

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: MICROPROCESSOR AND ASSEMBLY LANGUAGE
PROGRAMMING
(Code: 3341101)

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	4 th Semester

1. RATIONALE

Microprocessor is the heart of embedded system and computers. This course will provide basic knowledge of microprocessor architecture and programming in assembly language. The basic knowledge of microprocessor and assembly language programming will enable the students to learn microcontroller and embedded systems in the higher semesters. The intention of this course is to help the student to maintain microprocessor based electronic equipments.

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 microprocessor based electronic equipment.**

3. COURSE OUTCOMES

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

- Analyse the architecture of the Intel 8085 microprocessor for its various applications.
- Develop simple arithmetic programmes
- Use the addressing modes and timing diagram for executing programmes efficiently
- Develop assembly language program using stack and subroutine for various applications
- Interface peripheral devices with 8085 microprocessor

4. TEACHING AND EXAMINATION SCHEME

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

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-I Microprocessor Architecture	1a. Define microprocessor and Differentiate between types of microprocessor	1.1 Microprocessor and types of microprocessor
	1b. Describe the function of pins in the pin diagram of 8085 microprocessor with a sketch.	1.1 Pin diagram of 8085 microprocessor
	1c. Define and explain different operations performed by Microprocessor	1.2 Microprocessor operations
	1d. Describe the 8085 microprocessor architecture diagram with its functioning.	1.3 8085 Microprocessor architecture diagram with its functions
	1e. Describe the register set of 8085 1f. Describe the impact of ALU on flags of 8085 1g. Describe interrupt and serial I/O	1.4 Register set of 8085 1.5 Flag Classification 1.6 1.7 Interrupt types and serial I/O
1h. Define the various types of buses and clock speed. 1i. Importance of demultiplexing of address/data bus and control signal 1j. State the significance of clock speed.	1.7 Bus organisation: Address & Data bus and control bus and demultiplexing of buses 1.8 Clock speed	
Unit-II 8085 Microprocessor Instruction set	2a. Differentiate between opcode and operand with examples	2.1 Opcode and operand
	2b. Define the classification of the instruction set	2.2 Instructions: Data transfer, Arithmetic, Logical, Branch, Stack and I/O read and write cycle
Unit-III Addressing Mode And Timing Diagram	3a. Define the need of addressing modes. 3b. Classify the various addressing modes	3.1 Type of addressing mode of 8085
	3c. Differentiate between T-state, machine cycle and instruction cycle	3.2 T-state, Machine Cycle, Instruction cycle
	3d. Explain with sketches the timing diagram for I/O and memory read/write cycle	3.3 Timing diagram
	3e. Describe the timing delay using NOP instruction	3.4 Timing Delays
Unit-IV Programming In 8085	4a. Develop to execute simple addition and subtraction programmes using the instruction set	4.1 Addition and subtraction programmes 4.2 Multiplication and division programmes
	4b. Develop to execute simple multiplication and division programmes using the instruction set	
	4c. Develop to execute various assembly language programs using looping and	4.3 Looping, Counting and Indexing.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	counting concept.	
	4d. Develop to execute assembly language programs using logical functions	4.4 Logic operations viz. AND, OR, NOR, NAND NOT, EXOR.
	4e. Develop to execute an assembly language to generate delay of specific time.	4.5 Counter and Timing delays.
	4f. Develop to execute an assembly language sub program based on Stack and Subroutine concept.	4.6 Stack and subroutines.
Unit-V Interfacing Of 8085	5a. Define memory mapping. 5b. Discriminate between memory mapped I/O and I/O mapped I/O	5.1 Memory and I/O mapping.
	5c. Explain the functions of the chip selection and decoder interfacing.	5.2 Chip selection and decoder interfacing.
	5d. Interface 8085 to EPROM.	5.3 Interfacing to EPROM and R/W Memory
	5e. Sketch the interfacing circuit for LED using 74LS245	5.4 Interfacing LEDs and Switches using 74LS245
	5f. Explain the function of IC 8255 with a block diagram. 5g. Develop to execute assembly language program to read and display the data from IC 8255 ports.	5.5 Programmable Peripheral Interface- IC 8255: Configuration, Modes and Operation

6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Microprocessor Architecture	10	8	6	4	18
II	8085 microprocessor instruction set	6	2	4	4	10
III	Addressing mode and Timing Diagram	10	4	6	6	16
IV	Programming in 8085	8	2	6	4	12
V	Interfacing of 8085	8	4	4	6	14
	Total	42	20	26	24	70

7. SUGGESTED LIST OF EXERCISES/PRACTICAL

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.

Sl. No.	Unit No.	Practical/Exercise (outcome in psychomotor domain)	Approx. Hrs. Required
1.	I	Identify the components of the microprocessor trainer to configure in the programming mode	2
2.	II	Develop/Execute a simple programme to move data from one register to the other	2
3.	II	Develop/Execute programme immediate data between different registers	2
4.	II	Develop/Execute a programme for addition	2
5.	II	Develop/Execute a programme for subtraction	2
6.	II	Develop/Execute a programme for multiplication	2
7.	II	Develop/Execute a programme for division	2
8.	III	Develop/Execute an Assembly language program to convert Hexadecimal to ASCII code conversion.	2
9.	IV	Develop/Execute Assembly language program to check whether given no is odd or even	2
10.	IV	Develop/Execute a programme to transfer a block of data from one memory location to another memory location	2
11.	IV	Develop/Execute a programme to add two 32-bit numbers	2
12.	IV	Develop/Execute a programme to add 2 decimal numbers in BCD format	2
13.	IV	Develop/Execute a programme to convert data from grey code to binary code	2
14.	IV	Develop/Execute a programme to convert data from binary code to grey code	2
15.	IV	Develop/Execute an Assembly language programs based on 8 bit Logical instructions.	2
16.	IV	Develop/Execute an Assembly language programme to sum integers from 0 to 9.	2
17.	IV	Develop a programme to find the smallest number from an array of N numbers	2
18.	IV	Develop a programme to count negative values in given block of data.	2
19.	IV	Develop/Execute a Subroutine to find the square of given integer.	2
20.	V	Develop/Execute an Assembly language programme to sort given array of ten bytes in descending order.	2
21.	V	Develop/Execute an Assembly language programme to alternatively blink LEDs connected on Port –B of 8255 at an	2

