

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**  
**Course Curriculum**

**Digital Communication**  
**(Code: 3341102)**

<b>Diploma Programmes in which this course is offered</b>	<b>Semester in which offered</b>
Electronics & Communication Engineering	4 <sup>th</sup> Semester

### 1. RATIONALE

Digital communication plays vital role in the field of electronic communication systems which includes wired and wireless communications viz. telecommunication, radio, mobile and satellite communication systems . This course will enable Electronics and communication engineering diploma engineers to maintain digital communication and networking equipment and circuits used in the practical field. This course also laid the foundation to understand the advanced communication courses in the subsequent semesters.

### 2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Maintain digital communication based systems**

### 3. Course Outcomes:

1. Compare different types of pulse modulations technique for specific application
2. Select the relevant digital modulation technique for specific application
3. Choose the coding technique for minimum errors in transmitting information.
4. Choose the data transfer technique for specific application.
5. Demonstrate various applications based digital communication.

### 4. Teaching and Examination Scheme

<b>Teaching Scheme (In Hours)</b>				<b>Total Credits (L+T+P)</b>	<b>Examination Scheme</b>			
					<b>Theory Marks</b>		<b>Practical Marks</b>	
<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>ESE</b>	<b>PA</b>	<b>ESE</b>	<b>PA</b>	<b>150</b>
3	0	2	5	70	30	20	30	

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit ESE - End Semester Examination; PA - Progressive Assessment.

## 5. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
<b>Unit – I</b> Pulse Code Modulation	1a State the need for sampling theorem 1b State the Nyquist criteria 1c Explain Sample & Hold circuit 1d Describe quantization process , Basics of quantization , step - size, resolution, uniform and non- uniform quantize, Quantization noise, Commanding 1e Functions of each block of Pulse Code Modulation (PCM) Transmitter and Receiver in details, Effect of noise on PCM signal on basics of repeater, Merits and demerits of PCM 1f Explain modulator , demodulator, advantages, slope overload and granular noise of delta modulation 1g Differentiate between Delta and Adaptive delta modulation 1h Explain working of Differential PCM transmitter and receiver 1i Compare PCM, DM, ADM and DPCM	1.1. Sampling theorem, 1.2. Nyquist criteria 1.3. Sample & Hold Circuit 1.4. Quantization 1.5. PCM transmitter and receiver 1.6. Delta Modulation 1.7. Adaptive Delta Modulation 1.8. Differential PCM
<b>Unit-II:</b> Digital Modulation Techniques	2a Explain the principle, process of ASK signal generation with different techniques, Modulator , Demodulator, waveforms and constellation diagram 2b Explain the principle, process of FSK signal generation with different techniques, Modulator , Demodulator, waveforms and constellation diagram 2c Explain the principle, process of PSK signal generation with different techniques, Modulator , Demodulator, waveforms and constellation diagram 2d Explain the principle, process of QPSK signal generation with different techniques, Modulator , Demodulator, waveforms and constellation diagram 2e Explain the principle, constellation diagram and waveforms of 8-PSK 2f Explain the principle, constellation diagram and waveforms of 16-QAM 2g Explain the principle, constellation	2.1. Amplitude Shift Keying (ASK) 2.2. Frequency Shift Keying (FSK) 2.3. Principle of Phase Shift Keying(PSK) 2.4. Quadrature Phase shift Keying(QPSK) 2.5. 8- PSK 2.6. 16-Quadrature Amplitude Modulator(QAM)

Unit	Major Learning Outcomes	Topics and Sub-topics
	diagram and waveforms of MSK	2.7. Minimum Shift Keying(MSK)
<b>Unit-III:</b> Information Theory and Coding	3a Define Probability and its significance in communication 3b Define Entropy and Information and its physical significance, their units 3c define Channel Capacity in terms of SNR and explain its importance 3d Explain basics of coding, Huffman code, Error detecting and correcting code (Parity Codes, Hamming Codes)	3.1. Probability 3.2. Entropy and Information 3.3. Channel Capacity 3.4. Huffman Coding, Error detecting code, Error correcting code
<b>Unit-IV:</b> Data Communication	4a Introduce the basic data communication techniques 4b Explain types of Data Communications: Serial, Parallel, Synchronous, Asynchronous 4c Discuss the Data Communication Equipment, Data Terminating Equipment 4d Overview, signals, pin functions, limitations 4e Overview, advantages, disadvantages 4f Explain Synchronous data communication protocols: Introduction, message frame format and handshaking, data transfer process	4.1. Introduction of data communication techniques 4.2. Classification of Data communication 4.3. Data Communication Hardware 4.4. RS-232 4.5. RS-422 4.6. Synchronous Communication Protocols 4.6.1. BiSYNC 4.6.2. SDLC
<b>Unit-V:</b> Applications of Digital Communication	5a Explain requirement of MODEM in telecommunication, block diagrams of low speed, medium speed and high speed modem, modulation techniques used in it. 5b Explain the UART character format, receiver and transmitter in brief 5c Explain connector types and signaling of USB and applications 5d Explain the Bluetooth profiles and applications 5e Explain the Speech Coding techniques: Source Coding (VOCODER). Also compare source coding with waveform coding (PCM, DPCM, ADPCM)	5.1. MODEM 5.2. UART 5.3. USB 5.4. Bluetooth 5.5. Speech Coding

## 6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Pulse Code Modulation	10	05	10	06	21
II	Digital Modulation Techniques	10	05	10	06	21
III	Information Theory and Coding	07	01	03	03	07
IV	Data Communication	08	04	05	05	14
V	Applications of Digital Communication	07	01	03	03	07
	<b>Total</b>	42	16	31	23	70

