

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**COURSE CURRICULUM**  
**COURSE TITLE: DIGITAL COMMUNICATION**  
**(Code: 3341102)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Electronics and 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 lay 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 electronic digital communication systems**

**3. COURSE OUTCOMES**

The theory should be taught and practical should be performed in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Compare different types of pulse code modulations technique.
- Select the relevant digital modulation technique for specific application.
- Choose the coding technique for minimum errors in transmitting information.
- Choose the relevant data transfer technique for various types of data transfer.
- Use the relevant applications of 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>Total 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>	
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 (outcomes in cognitive domain)	Topics and Sub-topics
<b>Unit – I</b> <b>Pulse Code Modulation</b>	1a. State the need for sampling theorem. 1b. Describe the Nyquist criteria. 1c. Explain Sample and Hold circuit. 1d. Describe functions of each block of pulse code modulation (PCM) transmitter and receiver. 1e. Describe effect of noise on PCM signal 1f. Define the following: quantization , step - size, resolution, uniform and non- uniform quantizer, Quantization noise, Companding 1g. Describe slope overload and granular noise of delta modulation 1h. Differentiate Delta and adaptive delta modulation technique. 1i. Explain working of Differential PCM (DPCM) transmitter and receiver. 1j. Compare the features of PCM, DM, ADM and DPCM	1.1 Sampling theorem 1.2 Nyquist criteria 1.3 Sample and 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> <b>Digital Modulation Techniques</b>	2a. Explain the function of ASK signal generation and detection by various Modulator and Demodulator Circuits 2b. Explain the function of FSK signal generation and detection by various Modulator and Demodulator Circuits 2c. Explain the function of PSK signal generation and detection by various Modulator and Demodulator Circuits 2d. Explain the principle, process of QPSK signal generation with different techniques, Modulator , Demodulator, waveforms and constellation diagram 2e. Draw the waveforms and constellation diagram for ASK, FSK and PSK signal. 2f. Explain the principle, constellation diagram and waveforms of 8-PSK 2g. Explain the principle, constellation diagram and waveforms of 16-QAM 2h. Explain the principle, constellation diagram and waveforms of MSK	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 8ary- PSK 2.6 16-Quadrature Amplitude Modulator (QAM) 2.7 Minimum Shift Keying (MSK)

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
<b>Unit-III Information Theory and Coding</b>	3a. State the significance of probability in communication 3b. Define Entropy and Information and its physical significance, their units 3c. State Channel Capacity in terms of SNR and explain its importance 3d. State the step of following coding: Huffman code, Error detecting and correcting code (Parity Codes, Hamming Codes)	3.1 Probability 3.2 Entropy and Information 3.3 Mutual Information 3.4 Channel Capacity Huffman Coding, Error detecting code, Error correcting code
<b>Unit-IV Data Communication</b>	4a. State the need for data communication techniques. 4b. Discriminate between the various modes of Data Communications: Serial, Parallel, Synchronous, Asynchronous 4c. Differentiate between Data Communication Equipment and Data Terminating Equipment. 4d. Compare the features of RS-232 and RS-422 4e. Differentiate the Synchronous data communication protocols: message frame format and handshaking, data transfer process	4.1 Introduction of data communication techniques 4.2 Modes of Data communication 4.3 Data Communication Hardware: DCE and DTE 4.4 RS-232, RS-422 4.5 Synchronous Communication Protocols: BiSYNC, SDLC
<b>Unit-V Applications of Digital Communication</b>	5a. Explain need of MODEM in communication system. 5b. Compare the features of low speed, medium speed and high speed modems. 5c. Describe the USART/UART character format for receiver and transmitter in brief. 5d. Explain the Bluetooth profiles and applications 5e. Explain the need and Speech Coding techniques: Source Coding (VOCODER). Also compare source coding with waveform coding (PCM, DPCM, ADPCM)	5.1 Modulator and Demodulator (MODEM): low speed, medium speed and high speed modems 5.2 USART/UART 5.3 Bluetooth 5.4 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>	<b>42</b>	<b>16</b>	<b>31</b>	<b>23</b>	<b>70</b>

**Legends:** R = Remember; U = Understand; A = Apply 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

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

*Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.*

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

S. No.	Unit No.	Practical/Exercise	Approx. Hrs. Required
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 standard cable.	2
14	IV	Transfer the data using RS-422 standards.	2
15	V	Transfer data using UART technique and observe the transfer speed.	2
16	V	Transfer data using Bluetooth technique and check the range of the device.	2
17	V	Transfer various types of data using MODEM	2
		Total	34

## 8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- i. Design sample and hold Circuit
- ii. Explore ASK Modulator and Demodulator circuit
- iii. Explore FSK Modulator and Demodulator circuit.
- iv. Explore circuit of PSK Modulator and Demodulator
- v. Explore circuit of Modulator and Demodulator (modem)
- vi. Prepare data transfer cable for RS-232 standards
- vii. Prepare data transfer cable for RS-422 standards
- viii. Compare ranges of Bluetooth communication of various mobile
- ix. Collect technical specifications of Bluetooth headphone.
- x. Industrial visit to telephone exchange and mobile switching centre

## 9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

## 10. SUGGESTED LEARNING RESOURCES

### A) List of Books

Sr. No.	Title of Book	Author	Publication
1	Digital Communication (2 <sup>nd</sup> Edition)	R.N. Mupagi	Oxford University Press, New Delhi, Latest edition
2	Analog and Digital Communication	T. L. Singal	Tata McGraw Hill, India Latest edition
3	Modern Digital and Analog Communications Systems (3 <sup>rd</sup> Edition)	B.P. Lathi	Oxford University Press, New Delhi, Latest edition
4	Electronic Communications Modulation and Transmission	Robert J. Schoenbeck	PHI Learning, New Delhi, 2nd Edition
5	Electronics Communication System (Fundamental to Advance)	Wayen Tomasi	Pearson Education, New Delhi, 5th edition
6	Communication System(Analog and Digital)	Sanjay Sharma	S.K. Kataria and Sons, New Delhi, Latest edition
7	Electronic Communication Systems	George Kennedy and Bernard Davis	Tata McGraw Hill, New Delhi, 5th edition or latest
8	Data Communication and Networking	Behrouz A. Forouzan	Tata McGraw Hill, New Delhi, 3rd edition or latest

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

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

### C) List of Software/Learning Websites

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

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

- **Shri P.R.Patel,** HOD, (EC), B.S.Patel Polytechnic, Kherva, Mehsana.
- **Shri D. R. Bhojani,** HOD, (EC) Darshan Institute of Engineering and Technology for Diploma Studies, Rajkot
- **Shri M. Y. Kantharia,** HOD(EC), BBIT, Vallabh Vidhyanagar
- **Shri (Smt.) K.K.Shah,** Sr. Lecturer, (EC), Government Polytechnic, Rajkot

**Coordinator and Faculty Members from NITTTR Bhopal**

- **Prof. (Mrs.) Anjali Potnis,** Assistant Professor, Department of Electrical and Electronics Engineering.
- **Prof. (Mrs.) Susan S. Mathew,** Associate Professor, Department of Electrical and Electronics Engineering.