Sl. No.	Unit No.	Practical/Exercise (outcome in psychomotor domain)	Approx. Hrs. Required
		interval of 0.1 second. Draw Interface diagram.	
22.	V	Develop/Execute an Assembly language programme for 8255 to Interface keypad and display an LED	2
Total			44

8. SUGGESTED LIST OF STUDENT ACTIVITIES.

Following is the list of proposed student activities like:

- i. Develop unit wise topics related programs in laboratory.
- ii. Develop any module of to be useful in real life application.
- iii. Prepare Multimedia presentation of module developed by students.
- iv. Prepare the charts of block diagram, circuit diagram and timing diagrams.
- v. Interface with IC 8259, IC 8279, IC 8254, IC 8251.

9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. As much programming
- ii. Animation/Video presentation session.
- iii. Group discussion and seminar.

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Books	Author	Publication
1	Microprocessor Architecture Programming and Application	Ganonker, Ramesh	PHI Learning, New Delhi, latest edition
2	The 8080/85 Family: Design, Programming and Interfacing	Ufferbeck, John	PHI Learning, New Delhi, latest edition
3	Introduction to Microprocessor	Mathur, A.P.	TMH, New Delhi, latest edition
4	Microprocessor and its application	Ram, B.	BPB, New Delhi, latest edition
5	Microprocessor and Interfacing	Hall, Douglas	TMH, New Delhi, latest edition
6	Microprocessors and Microcontrollers	Kumar, Senthil, Saravanan, Jeevananthan	Oxford University, New Delhi, latest edition

B) List of Major Equipment/Materials with Broad Specifications

- i. 8085 microprocessor kits and simulator
- ii. Peripheral Interfacing circuit board of IC 8255.
- iii. CRO and Logic Analyser
- iv. Computer Systems with minimum P III processor (or equivalent) and 512 MB RAM.
- v. Multimedia Projector

C) List of Software/Learning Websites

- i. Go for free open source software wherever applicable
- ii. Simulator such as : <http://8085simulator.codeplex.com/> <http://gnusim8085.org/> or its

Equivalent.

- iii. Latest processor configuration : <http://www.intel.com/pressroom/kits/quickreffam.htm>
- iv. Intel 8085 microprocessor architecture: <http://www.cpu-world.com/Arch/8085.html>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty from Polytechnic Group

- **Prof. D. B. Vagadia**, HOD (EC), Government Polytechnic, Rajkot
- **Prof R. D. Raghani**, HOD (EC), L.E. Collage, Morbi
- **Prof. T. R. Parmar**, Sr. Lecturer (EC), Government Polytechnic, Palanpur
- **Prof. K. N. Vaghela**, Sr. Lecturer (EC) , Government Polytechnic, Ahmedabad
- **Prof. J D Chauhan**, Sr.Lecturer (EC), BBIT, Vallabh Vidhyanagar
- **Prof. (Ms) Sthuthi Rachel Joshua**, Assistant Professor, Oriental College of Engineering, Bhopal

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.

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

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

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	4 th 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

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE	PA	ESE	PA	150
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
Unit – I Pulse Code Modulation	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
Unit-II Digital Modulation Techniques	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
Unit-III Information Theory and Coding	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
Unit-IV Data Communication	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
Unit-V Applications of Digital Communication	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
	Total	42	16	31	23	70

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 nd 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 rd 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
- 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.
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- **Shri M. Y. Kantharia,** HOD(EC), BBIT, Vallabh Vidhyanagar
- **Shri (Smt.) K.K.Shah,** Sr. Lecturer, (EC), Government Polytechnic, Rajkot

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- **Prof. (Mrs.) Anjali Potnis,** Assistant Professor, Department of Electrical and Electronics Engineering.
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GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: OPTICAL COMMUNICATION
(Code: 3341103)**

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	4 th Semester

1. RATIONALE

Optical Communication is an essential component of the modern Telecom Industry. Therefore it is desired that the diploma engineering students should be able to operate and maintain the components used in Optical communication system.

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 Fibre Optics Communication system**

3. Course Outcomes

- Analyse optical fibre.
- Install fibre optic cables
- Test optical driver and receiver circuits
- Identify optical components
- Measure optical fiber parameters

4. TEACHING AND EXAMINATION SCHEME

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

S

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** - Practical; **C** - Credit; **ESE** - End Semester Examination; **PA** - Progressive Assessment

5. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit – I Light propagation in Optical Fiber	1a. Describe the phenomenon of total internal reflection.	1.1 Ray model: 1.1.1 Fundamental laws of optics : refraction, Snell's law, critical angle, total internal reflection 1.1.2 Ray propagation in step index fiber 1.1.3 Numerical Aperture and acceptance angle 1.1.4 Definition of Skew rays and Meridional rays 1.2 Wave model 1.2.1 Phase velocity and group velocity 1.3.2 Modes in optical fiber 1.3.3 V-number & normalized frequency
	1b. Classify the different types of Optical fiber used in industry.	1.3 Types of Optical Fiber: 1.3.1 SI and GI 1.3.2 SM and MM
	1c. Explain different types of losses in Optical fiber.	1.4 Attenuation: 1.4.1 Absorption losses: intrinsic and extrinsic 1.4.2 Linear scattering losses: rayleigh and mie 1.4.3 Fiber bend losses: micro and macro. 1.5 Dispersion: 1.5.1 Intermodal Dispersion in multi mode step index fiber 1.5.2 Intra-modal (Chromatic) Dispersion: material and wave guide dispersion. 1.6 Dispersion shifted and dispersion flattened fibers
	1d. Describe Fiber optics communication system with its advantages & disadvantages	1.7 General configuration of Fiber optic communication system
Unit – II Optical Fiber Cables & Connections	2a. Explain Fibre fabrication process and cabling techniques.	2.1 Fiber Fabrication: 2.1.1 Fiber Materials 2.1.2 Double crucible method 2.1.3 Vapor deposition methods: MCVD, VAD 2.1.4 Fiber drawing process 2.2 Fiber optic cables : 2.2.1 Needs of cabling 2.2.2 Fiber Cables: Slotted core, loose tube and multi-fiber ribbon
	2b. Describe splicing and joining of fibre cable	2.3 Connection losses: 2.3.1 Extrinsic Parameters: Fresnel reflection, Misalignment, and Other factors. 2.3.2 Intrinsic Parameters: NA mismatch, diameter mismatch 2.3.3 Fiber end preparation for loss minimization. 2.4 Splices: 2.4.1 Fusions Splices

