McEng 3272 - Industrial electronics and applications

Course Number: McEng 3272 **Course Title:** Industrial electronics and applications	**Credit Hours:** 3 **Contact Hours:** 2 Lecture hrs and 2 Lab. hrs

Course Objectives:

The course enables the student understand how mechanical engineering is integrated with computer control and the application of electronic devices for conversion, control and conditioning of electric power and study the characteristics of DC and AC drives.

Course Description:

Study of the working and implementing of the systems covering the following listed below:

1. Understanding the types and characteristics of semiconductor materials.
2. Know the construction of semiconductor devices,
3. Acquire the knowledge about single and three phase converters.
4. Understand the design of power converters for various types of loads.
5. Understand the principle and operation of chopper.
6. Learn the role of power supply in utility-related applications.
7. Learn the fundamental concept of speed control of electrical drives.
8. Learn the speed control of drives in an energy efficient manner using power electronics.
9. Acquire knowledge about operation of stepper motors and their types.
10. Know the various types of heating and control methods.

Course Outline:

UNIT I INTRODUCTION

Industrial control classification, motion and process control, feed forward control, interfacing Devices, Operational Amplifier, review of thyristor, SCR, TRIAC, Phototransistor, basic characteristics and working of power diodes, SCR, Triac, Power Transistor, MOSFETs, IGBT and GTO.

UNIT II RECTIFIERS, CONVERTERS AND INVERTERS

Single phase rectifiers: Working principles of half wave rectifier with resistive load, full

wave rectifier with resistive - capacitive load, with resistive – inductive load, with large inductive load and transformer leakage inductance.

Three phase rectifiers: Working principles of half wave rectifier with resistive load, full wave rectifier, double Y type rectifier with interface transformer.

Voltage and current driven inverters, analysis of controlled and fully controlled converters, Dual converters, Analysis of voltage source and current source, current source and series converters

UNIT III INDUSTRIAL MOTOR CONTROL

Method of controlling speed, Basic control circuit, DC motor control, AC motor control, Variable reluctance, permanent magnet and hybrid stepper motors, stepper motor control, Servo motor control, micro controller based speed control, solid state motor control, PWM control of a DC motor control, phase controlled converters and choppers, Principle of operation of choppers, step up, step down and reversible choppers, high frequency electronic ballast, switch mode power supply, fly back converter, forward /buck converter, boost converter, uninterruptible power supply, three phase induction motors.

UNIT IV RELAYS, HEATING & WELDING CONTROL

Introduction, principle of relays, electromechanical relay, solid state relays, Latching relays timing relays, resistance welding, resistance heating control, induction heating control and dielectric heating control.

UNIT V PROCESS AND MOTION CONTROL

Elements of process control, temperature control, Flow control, Level control, Methods of motion control, feedback control, Direct digital control.

Pre-Requisites: EcEng 3362 – Electrical Machines and Drives

Co-Requisite:

Textbook:

1. Terry Baltelt, “Industrial electronics, devices, systems and applications”, Delmar publishers, 1997.

2. Frank D. Petruzella, “Industrial electronics”, McGraw Hill, 1996.

3. Stephan L.Herman, Walter N.Alerich, “Industrial motor control”, Delmar publishers, fourth edition, 1998

References:

1. Biswanath Paul, “Industrial electronics and control”, PHI, 2001.

2. P.Harrott, “process control”, Tata McGraw Hill,1991.

3. P.C.Sen, "Power Electronics", Tata McGraw Hill Publishing, New Delhi, 2008.

4. Noel Morris, "Industrial electronics", TMH, New Delhi, 1994.

5. T.E.Kissell, "Industrial electronics", PHI Learning, New Delhi, 2011.

Teaching Methods:

- Lectures supported by tutorials,
- Laboratory exercises and
- Assignments.

Laboratory Exercises:

Basic practice of calibrating and executing simple circuits by incorporating different range of electrical components and simulating the electrical systems by MATLAB.

Attendance Requirement:

- Minimum of 75% attendance during lecture hours, and
- 100% attendance during practical laboratory sessions, except for some unprecedented mishaps.

Evaluation:

- Assignments 10%,
- Laboratory 10%,
- Mid-semester Examination 30%, and
- Final Examination 50%.

Hours Per-Semester: 64 hours