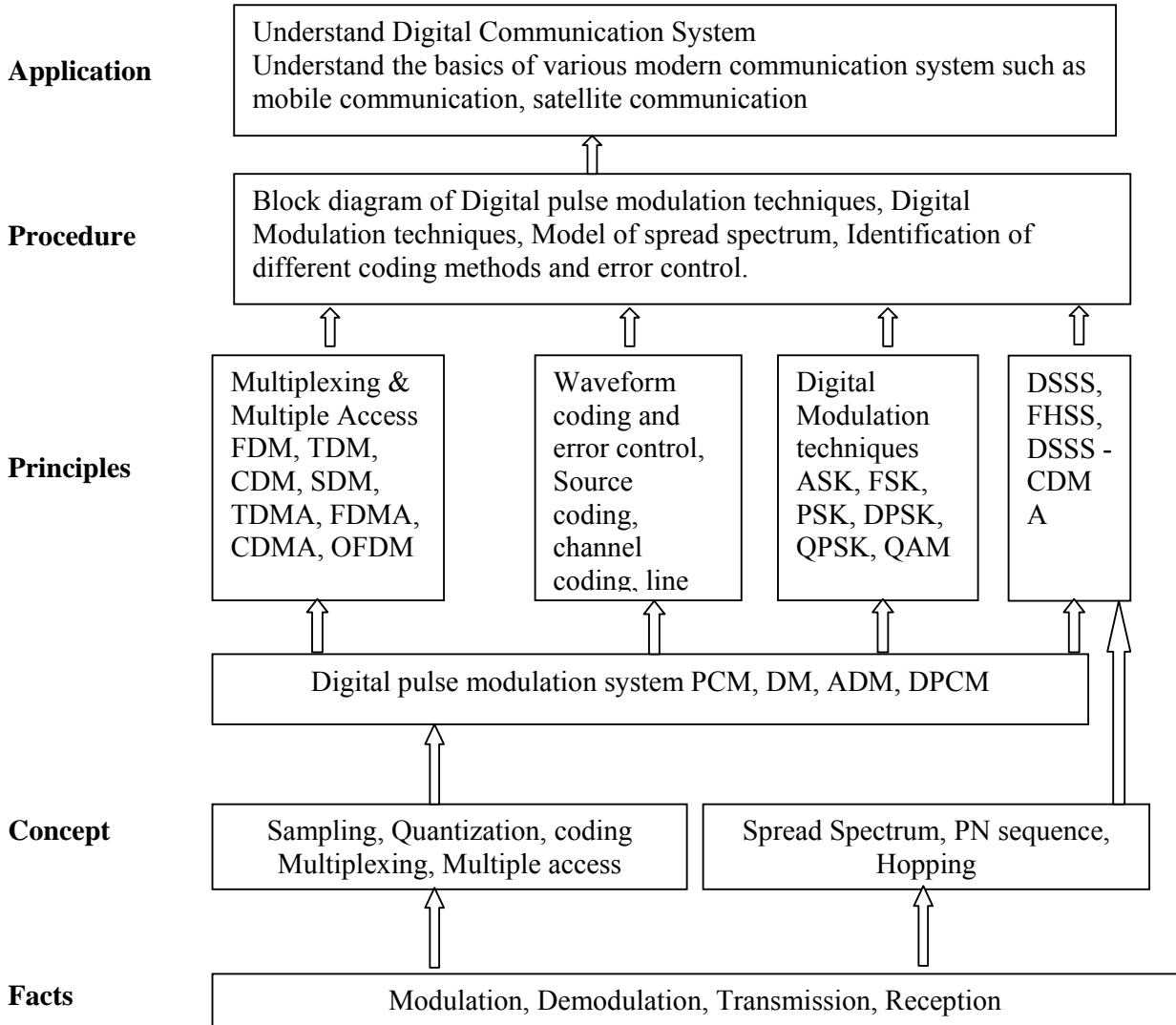
    This subject familiarizes the student with digital information theory, information rate and channel capacity. This subject helps the students to understand the concept of principles of digital modulation technique, channel coding method and error control multiplexing, Multiple Access scheme and spread spectrum modulation.. The Knowledge acquired by student will help them to apply in various modern communication systems.

General Objectives:

Student will be able to

- Understand principles and Concept of various digital modulation techniques.
- Understand various coding, error detection and error correction methods.
- Understand various multiplexing technique and multiple Access Scheme.
- Understand spread spectrum modulation and their different methods.

