

Advanced Power Electronics (404203)

Teaching Scheme:

Lectures: 4 Hrs/ Week

Examination Scheme:

In Semester Assessment:

Phase I : 30

End Semester Examination:

Phase II: 70

Course Objectives:

- To understand the operation of Dual converters, Cycloconverters and Multilevel inverters.
- Describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology.
- Study and understand the different types of drives and selection of drive and power converter for particular application.
- Study and understand the operation of electric motor drives controlled from a power electronic converter and to introduce the design concepts of controllers for closed loop operation
- Study and understand special motor drives and their control.

Course Outcomes:

After successful completion of this course students will be able to:

- Understand the operation of modern power converters and multilevel inverters.
- Understand the basic principles of power electronics in drives and its control, types of drives and basic requirements placed by mechanical systems on electric drives.
- Understand the operation of 1 ϕ & 3 ϕ converter drives for separately excited & series DC motors.
- Learn speed control of induction motor drives in an energy efficient manner using power electronics.
- Learn and understand working of cylindrical rotor motor, salient pole motor, reluctance motor and permanent magnet brushless DC motor drives.

Unit I: Dual Converters and Power factor improvement of single phase converters 8L

Single phase and three phase dual converters: Ideal and practical dual converter, Dual converter without circulating current operation, Dual converter with circulating current operation, control schemes for non-circulating current type dual converter.

Power factor improvement of single phase converters: Phase angle control, semi converter operation of full converters, asymmetric firing, forced commutation, sequence control of series converters, comparative evaluation of schemes.

Effect of source impedance on single-phase converters with analysis.

Unit II: Modern Rectifiers & Converters

8L

12 pulse converters, Three phase IGBT based PWM rectifier, analysis, comparison with SCR based conventional converters with respect to harmonic content, Power factor conditioning of diode rectifiers, EMI and Line Power quality problems of thyristor converters, Double sided PWM converter systems.

Unit III: Cycloconverters and Multilevel Inverters

8L

Cycloconverters: 1 phase to 1 phase step up and step down Cycloconverter: Mid-point and bridge type Cycloconverters, 3 phase to 1 phase cycloconverters, 3 ph to 3 ph cycloconverters.

Multilevel Inverters: Concept of multilevel inverter, Types of multilevel inverter, Diode clamped, Flying Capacitor and Cascade Multilevel inverters , Advanced modulation Techniques, Trapezoidal, staircase, stepped, harmonic injection and delta modulation.

Unit IV: DC Motor Drives

8L

Basic characteristics of DC motors, Operating modes, Motor performance parameters, 1 ϕ & 3 ϕ converter drives for separately excited & series DC motors for continuous & discontinuous operations, Chopper fed DC drives, Comparison of converter fed drive & chopper fed drive, Open loop & closed loop control of dc drives with transfer function , Microprocessor based control of dc drives, Dynamic and regenerative braking of DC motors.

Unit V : Induction Motor Drives & Control

8L

Induction motor characteristics, Control strategies like stator voltage control, Stator frequency control, Stator voltage & frequency control, rotor resistance control ,Variable frequency Square wave VSI Drives ,Variable frequency PWM VSI Drives, Variable frequency CSI Drives ,Vector Control (Field oriented Control): Basic principle of vector control, Direct & Indirect vector control, Breaking of induction motor, soft acceleration and deceleration, various protections.

Unit VI: Synchronous Motor Drives & Special Motor Drives

8L

Cylindrical rotor motor Drive, Salient pole motor drives, Switched reluctance motor drive, Synchronous Reluctance motor drive, Stepper motor drives, Servo motor drive, Permanent magnet brushless DC motor drive, Universal motor drive.

Text Books

1. Power Electronics Circuit Devices & Applications, M.H Rashid, Pearson
2. Fundamental of Electrical Drives, Gopal K. Dubey, Narosa Publishing House
3. Power Electronics, Converters Applications and Design, N. Mohan, T. M. Undeland & W. P. Robbins, John Wiley and Sons, 3rd Edition

Reference Books

1. Thyristor DC drives, P.C Sen, Jhon Wiely.
2. Modern Power Electronics and AC Drives, Bimal K. Bose, Pearson
3. Power Electronics, M.D. Singh & K.B.Khanchandani, TMH
4. Power Electronics, P.S.Bimbhra, Khanna Publication
5. Modern power Electronics by P.C.Sen, S.Chand & Company