Unit	Major Learning Outcomes	Topics and Sub-topics
		2.4.2 Mechanical splices: Capillary, V-grooved, Loose tube, Spring groove and elastomeric splices.
	2c. Explain the process of Connecting the fibre cable with connectors	2.5 Fiber optic connectors: Ferrule, Expanded beam.
Unit – III Optical Sources and Detectors	3a. Describe working principle of various optical Source	3.1 Basic concepts of Absorption and Emission in semiconductor 3.2 Construction and Operating Principle of LED 3.3 Heterojunction structure: SLED, EELED 3.4 Construction and Operating Principles of Semiconductor LASER Diode
	3b. Describe working principle of various optical detector	3.5 Quantum efficiency and Responsivity 3.6 p-n photodiode 3.7 p-i-n photodiode 3.8 Avalanche photo diode
	3c. Write steps for coupling : Source to fibre and fibre to detector	3.9 Coupling between fiber and source/detector
	3d. Understand driver circuits used in Optical communication system	3.10 LED driver circuit: Analog, Digital 3.11 LASER driver circuit: analog, digital 3.12 Optical receiver block diagram 3.13 Common source FET preamplifier 3.14 Regenerative repeater
Unit – IV Optical components & Integrated optics	4a. Explain the functions of various Optical Components	4.1 Optical couplers and isolators: types and functions 4.2 Optical switches 4.3 Beam splitter 4.4 Optical multiplexer and demultiplexer 4.5 Optical wavelength converter 4.6 Bragg grating
	4b. Describe working of optical amplifier	4.7 Optical Amplifiers-Semiconductor optical amplifier, EDFA, Raman amplifier
	4c. Understand concept of Integrated optics	4.8 Concept of Integrated optics
Unit – V Characterization & Applications	5a. Measure optical fiber parameters	5.1 fiber parameters measurement: attenuation, NA, inter modal dispersion, RI profile
	5b. Describe working principle of Optical Power Meter & OTDR	5.2 Optical power meter 5.3 Optical time domain reflectometer
	5c. Understand application of WDM in Fibre optics communication system	5.4 WDM & DWDM

Unit	Major Learning Outcomes	Topics and Sub-topics
	5d. Classify & application of fibre optic sensors.	5.5 Fiber Sensors
	5e List application of various LASER used in industries & medical surgery.	5.6 laser Types: Concept of solid state, semi conductors & gas laser 5.7 Application of Different Lasers

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

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Light propagation in Optical Fiber	10	9	4	2	15
II	Optical Fiber Cables and Connections	8	10	3	2	15
III	Optical Sources and Detectors	10	8	4	3	15
IV	Optical components & Integrated optics	7	10	1	0	11
V	Applications	7	10	2	2	14
Total		42	47	14	9	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

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

7. SUGGESTED LIST OF EXERCISES/PRACTICAL

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	Apprx. Hrs. Required
1	I	Measure N.A. of optical fiber	2
2	I	Establish Analog communication optical link	2
3	I	Establish Digital communication optical link	2
4	I	Measure attenuation of given optical fiber	2
5	I	Measure bending loss of given optical fiber	2
6	I	Demonstrate various fiber cables	2
7	II	Demonstrate fiber end preparation process.	2
8	II	Demonstrate Splicing Techniques	2
9	II	Demonstrate various connectors	2
10	III	Plot characteristics of LED	2
11	III	Plot characteristics of LASER diode	2
12	III	Plot characteristics of Photo Diode	2
13	III	Build and test LED drive circuits	2
14	IV	Demonstrate OTDR	2
15	IV	Demonstrate Optical Power Meter.	2
16	III	Build fibre optics link using PAM technique	2
17	III	Build fiber optics link using TDM technique	2
		Total	34

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

1. Visit nearby fiber optics industries.
2. Hands on training on fibre connectorization.
3. Arrange visit to BSNL to see live circuits and measurement of parameters
4. Collect information of transatlantic optical network used for communication.
5. Visit any Campus Wide area network which uses optical fiber .
6. Explore use of lasers in medical treatment (Eye, Kidney ,brain,ulcer,cancer etc)

9. SUGGESTED LEARNING RESOURCES

(A) List of Books:

S. No.	Title of Books	Author	Publication
1	Optical Fiber Communication	John M Senior	Pearson
2	Fiber Optics & Optoelectronics	R P Khare	Oxford
3	Fiber Optic Communication	D C Agarwal	S Chands
4	Light wave Communication Systems: A Practical Perspectives	Rajappa Papannareddy	Penram
5	Optical Fiber & Fiber Optic Communication	Subir Kumar Sarkar	S Chands

B. List of Major Equipment/Materials

1. OTDR
2. Optical power meter
3. CRO
4. Fusion splicing machine
5. Optical fiber : Glass,Plastic
6. Semiconductor laser

C List of Software/Learning Websites

Material / Products:

<http://computer.howstuffworks.com/fiber-optic.htm>

<http://www.ntu.edu.sg/library/Pages/default.aspx>

<http://nptel.iitm.ac.in/courses/askaquestion.php?subjectId=117101002>

<http://www.thefoa.org/tech/>

http://www.thefoa.org/fo_urls.htm

http://en.wikipedia.org/wiki/Optical_fiber

<http://www.telecomramblings.com/network-maps/usa-fiber-backbone-map-resources/>

http://www.foci.com.tw/pd_scw.html

Videos:

<http://nptel.iitm.ac.in/courses/117101002/>

<http://www.youtube.com/watch?v=aqazAcE19vw>

<http://www.youtube.com/watch?v=pIIBINW7sOo>

<http://www.youtube.com/watch?v=ASMcrcgZSrw>

http://www.youtube.com/watch?v=III8Mf_faVo

<http://fiberu.org/basic/LP3.html>

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

1. **Shri M S Dave** Sr. Lecturer, EC Dept, Government Polytechnic, Ahmedabad.
2. **Shri U V Buch** Sr. Lecturer, EC Dept, Government Polytechnic, Gandhinagar.
3. **Shri S M Gheewala**, Sr. Lecturer, EC Dept, Government Polytechnic, Valsad.

