**6.3 INDUSTRIAL ELECTRONICS AND CONTROL OF DRIVES**

**L T P**

**4 - 3**

**RATIONALE**

Industrial electronics plays a very vital role in the field of control engineering specifically in the modern industries as they mostly use electronic controls, which are more efficient, effective and precise as compare to the conventional methods. The old magnetic and electrical control schemes have all become obsolete. Electrical diploma holder many times has to maintain the panels used in the modern control process. Therefore, the knowledge of components like thyristors and other semiconductor devices used in such control panels is must for them in order to supervise the work efficiently and effectively. Looking in to usefulness and importance of the subject this has been incorporated in the curriculum.

**LEARNING OUTCOMES**

After undergoing the subject, students will be able to:

* Use SCR, TRIAC and Diac as per requirement of circuit
* Control fan speed using Triac and Quadriac
* Control speed of D.C. shunt motor or universal motor
* Demonstrate the output wave shape on CRO
* Repair UPS and Inverter
* Maintain storage batteries
* Maintain panels used in the modern control process

##### DETAILED CONTENTS

1. Introduction to SCR (16 Periods**)**

1. Construction and working principles of an SCR, two transistor analogy and characteristics of SCR
2. SCR specifications and rating
3. Construction, working principles and V-I characteristics of DIAC, TRIAC and Quadriac
4. Basic idea about the selection of heat sinks for SCR and TRIACS
5. Methods of triggering a Thyristor. Study of triggering circuits
6. UJT, its Construction, working principles and V-I characteristics, UJT relaxation oscillator
7. Commutation of Thyristors
8. Series and parallel operation of Thyristors
9. Applications of SCR, TRIACS and Quadriac such as light intensity control, speed control of DC and universal motor, fan regulator, battery charger etc.
10. dv/dt and di/dt protection of SCR.

2. Controlled Rectifiers (10 Periods**)**

2.1 Single phase half wave controlled rectifier with resistive load and inductive load, concept of free wheeling diode.

2.2 Single phase half controlled full wave rectifier

2.3 Single phase fully controlled full wave rectifier

2.4 Single phase full wave centre tapped rectifier

2.5 Three phase full wave half controlled bridge rectifier

2.6 Three phase full wave fully controlled bridge rectifier

3. Inverters, Choppers, Dual Converters and Cyclo Convertors (18 Periods**)**

3.1 Inverter-introduction, working principles, voltage and current driven series and parallel inverters and applications

3.2 Choppers-introduction, types of choppers and their working principles and applications

3.3 Dual converters-introduction, working principles and applications

3.4 Cyclo-converters- introduction, types, working principles and applications

4. Thyristor Control of Electric Drives (15 Periods**)**

* 1. DC drives control (Basic Concept)
  2. Half wave drives
  3. Full wave drives
  4. Chopper drives
  5. AC drives control
  6. Phase control
  7. Variable frequency a.c. drives
  8. Constant V/F application
  9. Voltage controlled inverter drives
  10. Constant current inverter drives
  11. Cyclo convertors controlled AC drives
  12. Slip control AC drives

1. Uninterrupted power supplies (05 Periods**)**
   1. UPS online, off line
   2. Storage devices (batteries)
   3. SMPS, CVT

#### LIST OF PRACTICALS

1. To draw V-I characteristics of an SCR
2. To draw V-I characteristics of a TRIAC
3. To draw V-I characteristics of a DIAC
4. To draw uni-junction transistor characteristics
5. Observe the output wave of an UJT relaxation oscillator
6. Observe the wave shape across SCR and load of an illumination control circuit
7. Fan speed regulator using TRIAC Quadriac (fabrication of this circuit)
8. Speed-control of a DC shunt motor or universal motor
9. To observe the output wave shape on CRO of (a) Single phase half controlled full wave rectifier(b)Single phase controlled rectifier

#### INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. The available video films on the subject must be shown to the students.

**MEANS OF ASSESSMENT**

* Assignments and quiz/class tests, mid-term and end-term written tests.
* Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

#### BOOKS RECOMMENDED

1. Industrial Control Electronics. John Webb, Kevin Greshock, Maxwell, Macmillan International editions.
2. Fundamentals of Power Electronics by S Rama Reddi, Narosa Publishing House Pvt. Ltd, New Delhi
3. Power Electronics, Circuits Devices and Applications by Mohammad H. Rashid
4. Power Electronics by PC Sen
5. Power Electronics by Dr. PS Bhimbra, Khanna Publishers, New Delhi
6. Industrial Electronics & Control by SK Bhattacharya & S Chatterji, New Age international Publications(P) Ltd, New Delhi
7. Power Electronics by SK Sahdev, Uneek Publication, Jalandhar
8. Industrial Power Electronics by JC Karhava, King India Publication,
9. Power Electronics and Controls by Samir K Datta, Prentice Hall of India, New Delhi
10. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

**Websites for Reference:**

http://swayam.gov.in

**SUGGESTED DISTRIBUTION OF MARKS**

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| --- | --- | --- |
| **Topic No.** | **Time Allotted**  **(Periods)** | **Marks Allocation (%)** |
| 1. | 16 | 25 |
| 2. | 10 | 15 |
| 3. | 18 | 30 |
| 4. | 15 | 20 |
| 5. | 05 | 10 |
| **Total** | **64** | **100** |