**Legends:** R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

**Note:** This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

## 7. SUGGESTED LIST OF EXERCISES/PRACTICALS

S. No.	Unit No.	Practical/Exercise	Approx. Hrs. Required
1	I	Check the performance of Pulse code modulator and Demodulator	2
2	I	Check the performance of Delta Modulator	2
3	I	Check the performance of Adaptive Delta Modulator	2
4	I	Check the performance of DPCM	2
5	II	Check the performance of Amplitude Shift Keying modulation and demodulation	2
6	II	Check the performance of Frequency Shift Keying modulation and demodulation	2
7	II	Check the performance of Phase Shift Keying modulation and demodulation	2
8	II	Check the performance of Quadrature Phase Shift Keying modulation and demodulation	2
9	II	Check the performance of 8- Phase Shift Keying modulation and demodulation	2
10	II	Check the performance of Minimum Shift Keying modulation and demodulation	2
11	IV	Convert the Parallel data into serial data	2
12	IV	Convert the Serial data into Parallel data.	2
13	IV	Transfer the data using RS-232 standards	2

S. No.	Unit No.	Practical/Exercise	Approx. Hrs. Required
14	IV	Transfer the data using RS-422 standards	2
15	V	Transfer data using UART technique.	2
16	V	Transfer data using Bluetooth technique.	2
17	V	Check Performance of MODEM	2
		Total	34

## 8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

1. Explore circuit of sample & hold Circuit
2. Explore circuit of ASK Modulator and Demodulator
3. Explore circuit of FSK Modulator and Demodulator
4. Explore circuit of PSK Modulator and Demodulator
5. Explore circuit of Modulator and Demodulator (modem)
6. Prepare data transfer cable using RS-232 standards
7. Prepare data transfer cable using RS-422 standards
8. Industrial visit Telephone exchange, mobile switching centre

## 9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

1. Animation/video films showing the principle, working, Waveforms and features of PCM/DM/ADM/DPCM and Digital Modulation Techniques should be shown to students while teaching the concern topic.
2. Demonstrate how to transfer data through Modem, USB, Bluetooth using Mobile, Computers.

## 10. SUGGESTED LEARNING RESOURCES

### A) List of Books

No.	Title of Book	Author	Publication
1.	Digital Communication (2 <sup>nd</sup> Edition)	R N Mutagi	Oxford University Press
2.	Modern Digital and Analog Communications Systems (3 <sup>rd</sup> Edition)	B P Lathi	Oxford University Press
3.	Analog and Digital Communication	Singal, T. L.	Tata McGraw Hill, India latest edition
4.	Communication System(Analog & Digital)	Sanjay Sharma	S.K. Kataria & Sons

5.	Electronic Communications Modulation and Transmission	Robert J. Schoenbeck	PHI Learning, 2nd Edition
6.	Electronics Communication System ( Fundamental to Advance)	Wayen Tomasi	Pearson Education, 5th edition
7.	Electronic Communication Systems	George Kennedy and Bernard Davis	Tata McGraw Hill 5th edition or latest
8.	Data Communication and Networking	Behrouz A. Forouzan	Tata McGraw Hill 3rd edition or latest

### B) List of Major Equipment/ Instrument with Broad Specifications

1. Spectrum analyzer, 9 kHz to 1.5 GHz Frequency Range, Typical -135 dBm Displayed Average Noise Level (DANL).
2. CRO – Dual trace, 20 MHz Choice of any one built-in option, 30 MHz Bandwidth
3. RF generator/wideband oscillator Wide Frequency Range 100 KHz to 150 MHz.
4. Function Generator: Frequency Range 0.1 Hz to 1 MHz.
5. Digital Communication Training System, In-built internal data generator, Type of Modulations & Demodulations: ASK, FSK, BPSK, QPSK, 8-PSK, 16-QAM
6. Delta Modulation & Demodulation Techniques -Receiver on same board.

### C) List of Software/Learning Websites

1. [http://en.wikipedia.org/wiki/Data\\_transmission](http://en.wikipedia.org/wiki/Data_transmission)
2. <http://www.mathworks.in/matlabcentral/fileexchange/28416-pulse-code-modulation/>
3. <http://www.gobookee.org/amplitude-shift-keying-advantages-and-disadvantages/>
4. <http://ninjacraze.hubpages.com/hub/What-is-Data-Communication>
5. <http://www.lincolnelectric.com/assets/US/EN/literature/nx320.pdf>
6. <http://www.amazon.com/Information-Theory-Network-Coding-Technology/dp>
7. <http://www.gobookee.org/information-theory-coding-by-k-giridhar/>
8. PCM/DM/ADM/DPCM and Digital Modulation Techniques generation using any simulation software.
9. MATLAB software/ Electronics work bench software for the simulation

**11. COURSE CURRICULUM DEVELOPMENT COMMITTEE****Faculty Members from Polytechnics**

1. Prof. P.R.Patel, HOD (EC) B.S.Patel Polytechnic, Kherva, Mehsana.
2. Dr. D. R. Bhojani, HOD (EC) Darshan Institute of Engineering & Technology for Diploma Studies, Rajkot
3. Prof. M. Y. Kantharia, HOD (EC) B & B Institute of Technology, Vallabh Vidhyanagar
4. Prof. (Smt.) K.K.Shah, Sr. Lecturer, (EC) Government Polytechnic, Rajkot

**Coordinator and Faculty Members from NITTTR Bhopal**

Dr. (Mrs.)Anjali potnis ,Assistant Professor , DEEE, NITTTR, Bhopal