Learning Structure:

Application

> Understand Digital Communication System
> Understand the basics of various modern communication system such as mobile communication, satellite communication

⇧

Procedure

> Block diagram of Digital pulse modulation techniques, Digital Modulation techniques, Model of spread spectrum, Identification of different coding methods and error control.

⇧   ⇧   ⇧   ⇧

Principles

| Multiplexing & Multiple Access FDM, TDM, CDM, SDM, TDMA, FDMA, CDMA, OFDM | Waveform coding and error control, Source coding, channel coding, line | Digital Modulation techniques ASK, FSK, PSK, DPSK, QPSK, QAM | DSSS, FHSS, DSSS - CDMA |

⇧   ⇧   ⇧   ⇧ ⇧

> Digital pulse modulation system PCM, DM, ADM, DPCM

⇧   ⇧

Concept

| Sampling, Quantization, coding Multiplexing, Multiple access | Spread Spectrum, PN sequence, Hopping |

⇧   ⇧

Facts

> Modulation, Demodulation, Transmission, Reception

Theory:

Topic and Contents	Hours	Marks
Topic 1: Introduction of Digital Communication Specific Objectives: ▷ Define Digital Communication, communication channel ▷ Explain different element of Digital Communication. ▷ Compare analog. with digital communication Contents: • Historical perspective of Digital Communication • Elements of Digital Communication system with its block diagram. • Communication channel types and their Characteristics (bit rate, bandwidth, repeater distance) applications, and Channel modeling, channel noise. • Comparison of Analog and digital communication system.	02	06
Topic 2: Digital Pulse Modulation Techniques. Specific Objectives: ▷ Define and explain, generation and demodulation of various digital pulse modulation techniques. ▷ Define Sampling theorem ▷ Compare digital pulse modulation with analog modulation Contents: 2.1 [04 Marks] • Sampling process Nyquist sampling theorem. • Quantization process , Quantization error, Quantization noise, Uniform ,Non Uniform Quantization (companding) u law, A law (concept) 2.2 [16 Marks] • Pulse code modulation (PCM) Transmitter and Receiver block diagram and its working. Advantage and Disadvantages of PCM. • Differential pulse code modulation (DPCM). Transmitter and Receiver block diagram and its working, Advantage and disadvantage of DPCM • Delta Modulation (DM) Block diagram of Transmitter and Receiver, slope overload and Granular noise, Advantage and disadvantage of DM. • Adaptive Delta modulation (ADM) Transmitter and Receiver block diagram. Advantage and Disadvantages of ADM • Comparison of analog and Digital Pulse modulation, Comparison of various digital pulse Modulation	12	20
Topic 3: Coding Methods and Error Control. Specific Objectives: ▷ Define bit rate, baud rate ▷ State Hartleys law, Shannon Hartleys theorem and channel capacity. ▷ Define source coding ▷ Explain channel coding and their types and error correction codes. ▷ Define various types of line coding. Contents: 3.1 [06 Marks] • Bits, bit rate and baud rate, Hartleys law, Shannon Hartleys theorm, Channel capacity.	08	16

• Source coding, sources, Entropy, baudot code, Huffman coding. 3.2 [10 Marks] • Channel coding : error, causes of error and its effect ,error detection and correction using parity, error control codes, checksum, Two dimensional parity check Vertical redundancy Check (VRC) , Longitudinal Redundancy Check (LRC) , ,,,Cyclic Redundancy Check (CRC), Hamming codes. • Line coding: classification of line codes uni polar, Polar Non return to Zero (NRZ) and Return to zero (RZ), Bipolar (NRZ), Manchester (split phase), Differential Manchester Bipolar RZ, Pseudo ternary, alternate Mark Inversion (AMI) and their waveforms.	

Topic 4: Digital Modulation Technique.
Specific Objectives:
  ➢ Define M- ary encoding
  ➢ Explain various transmitter & receiver for digital communication
  ➢ Compare various digital modulation techniques.
  ➢ Draw constellation and proper diagram.
 	
