

## 3/4 B.Tech. SECOND SEMESTER

**EE6T5 POWER SEMICONDUCTOR DRIVES**

**Credits: 4**

**Lecture: 4 periods/week**

**Internal assessment: 30 marks**

**Tutorial: 1 period /week**

**Semester end examination: 70 marks**

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### **Objectives:**

This course is an extension of power electronics applications to electric drives. It covers in detail the basic and advanced speed control techniques using power electronic converters that are used in industry. It is equally important to understand the four quadrant operation of electric drives and slip power recovery schemes in induction motors. These concepts are also discussed in detail in this course

### **Learning outcomes**

Upon completing this course students must be able to choose their electric drive system base on this applications. Also the operation of single and multiquadrant operation of drive, they will be able to analyse any type of  $1\Phi$  &  $3\Phi$  rectifiers fed to DC motors as well as chopper fed to DC motors.

Upon completing this course students must be able to control the speed of an AC-AC & DC-AC converter fed to induction motor and synchronous motor. Also the closed loop operation of an electric drive and their controllers. Student will be able to model any type of machines using linear transformation.

### **UNIT I Introduction to Electric Drives**

Parts of electric drives, choice of electric drives, fundamental torque equation, multi quadrant operation, equivalent values of drive parameters.

### **UNIT II Control of Dc Motors by Single Phase Converters**

Control rectifier fed dc drives, single phase fully controlled rectifier control, single phase half controlled rectifier control of dc separately excited motor, rectifier control of dc series motor, fractional hp motor

### **UNIT III Control of Dc Motors by Three Phase Converters**

three phase fully controlled rectifier control, three phase half controlled rectifier control of dc separately excited motor, multi quadrant operation of separately excited motor fed from fully controlled rectifier, supply harmonics, power factor and ripple in motor current.

### **UNIT IV Control of Dc Motors by Choppers**

Steady-state analysis of chopper-controlled dc motor drive of separately excited dc motor, Analysis by averaging, instantaneous steady state computation, continuous current conduction, discontinuous current conduction, chopper fed dc series motor.

#### **UNIT V Control of Induction Motors**

Stator voltage control- variable frequency control from voltage sources- VSI induction motor drives- cycloconverter control- variable frequency control for current source- Current source inverter control (Block Diagram)-rotor resistance control-slip power recovery scheme.

#### **UNIT VI Synchronous Motor Drives**

Synchronous motor variable speed drives, variable frequency control of multiple synchronous motors, self control synchronous motor drive employing load commutated thyristor inverter, starting of large synchronous machines, self controlled synchronous motor drives employing a cycloconverter.

#### **UNIT VII Closed Loop Operation of Drives**

Introduction- transfer function of subsystems ,closed loop transfer function- speed controller, pwm current controller, hysteresis current controller , design of speed and current controllers - closed loop speed control of induction motor.

#### **UNIT VIII Linear Transformation of Machines**

Introduction, transformation from three phases to two phases and vice versa, transformation from rotating axes to stationary axes, physical concepts of park transformation, Introduction to vector control and Direct Torque control.

### **Learning Resources**

#### **Text Books:**

1. Fundamentals of Electric Drives – by G K Dubey Narosa Publications( Units-1,2,3,5,6).
2. Power Electronics – MD Singh and K B Khanchandani, Tata – McGraw-Hill Publishing company,1998(Units-4,7).
3. Electric motor drives- modelling analysis and control –by R.Krishnan, PHI(Units-4,7).
4. Generalized theory of electrical machines—by Dr.P.S.Bhimbhra, kanna publications, 5<sup>th</sup> edition (Unit-8).

#### **Reference Books:**

1. Modern Power Electronics and AC Drives by B.K.Bose, PHI.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications.
3. A First course on Electrical Drives – S K Pillai New Age International(P) Ltd. 2nd Edition