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.

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT
COURSE CURRICULUM
COURSE TITLE: ELECTRONICS INSTRUMENTS AND MEASUREMENT
(Code: 3341104)

Diploma Programme in which this course is offered	Semester in which offered
Electronics And Communication Engineering	4 th Semester

1. RATIONALE

Troubleshooting of electronic equipment is an essential requirement of Service sector industry. This course will help to develop skills to become professional technician with capability to measure electrical parameters using various instruments. By learning this course students will able to know basics of various Instruments, transducers and working of electronic circuits used in electronic test and measuring instruments.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills leading to the achievement of following competency

- **Maintain various electronic, test and measuring instrument.**

3. COURSE OUTCOME

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

- i. Measure various electrical parameters with accuracy, precision, resolution.
- ii. Use AC and DC bridges for relevant parameter measurement.
- iii. Select appropriate passive or active transducers for measurement of physical phenomenon.
- iv. Use Signal Generator, frequency counter, CRO and digital IC tester for appropriate measurement.
- v. Test and troubleshoot electronic circuits using various measuring instruments.
- vi. Maintain various types of test and measuring instruments.

4. TEACHING AND EXAMINATION SCHEME

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

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

5. COURSE DETAIL

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Characteristic of Measurements and Bridges	1a. Define accuracy, precision, resolution	1.1 Accuracy, precision, resolution, error and noise
	1b. Describe the types of error	1.2 Types of errors 1.3 Limiting of errors
	1c. Explain working and application of DC bridges	1.4 Wheatstone bridge, Kelvin's double bridge
	1d. Explain working and application of AC bridges	1.5 Maxwell's bridge, Hay bridge, Schering bridge
Unit – II Basic Parameter Measurements	2a. Differentiate between moving iron and moving coil type instruments	2.1 Moving coil and moving iron type instruments
	2b. Measure DC and AC voltage and current using analogue meter.	2.2 DC and AC voltmeter
	2c. Extend the measuring range of the meters.	
	2d. Explain its working of DVM with sketches.	2.3 Electronic multimeter (DVM)
	2e. Describe working and advantage of digital multi meter	2.4 Types- ramp type, integrating type and successive approximation type DVMs
	2f. Discriminate between energy and power.	2.5 Watt meter, Energy meter, clip-on meter
	2g. Measure energy and power using Watt meter and Energy Meter.	2.6 Hot wire instrument
	2h. Describe the construction of hot wire instrument .	
	2i. Describe its working LCR –Q meter with sketches	2.7 LCR- Q meter : Basic circuit, applications
	2j. Measure quality factor of a	2.8 Series and parallel

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	coil and a capacitor .	connection of Capacitor and Inductor.
Unit – III Oscilloscopes	3a. Describe functions of basic building of CRO 3b. Explain deflection systems. 3c. Measure parameters viz. Amplitude, frequency and time period using CRO.	3.1. Block diagram of C.R.O. 3.2. Cathode ray tube: construction, operation, screens, graticules 3.3. Vertical deflection system, Horizontal deflection system, Delay line, 3.4. Measurement of frequency, time delay, phase angle and modulation index (trapezoidal method) 3.5. Oscilloscope probe: structure of 1:1 and 10:1 probes 3.6. multiple trace CRO
	3d. Explain working principle of digital storage oscilloscope.	3.7. Digital storage oscilloscope and its features
Unit – IV Transducers	4a. Differentiate the following: active and passive, primary and secondary transducers. 4b. Describe working of LVDT transducer.	4.1. Classification of transducers 4.2. Unbonded strain gauge 4.3. Displacement transducers 4.4. LVDT
	4c. Explain the principle of Capacitive and Inductive transducer	4.5. Capacitive transducers 4.6. Inductive transducers 4.7. Resistive and capacitive touch screen transducer used in mobile
	4d. Describe functions of velocity and pressure transducers. 4e. Explain optical & stroboscopic tachometer.	4.8. Piezo-electric transducer 4.9. Velocity transducer 4.10. RPM measurement technique
	4f. Describe the working of different types of temperature transducers. 4g. Explain principle of Thermocouple. 4h. Describe working of RTD and Thermistor	4.11. Temperature measurement: Thermocouples: Seebeck, Peltier Effect, J,K,R,S,T Types, Thermistors 4.12. Resistance thermometer RTDs – PTC,PT-100 (2-3-4 Wire systems-only circuit

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – V Test And Measuring Instruments	5a. Describe working principle of function generator.	5.1. Function generator
	5b. Describe working principle of audio signal generator.	5.2. Audio frequency signal generation
	5c. Describe working principle of Sweep frequency generator	5.3. Sweep frequency generator
	5d. Define pulse parameters viz. pulse duration ,pulse width, duty cycle, On and off time of pulse	5.4. Pulse and square wave generator
	5e. With sketches explain the functions of different types of frequency counters	5.5. Simple frequency counter, Display counter, Cascading counters 5.6. Multiplexing of display in frequency counter 5.7. Period measurement
5f. Explain working of digital IC tester.	5.8. Digital IC tester, Logic analyzer, Spectrum analyzer, Harmonic distortion analyzer, Field strength meter (dB meter)	
5g. Explain working of Logic analyzer		
5h. Explain working function of Spectrum analyzer.		
5i. Explain working function of Harmonic distortion analyzer.		
5j. Explain working function of Field Strength Meter.		

