

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
L	T	P		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. 3b Describe the applications of Poly-phase rectifiers. 3c Explain working of Three-phase H.W. & Three-phase F.W. rectifiers.	3.1 Single phase rectifiers and Polyphase rectifiers 3.2 Three-phase H.W. & Three-phase F.W. rectifiers
	3d Explain the Principle & working of Series, Parallel and bridge type Inverter circuits. 3e Describe the applications of Series, Parallel and bridge type Inverters	3.3 Inverters: Series, Parallel and bridge 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. 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 .
4c Explain the principle of 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.		4.6 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.