Contents:
• M-ary encoding , Minimum bandwidth
• Amplitude Shift Keying (ASK) Frequency shift keying (FSK), Phase shift keying (PSK), transmitter and receiver block diagram and their working with waveform.
• Quadrature Phase shift keying (QPSK) , Quadrature amplitude modulation (QAM), Differential Phase shift keying (DPSK) transmitter and receiver block diagram and their working with waveform.
• Constellation diagram and phasor diagram of each modulation techniques.
• Comparison of Digital modulation technique along with bandwidth of each one.
	12	24

Topic 5: Multiplexing & Multiple Access.
Specific Objectives:
  ➢ Define FDM , TDM , CDM SDM
  ➢ Explain multiple acess system like FDMA , TDMA , CDMA , SDMA
  ➢ Compare OFDM , and CDMA
 	
Contents:
5.1   [10 Marks]
• Need of Multiplexing Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), Code Division multiplexing (CDM), Space Division Multiplexing (SDM) definition, block diagram and their comparison.
• T carrier system, Digital multiplexing hierarchy, North American hierarchy, The CCITT digital multiplexing hierarchy
• Introduction to Wavelength Division Multiplexing (WDM)
5.2   [10 Marks]
• Access techniques Time Division Multiple Access (TDMA), Frequency Division multiple Access (FDMA), Code Division Multiple access (CDMA), Space Division Multiple Access (SDMA), comparison of different Access techniques.
	08	20

• Wide band modulation Techniques: Orthogonal Frequency Division Multiplexing (OFDM) basic principle of orthogonality, single vs. multicarrier system OFDM block diagram and its explanation. Comparisons between CDMA and OFDM		
Topic 6: Spread Spectrum Modulation Specific Objectives: ➢ Define PN sequence ➢ Explain Spread Spectrum modulation s DSSS & FHSS ➢ Sate Applications of S.S modulation Contents: 6.1 [06 Marks] • Introduction to spread spectrum (SS) Modulation, advantages over fixed frequency, Types of SS Modulation Applications of SS modulation. • Pseudo Noise (PN) sequence: definition, generation and maximum length sequence • Model of Spread Spectrum modulation system 6.2 [08 Marks] • Direct sequence spread spectrum signal. • Frequency spread spectrum. Slow frequency hopping and fast frequency hopping. • Comparisons of Direct sequence spread spectrum (DSSS) and Frequency Hop spread spectrum (FHSS) • DSSS based CDMA system , CDMA with FHSS block diagram	06	14
Total	**48**	**100**

Practical:
Skills to be developed:

Intellectual Skills:
1. Interpret given circuit, type of modulation
2. Interpret the results
3. Interpret the various types of waveforms

Motor Skills:
1. Draw circuit diagram
2. Setting up of equipment
3. Accurate observation and draw the waveforms

List of Practicals:
1. Observe and plot waveforms of PCM modulation and demodulation observe the effect of sampling frequency. Study A law and u law.
2. Observe and plot waveforms of DPCM modulation and demodulation
3. Observe and plot waveforms of DM and ADM modulation and demodulation
4. Generate different line codes UPRZ, UPNRZ, PRZ, PNRZ, BPRZ and observe waveforms. Generate and decode Manchester and differential Manchester codes.
5. Observe and plot waveforms of ASK ,FSK,PSK modulation and demodulation
6. Observe and plot waveforms of QPSK modulation and demodulation
7. Observe and plot waveforms of QAM modulation and demodulation

8. Observe and plot waveforms of DPSK modulation and demodulation
9. Observe and plot waveforms of FDM and TDM multiplexing and demultiplexing techniques.
10. Generate variable length PN sequence for CDMA-DSSS signal and demodulate. Observe and draw spreading and dispersing waveforms.
11. Generate FHSS and demodulate it Observe and draw spreading and dispersing waveforms

Learning Resources:
1. Books:

Sr. No.	Author	Title	Publisher
1.	P. Ramakrishna Rao	Digital Communication	Tata Mcgraw Hill
2.	Amitabha Bhattacharya	Digital Communication	Tata Mcgraw Hill
3.	Wayne Tomasi	Electronics Communication System	Pearson Education
4.	Upen Dalal	Wireless Communication	Oxford

2. Websites:

1. http://academicearth.org/courses/principles-of-digital-communication lecture 1 & lecture 6

2. http://nptel.iitm.ac.in/video.php?subjectId=117101051digital communication lecture series

3. http://educypedia.karadimov.info/electronics/javamodulationdig.htm   FDMA,   TDMA, CDMA, FSK, PAM etc Animations

4. http://educypedia.karadimov.info/electronics/rfdigmod.htm   various   topics   on   digital modulation