

ELECTRICAL DRIVES

ENEE 353

Lecture : 3
Tutorial : 1
Practical : 3/2

Year : III
Part : II

Course Objectives:

The objective of this course is to equip students with fundamental knowledge of electric drive and traction systems, focusing on their principles, components, motor selection, control strategies, performance analysis, and energy-efficient operation in traction applications.

- 1 Introduction (8 hours)**
 - 1.1 Concept of electric drives
 - 1.2 Classification of electric drives
 - 1.3 Advantages of electric drives
 - 1.4 Components of electric drive system
 - 1.5 Methods of power transfer
 - 1.6 Factors influencing selection of electric drives
 - 1.7 Control of electric drive

- 2 Dynamics of Electric Drive (6 hours)**
 - 2.1 Fundamental torque equation of drive system
 - 2.2 Load torque and load characteristics
 - 2.3 classification of electric drives
 - 2.4 Steady state stability of an electric drive
 - 2.5 Transient stability of an electric drive

- 3 Control of DC Motor Drives (8 hours)**
 - 3.1 Speed control of DC motors
 - 3.2 Braking of DC motors
 - 3.3 Ward Leonard system
 - 3.4 Four-quadrant operation of DC drives
 - 3.5 Single phase controlled rectifier fed DC drives and closed loop control
 - 3.6 Three phase controlled rectifier fed DC drives and closed loop control
 - 3.7 Chopper fed DC drives and closed loop control

- 4 Control of AC Motor Drives (8 hours)**
- 4.1 Speed control of induction motors
 - 4.1.1 Stator voltage control method
 - 4.1.2 Rotor rheostat method
 - 4.1.3 Variable frequency drive through inverter and constant Volt-Hertz methods with closed loop control, effect of harmonics produced by Inverter on heating and torque production
 - 4.2 Soft start of AC voltage
 - 4.3 Slip power recovery schemes
 - 4.4 Introduction to vector control
 - 4.5 Speed control of synchronous motors
- 5 Electric Traction (8 hours)**
- 5.1 Introduction to electric traction
 - 5.2 Speed–time curve and performance of trains
 - 5.3 Power supply system for electric traction
 - 5.4 Traction motors and control
 - 5.5 Modern electric traction systems
- 6 Selection and Application of Electric Drives (7 hours)**
- 6.1 Selection of motor for different applications
 - 6.2 Duty cycles
 - 6.3 Types of enclosures
 - 6.4 Effects of altitude on rated output
 - 6.5 Electric drives used in industrial applications
 - 6.6 Energy conservation in electric drives
- Tutorial (15 hours)**
- 1. Design based conceptual questions in introduction to electric drives
 - 2. Numerical problems related to dynamics of electric drive
 - 3. Numerical problems related to control of dc motor drives
 - 4. Numerical problems related to control of ac motor drives
 - 5. Numerical related to electric traction
 - 6. Conceptual questions and numerical related to selection and application of electric drives
- Practical (22.5 hours)**
- 1. Speed control of DC shunt motor by controlled rectifier
 - 2. Speed control of Induction motor by rotor rheostat method
 - 3. Speed control of Induction motor by frequency control method
 - 4. Study of PWM controller for an ac machine
 - 5. Traction motor characteristics analysis using simulation for DC traction drive
 - 6. Traction motor characteristics analysis using simulation for AC traction drive

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	8	10
2	6	6
3	8	12
4	8	12
5	8	12
6	7	8
Total	45	60

* There may be minor deviation in marks distribution.

References

1. Gupta, J.B. (2014). Utilization of electric power and electric traction. New Delhi, India: S.K. Kataria & Sons Publishing House.
2. Bimbhra, P.S. (2002). Power electronics (Latest Edition). New Delhi, India: Khanna Publishers.
3. Pillai, S.K. (2015). Basics of electrical drives. New Delhi, India: New Age International Pvt. Ltd.
4. Dubey, G.K. (2001). Fundamentals of electrical drives (Latest Edition). New Delhi, India: Narosa Publishing House.
5. Krishnan, R. (2015). Electric motor drives. Upper Saddle River, NJ: Prentice Hall.