6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Characteristic of Measurements and Bridges	05	04	03	03	10
II	Basic Parameter Measurements	10	03	06	07	16
III	Oscilloscopes	07	02	08	02	12
IV	Transducers	10	03	05	08	16
V	Test and Measuring Instruments	10	02	08	06	16
Total		42	14	30	26	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised 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 PRACTICAL/EXERCISES

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 (outcomes in psychomotor domain)	Approx. Hrs. Required
1	I	Measure various parameters viz. voltage, current, resistance using Digital Multimeter.	2
2	I	Measure the value of unknown resistor using Wheatstone bridge.	2
3	II	Convert given galvanometer to DC/AC current- meter.	2
4	II	Convert given galvanometer to DC/AC Volt-Meter.	2
5	II	Measure quality Factor of given Inductor and Capacitor using LCR Q-Meter.	
6	IV	Obtain characteristic of LVDT.	2
7	IV	Obtain characteristics of strain gauge.	2
8	IV	Obtain characteristics of thermocouple.	2
9	IV	Obtain characteristics of thermistor.	2
10	IV	Obtain characteristics of RTD transducer.	2
11	IV	Control temperature using RTD in any specific application.	2
12	III	Measure voltage, frequency, phase and modulation index (trapezoidal method) using CRO.	2
13	III	Measure Unknown frequency using Lissajous patterns.	2
14	III	Demonstrate features of digital storage oscilloscope.	2
15	V	Analyse sine/square wave in frequency domain using spectrum analyser.	
16	V	Test various digital IC using I.C. Tester.	2
17	V	Measure various RF signal strength using field strength meter.	2
Total			34

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities:

- i. Explore data sheets/ technical specifications of transducers.
- ii. Present seminar on advanced Instrumentation topic.
- iii. Mini project based on transducer.
- iv. Explore Circuit of temperature/pressure control.

9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Computer based CBT describing operation of transducer.
- ii. Bridge simulation using Software like Electronic Workbench/multiSIM.
- iii. Seminars /experts lecture and group discussion.
- iv. Visit of Electronics Instruments calibration laboratories.

10. SUGGESTED LEARNING RESOURCES**(A) List of Books**

S. No.	Title of Books	Author	Publication
1	Electronic Instruments and Measurement Techniques	Cooper, W.D. Halfrick, A.B.	PHI Learning, New Delhi, latest edition
2	Electrical and Electronic Measurements	Sahani, A.K.	Dhanpat Rai, New Delhi, latest edition
3	Elements of Electronic Instrumentation and Measurement	Joseph, J.Carr	Pearson, New Delhi, latest edition
4	Electronic Instrumentation and Measurements	David, Bell	PHI New Delhi, latest edition
5	Electronic Measurements and Instrumentation	Kishor, K Lal	Pearson, New Delhi, latest edition

B. List of Major Equipment/Materials with broad specification

- i. Function generator
- ii. Digital multimeter
- iii. D.C. power supply
- iv. Cathode Ray Oscilloscope
- v. Digital Storage Oscilloscope
- vi. LCR-Q meter
- vii. Field strength meter(dB meter)
- viii. Experimental trainer kits, Bread board, Computers

C List of Software/Learning Websites

- i. Electronic Workbench/MultiSIM/Circuit Maker
- ii. www.ocw.mit.edu
- iii. www.home.agilent.com

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

- **Shri B. P. Raval**, Sr. Lecturer, (EC), Government Polytechnic, Rajkot
- **Shri B. B. Renuka**, Sr. Lecturer, (EC) Government Polytechnic, Ahmadabad
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GTUQuestionPapers.com

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: INDUSTRIAL ELECTRONICS
(Code: 3341105)**

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	4th Semester

1. RATIONALE

Exposure to application oriented electronic circuits commonly used in the industries is very essential for any Electronics and Communication Diploma Engineering. This course will enable the students to understand the construction, working, and applications of various types of power electronic components like SCR, DIAC, TRIAC, IGBT and applications based circuits such as fan regulator, photo-electric relay, AC/DC power controller, Polyphase rectifier, Inverters etc. Hence study of this course will enable the students to test and troubleshoot the Industrial electronic circuits and components.

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 the industrial electronic equipments.**

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.

- Choose relevant thyristor for the given application
- Troubleshoot AC & DC power control circuits employing thyristors
- Troubleshoot inverter, chopper and cyclo-converters
- Use photoelectric devices in relevant applications
- Use different types of timers in specific applications
- Maintain induction heating and dielectric heating equipment

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	
04	00	02	06	70	30	20	30	150

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-I Introduction to Thyristors	1a Describe working & constructional features of SCR, DIAC, TRIAC, PUT, IGBT with the help of characteristic curve . 1b Draw the characteristic curve of SCR, DIAC, TRIAC, PUT, IGBT . 1c List applications of SCR, DIAC, TRIAC, PUT, IGBT 1d Explain working of SCR using transistor analogy	1.1 Industrial electronics devices : SCR, DIAC, TRIAC, PUT, IGBT
	1e Explain the turn ON methods of thyristor (SCR) - triggering methods 1f Explain the turn OFF methods of SCR - commutation techniques of SCR	1.2 Triggering methods of SCR 1.3 Commutation techniques of SCR
	1g Describe construction & working of Opto- Isolators, Opto-TRIAC, Opto-SCR, Opto-transistor. 1h Draw characteristics of Opto-Isolators, Opto-TRIAC, Opto-SCR, Opto-transistor 1i List industrial applications of Opto-Isolators, Opto-TRIAC, Opto-SCR, Opto-transistor	1.4 Opto electronic devices: Opto-Isolators, Opto-TRIAC, Opto-SCR, Opto-transistor
Unit-II Industrial & Power Applications	2a Explain working of Half & Full wave control bridge rectifiers, various types of control rectifier circuits using SCR. 2b Explain use of SCR as a static switch.	Typical Industrial Thyristor Applications: 2.1 Control rectifiers using SCR 2.2 SCR as a static switch
	2c Describe function of single phase AC power control circuit using DIAC-TRIAC. 2d Draw schematic circuit for the above application.	2.3 Single phase AC power control using DIAC-TRIAC
	2e Describe function of DC power control circuit using SCR with UJT in triggering circuit. 2f Draw schematic circuit for the above application.	2.4 UJT Triggered SCR power control.
	2g Select the appropriate Photoelectric devices for switching in power control application	Photoelectric devices for switching 2.5 Photo electric relay/switch using LDR, LASCR, photodiode
	2h Explain the working of Solid State	2.6 Solid state relay using Opto-

	relays using Opto-TRIAC, Opto-SCR, Opto-transistor	TRIAC, Opto-SCR, Opto-transistor
Unit-III Power Converters	3a Compare single and Poly-phase rectifier circuits.	3.1 Single phase rectifiers and Polyphase rectifiers
	3b Describe the applications of Poly-phase rectifiers.	3.2 Three-phase H.W. & Three-phase F.W. rectifiers
	3c Explain working of Three-phase H.W. & Three-phase F.W. rectifiers.	
	3d Explain the Principle & working of Series, Parallel and bridge type Inverter circuits.	3.3 Inverters: Series, Parallel and bridge Inverters
	3e Describe the applications of Series, Parallel and bridge type Inverters	
	3f Explain the Principle & working of single phase Cyclo converter circuits 3g Describe the applications of single phase Cyclo converter	3.4 Single phase cyclo-converters
3h Explain the Principle & working of Chopper circuits. 3i Describe the applications of Chopper	3.5 Chopper	
3j Describe the working of UPS & SMPS with the help of block diagram. 3k List the applications and technical specifications of UPS & SMPS.	3.6 UPS : online & offline 3.7 SMPS	
Unit-IV Timers and High Frequency applications	4a Explain Principles of RC based time constant circuit.	4.1 Basic Time Constant ckt. : RC timing circuits
	4b Simulate / Describe applications as timer circuits using SCR, IC 555 , IC XR-2240 and IC 556 for Timer, Sequential timer, Delay timer, Programmable timer .	4.2 Timer using IC555 4.3 Sequential timer using IC555, IC556 4.4 SCR Delay timer 4.5 Programmable timer using IC XR-2240
	4c Explain the principle of Induction heating.	4.6 Induction heating
	4d Describe the working of Induction heating, drawing the schematic block diagram	
	4e List merits-demerits of Induction heating	
	4f List application of Induction heating.	
4g Explain the principle of Dielectric heating 4h Describe the working of Dielectric heating, drawing the schematic block diagram 4i Compare merits-demerits of Dielectric heating 4j List applications of Dielectric heating	4.7 Dielectric heating	

Unit-V Solid State Controls	5a Explain the working of Solid State Controls for the various types of motors i.e. Series, Shunt, Universal, Servo and Stepper motor.	5.1 Single phase DC shunt motor and its speed control using thyristors 5.2 Single phase Induction motor (AC motor) and its speed control using thyristors-TRIAC 5.3 Universal motor and its speed control 5.4 Stepper motor – construction, working and its applications 5.5 Servo motor - construction, working and its applications.
	5b Explain the working of Synchros	5.6 Synchros - construction, working and its applications.
	5c Draw the block diagram of Programmable Logic Control and explain the function of each block	5.7 Programmable Logic Control - block diagram, working, advantages, applications.

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

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Thyristors	12	6	6	4	16
II	Industrial & Power Applications	10	2	4	6	12
III	Power Converters	12	3	4	8	15
IV	Timers and High Frequency applications	12	8	4	3	15
V	Solid State Controls	10	3	3	6	12
Total		56	22	21	27	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised 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/PRACTICAL

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 (Outcomes' in Psychomotor Domain)	Approx Hrs. Required
1	I	Plot V/I Characteristics of SCR	2
2	I	Plot V/I Characteristics of DIAC	2
3	I	Plot V/I Characteristics of TRIAC	2
4	I	Plot Characteristics of Opto-Isolator	2
5	I	Perform R-C phase shift control of SCR	2
6	II	Demonstrate dv/dt limitation of SCR	2
7	II	Test Half control bridge rectifier with filter	2
8	II	Test Light operated Relay/Photo-electric switch	2
9	II	Obtain Characteristics of LASCR	2
10	III	Measure efficiency of Poly phase Rectifier	2
11	III	Measure Load/Line regulation of SMPS	2
12	IV	Implement RC Timer using Zener diode & Transistor	2
13	IV	Perform Sequential Timer operation using IC-555	2
14	IV	Implement On-delay timer using IC-555	2
15	IV	Implement Delay timer using SCR	2
16	IV	Implement Programmable Timer IC-XR2240	2
17	V	Measure Speed of DC shunt motor controlled by open loop–close loop control system	2
18	V	Measure Speed of Universal Motor controlled by SCR/TRIAC	2
19	V	Test Characteristics of Solid State Relay	2
20	V	AC Single phase Servomotor FW/REV control	2
21	V	Perform the position control using synchro transmitter & synchro receiver.	2
Total (perform sufficient number of practical from above for 28 hours)			42

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- Find Specifications and package of SCR, TRIAC, DIAC, PUT from datasheet.
- Find Specifications and package of Opto-TRIAC, Opto-SCR, Opto-Transistor from datasheet.
- Collect specification of commercially used UPS, Inverter, SMPS & all motors in syllabus.
- Find Specifications and package of IC-555, IC-556, IC-XR2240 from datasheet.

- v. Find Specifications and package of DC shunt motor, Induction motor, Universal motor, Synchro, Servo motor from datasheet.
- vi. **Mini projects:** (Should be given individual basis from following)
- Fan regulator using TRIAC/DIAC
 - Light operated Relay
 - Cyclic Timer using IC555
 - Star-Delta timer using IC 555
 - Solid State Relay using Diac-Triac
 - SCR Firing using UJT
 - Tone burst modulation using IC 556
 - Project on XR2240
 - SMPS based on IC 7840
 - Projects on MOC3011
 - Projects on MOC3031
 - Zero cross detector using PC817

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Industrial Visit
- ii. Internet based assignments
- iii. Organising expert lecture
- iv. Display of appropriate video films

10. SUGGESTED LEARNING RESOURCES

A) List of Books

No.	Title of Book	Author	Publication
1	Industrial Electronics and Control	S.K.Bhattacharya & S.Chatterjee	TTTT, Chandigarh
2	Industrial Electronics	G.K. Mithal	Khanna
3	Industrial and Power Electronics	Harish C. Rai	Umesh Publication
4	Thyristor Engineering	M.S. Berde	Khanna
5	Electronics in Industry	George M. Chute & Robert D. Chute	McGraw-Hill
6	Power Electronics	M.H. Rashid	PHI
7	Industrial electronics Manual	Paul Zbar	McGraw Hill

B) List of Major Equipment/Materials with Broad Specifications

- i Trainer kits for
 - SCR, DIAC, TRIAC
 - Photo devices, LASCR, Opto-TRIAC
 - Controlled Rectifier, Polyphase rectifiers, Inverters

- SMPS,
 - IC-555 timer, Sequential Timer
 - Speed control of AC/DC Motor, Universal motor, AC Servomotor
 - Synchros, Solid State Relay
- ii CRO, Function Generator, Power supply, Digital multi meter, bread board
- iii Consumables Component: IC555/556, XR2240, MOC3011, MOC3031, PC817, MCT2E, SCR S104, TYN604, TRIAC BT136, DIAC DB32

C) List of Software/Learning Websites

- i. Common website for Industrial electronics:
- ii. Datasheets: <http://www.epanorama.net/links/searchlinks.html#datasheets>
- iii. Thyristor: <http://www.epanorama.net/links/componentinfo.html#thyristor>
<http://en.wikipedia.org/wiki/Thyristor>
- iv. SCR: <http://www.allaboutcircuits.com>
- v. Opto-Electronics: <http://www.epanorama.net/links/lights.html#dimmer>
- vi. Opto-isolator: <http://en.wikipedia.org/wiki/Opto-isolator>
- vii. Solid State Relay: http://en.wikipedia.org/wiki/Solid-state_relay
- viii. UPS: <http://www.epanorama.net/links/psu.html>
- ix. PLC: <http://www.epanorama.net/links/automation.html#plc>
http://en.wikipedia.org/wiki/Programmable_logic_controller
- x. Motors: <http://www.epanorama.net/links/motorcontrol.html>
- xi. AC/DC motors: <http://en.wikipedia.org/wiki/Motor>
- xii. Stepper motor: http://en.wikipedia.org/wiki/Stepper_motor
- xiii. Universal motor: http://en.wikipedia.org/wiki/Universal_motor
- xiv. Servo motor: <http://en.wikipedia.org/wiki/Servomotor>
- xv. Synchro: <http://en.wikipedia.org/wiki/Synchro>
- xvi. Induction heating: http://en.wikipedia.org/wiki/Induction_heating
- xvii. Dielectric heating: http://en.wikipedia.org/wiki/Dielectric_heating

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Shri T. P. Chanpura**, Lecturer (EC), Government Polytechnic, Ahmedabad
- **Shri T. R. Parmar**, Lecturer (EC), Government Polytechnic, Palanpur
- **Shri S. G. Valvi**, Lecturer (EC), Government Polytechnic for Girls, Surat
- **Shri N. M. Rindani**, Lecturer (EC), Government Polytechnic, AVPTI, 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.

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: CIRCUIT DESIGN TOOLS
(Code: 3341106)

Diploma Programmes in which this course is offered	Semester in which offered
Electronics and Communication Engineering	4 th Semester

1. RATIONALE

In the era of miniature electronic gadgets and automation, it is required to have electronic circuit simulation for better design and cost effective PCB layout for better performance. This course aims to teach students about how to simulate the electronic circuit and how to design PCB layout of given circuit using available circuit simulation and PCB layout design tools (free or licensed). This course helps the student to simulate the circuit and develop complete hardware circuit on PCB.

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:

- **Simulate/test the electronic circuit using circuit Simulation Tools.**
- **Fabricate PCB layout of electronic circuits by using PCB layout design tools**

3. COURSE OUTCOMES

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

- i. Compare different circuit simulation and PCB layout design software.
- ii. Make schematic electronic circuits in the software
- iii. Simulate simple electronics in the software
- iv. Design and develop layout of PCB using PCB layout design tool with fabrication (free or licensed).

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	100
0	0	4	4	0	0	40	60	

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

5. COURSE DETAILS

Note: There is no exclusive input sessions for theory in this course, however following theory should be discussed during practice sessions. There is no theory based exams.

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
Unit – I Circuit Simulation and PCB Design Software	1a. State the features of different circuit simulation tools (Open source or licensed) used for electronic circuit simulation.	1.1 Circuit simulation software.
	1b. List different PCB layout design tools (Open source or License) used for PCB layout design.	1.2 PCB layout design software.
Unit – II Design of Schematic Electronic Circuits Using Software	2a. Define the general terms used in circuit simulation software.	2.1 Wire, bus, junction, probe, voltage source, current source, and ground etc. used in circuit simulation software.
	2b. Create new projects and save it.	2.2 Create new project, and schematic file.
	2c. Use 'Search', 'add' and 'create' commands of the simulation software.	2.3 Search, add and create new electronic part.
	2d. Assemble electronics circuit using circuit simulation software.	2.4 Edit, Connect or wire the circuit.
Unit – III Simulation of Electronic Circuits	3a. Simulate and test the RC, LC, or RLC based electronic circuit using circuit simulation software.	3.1 Test RC, LC or RLC based electronic circuit.
	3b. Simulate and test the diode, transistor or MOSFET based electronic circuit using circuit simulation software.	3.2 Test diode, transistor or MOSFET based electronic circuit.
	3c. Simulate and test the analog or digital IC based electronic circuit using circuit simulation software.	3.3 Test analog/digital IC based electronic circuit.
	3d. Find the transient analysis of RC, LC, or RLC based circuit using circuit simulation software.	3.4 Transient analysis of RC, LC, or RLC based electronic circuit.
	3e. Find the bias point analysis of diode, transistor or MOSFET based circuit using circuit simulation software.	3.5 Bias point analysis or characteristic curve of diode, transistor or MOSFET based electronic circuit.
	3f. Find the transient analysis of diode, transistor or MOSFET etc. based circuit using circuit simulation software.	3.6 Transient analysis of diode, transistor or MOSFET etc. based electronic circuit.

Unit	Major Learning Outcomes (outcomes in cognitive domain)	Topics and Sub-topics
	3g. Find the frequency response (AC Analysis) of RC, diode, transistor etc. based electronic circuit using simulation software.	3.7 Frequency response (AC Analysis) of RC, diode, and transistor etc. based electronic circuit.
	3h. Find the frequency response (AC Analysis) of analog/ digital IC based circuit using simulation software.	3.8 Frequency response (AC Analysis) analog/ digital IC based electronic circuit.
Unit – IV PCB Layout Design	4a. Identify the terms net list file, back annotation, bill of material, foot print, PTH, track width, mil , etc. used in PCB layout design software.	4.1 Net list file, back annotation, bill of material, foot print, PTH, track width, mil, etc.
	4b. Transfer an electronic circuit to PCB layout design software.	4.2 Transfer circuit to PCB layout
	4c. Search, add and create footprint of different electronic components used in PCB layout design software.	4.3 Search, add and create footprint
	4d. Place, route and generate the layout of given circuit using manual or auto routing using PCB layout design software.	4.4 Place, route and generate PCB Layout
Unit – V PCB Fabrication Techniques	5a. Follow the PCB manufacturing steps.	5.1 Drawing and printing layout on board, photo etching process, masking process, etc.
	5b. Undertake Different PCB manufacturing techniques.	5.2 PCB manufacturing techniques

6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS

Not Applicable

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 Exercises (Outcomes' in Psychomotor Domain)	Approx. Hrs. required
1	I	Evaluate different Circuit simulation tools for Circuit Simulation (Presentation)	02
2	I	List and compare different PCB layout design tools used for PCB Layout Design (Presentation)	02
3	II	Create and save new schematic file with Project using circuit simulation software.	02
4	II	Use different options like wire, Bus, junction, AC and DC voltage source, current source, probe, Pulse generator, ground, probe etc. of circuit simulation software library.	02
5	II	Search, create and add the electronic component to the schematic file from the library used in circuit simulation software.	02
6	II	Connect the electronic circuit using Place and route method used in circuit simulation software.	02
7	II	Connect, simulate and test the RC, LC, and RLC based electronic circuit using circuit simulation software.	02
8	II	Connect, simulate and test the Diode, Transistor, MOSFET based electronic circuit using circuit simulation software.	02
9	II	Connect, simulate and test IC based electronic circuit using circuit simulation software.	02
10	III	Calculate the Bias point and verify V- I characteristic (DC Analysis) curve of given diode or transistor based circuitry using circuit simulation software.	02
11	III	Draw the Transient analysis curve of a given diode circuit using circuit simulation software.	02
12	III	Draw the Transient analysis curve of a given transistorized electronic using circuit simulation software.	02
13	III	Draw the Transient analysis curve of a given Analog IC based electronic circuit using circuit simulation software.	02
14	III	Draw the Frequency response (AC Analysis) curve to check the functionality of RC, LC and RLC based circuit using circuit simulation software.	02
15	III	Draw the Frequency response (AC Analysis) curve to check the functionality of Transistorized based circuit using circuit simulation software.	02
16	III	Draw the Frequency response (AC Analysis) curve to check the functionality of analog IC based circuit using circuit simulation software.	02
17	III	Use the following options netlist file, back annotation , Bill of material, single layer PCB, double layer PCB, PTH, footprint, track width, mil, etc. and develop a complete project.	04
18	IV	Synthesize and Transfer an electronic circuit using circuit simulation software to the PCB layout design software.	02
19	IV	Search, create and add footprint of different electronic components to the PCB layout design file .	02
20	IV	Synthesize the PCB Layout of the given RC, RLC, diode or transistor based electronic circuit with manual and auto routing technique using PCB design software.	02

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Approx. Hrs. required
21	IV	Synthesize the PCB Layout of given analog or digital IC based electronic circuit with manual and auto routing technique using PCB design software.	06
22	V	Synthesize complete PCB for a given electronic circuit (mini project)	04
23	V	Synthesize complete PCB through following Fabrication Techniques step by step.	06
Total			58

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

- i. Prepare PCB layout of a given circuit on butter paper (Mini Project).
- ii. Transfer the layout from Butter paper to Copper claded board (Paper Phenolic or glass epoxy material etc.)
- iii. Industrial Visit to any PCB manufacturing Industry.
- iv. Prepare PCB layout using circuit simulation software.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Expert Lecture from PCB manufacturing industry personal
- ii. Videos of PCB making steps and different PCB making Techniques
- iii. Install “everyCircuit” Android application & demonstrate it using “BlueStack” on computer
Use link: <http://www43.zippyshare.com/d/66433193/559625/EveryCircuit%20v2.00%20apkmania.com.rar>

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book/user manual	Author	Publication
1.	Printed Circuit Boards: Design and Technology	Bossart	TMH, New Delhi 2008 or latest edition
2.	Multisim user manual	National Instruments	www.ni.com
3.	Ultiboard user manual	National Instruments	www.ni.com
4.	Orcade online manual	Cadence	www.cadence.com

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

- i. Multisim (Academic Version or Licensed Version)
- ii. UltiBoard (Academic Version or Licensed Version)
- iii. Orcade (Student Version or Licensed Version)
- iv. Express PCB (Free Version or Licensed Version)
- v. Circuit Maker (Free Version or Licensed Version)
- vi. Tinapro (Free Version or Licensed Version)
- vii. EaglePCB Design Software (Free Version or Licensed Version)
- viii. FreePCB (Free Version)

C) List of Software/Learning Websites

- www.ni.com (Multisim and Ultiboard - Academic version)
- www.cadence.com (Orcade - Student version)
- www.youtube.com (PCB Manufacturing Videos)

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

- **Shri S. N. Sampat**, I/C Head (EC) Government Polytechnic, Gandhinagar.
- **Shri K. J. Pithadiya**, Lecturer (EC), BBIT, Vallabh Vidyanagar
- **Shri G. V. Parmar**, Lecturer (EC), Government Polytechnic, Jamnagar
- **Shri K. V. Chhaniyara**, Lecturer (EC), AVPTI Rajkot.

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