

## **3<sup>rd</sup> Semester**

### **ED 601 ELECTRIC DRIVES II**

Review of power electronic converters for drive control, LCI fed IM Drive, Drive configuration, Commutation at different speed, control structure.

FOC IM Drive, Drive configuration, Mathematical modeling, Direct and indirect FOC, Influence of parameter, VSI and CSI fed schemes, Adaptive drive control.

Brushless dc drive, self control, CSI with load commutation, low speed commutation, inverter control strategies, performance.

Permanent Magnet SM Drive, control fundamentals, converter configuration, synchronization, trapezoidal and sinusoidal drive control structure, performance.

Switched Reluctance Motors, Principle of operation, converter circuits, sensors, speed control, performance characteristics.

Advance Control Technique Application, Application of modern & evolutionary techniques in drives.

Stepper motor and switch reluctance motor drives, solar and battery powered drives, Traction Drives, Energy conservation in Electrical Drives.

#### **Reference Books:**

1. Power semi conductor controlled drives by G.K.Dubey
2. Fundamentals of Electrical Drives by G.K.Dubey
3. Electrical Machine & Power Electronics by P.C.Sen
4. Electrical Drives by S.A. Nasar
5. Power electronics and variable frequency drives by B. K. Bose

## **ED-602**

### **POWER QUALITY**

Understanding Power quality, types of power quality disturbances, power quality indices, Causes and effects of power quality disturbances

Causes and effects of harmonics, converter configuration and their contribution to supply harmonics, other sources of harmonics

Radio interference, supply standards, elimination/suppression of harmonics, classical solutions & their drawbacks, passive input filters, high power factor pre-regulator, switching control circuit, transformer connections,

Elimination/suppression of harmonics using active power filters – topologies, and their control methods, PWM converter as a voltage source active filter, current source active filter,

Electro-magnetic compatibility, constant frequency control, constant tolerance band control, variable tolerance band control, discontinuous current control.

#### **References Books :**

1. Power Quality – by R.C. Duggan
2. Power system harmonics – by A.J. Arrillga
3. Power electronic converter harmonics – by Derek A. Paice

## ED-611 ELECTIVE III

### (i) REACTIVE POWER CONTROL AND FACTS

Introduction to FACTS- Basic Types of FACTS controllers, Static Var Compensator (SVC), Principle of operation, configuration and control of Thyristor Controlled Series compensator(TCSC), Applications, Static Compensator (STATCOM): Principle of operation, configuration and control, Unified Power Flow Controller(UPFC): Principle of operation, configuration and control.

Oscillation Stability Analysis and Control: Introduction – Linearised model of power systems installed with FACTS based Stabilizers – Heffron-Phillips model of a SMIB system installed with SVC, TCSC and TCPS.

Analysis and Design of FACTS based stabilizers: Analysis of damping torque contribution by FACTS based stabilizers installed in SMIB systems, Design of robust FACTS based stabilizers, Selection of installing locations.

Transient Stability control with FACTS: Introduction – Analysis of Power systems installed with FACTS devices: Power transmission control using Controllable Series Compensation(CSC), Power Transmission Control using SSSC, Power Transmission Control using UPFC, Power Transmission Control using Phase Shifting Transformer(PST), Power Transmission Control using UPFC, Control of FACTS devices for transient stability improvement – General considerations of FACTS control strategy: CSC,SSSC, SVC, STATCOM and UPFC control strategy – General Structure of the FACTS devices control.

#### **References:**

1. '*Reactive Power Control in Power Systems*'
  - T J E Miller
  - John Wiley, 1982
2. '*Computer modeling of Electrical Power Systems*'
  - J Arriliga and N R Watson
  - Wiley, 2001
3. '*Understanding FACTS*'
  - N G Hingorani and L Gyugyi
  - IEEE Press, 2000
4. '*Flexible ac Transmission Systems(FACTS)*'
  - Y.H. Song and A.T. Johns
  - IEE Press, 1999

## **ED-612 ELECTIVE – III**

### **(ii) SPECIAL MACHINES**

Introduction : Review of adjustable speed drives, permanent magnet materials and circuits.

Square-wave, Sine-wave P.M. brushless motor drives - Principle, construction, operation and drive application.

P.M. & synchronous-reluctance based motors - Principle, construction, operation and drive application.

Switched reluctance motors, Linear induction motors, Stepper motors - Principle, construction, operation and drive application.

Energy efficient motors

#### **Reference Books :**

1. Power electronics control of AC machine by J.M.P. Murphy.
2. Brushless Permanent-magnet and reluctance motor Drives by T.J.E. Miller
3. Power electronics and variable frequency drives edited by B.K.Bose
4. Linear induction machine by S.A.Nasar
5. Energy efficient electric motors by J.C. Andreas.

## **ED-613 ELECTIVE III**

### **(iii) EHV AC & DC TRANSMISSION**

1. Long line theory, long distance transmission problems, corona power loss and audible noise. Radio Interference RIV and excitation functions, Reactive Power compensation of EHV AC lines, FACTS devices.
2. Sequential impedances of AC systems EHVAC transmission overvoltages, insulation design of lightning and switching over voltages. High voltage testing of AC equipments.
3. Comparison of EHV AC & DC transmission HVDC system configuration and components conversion and inversion, Analysis of three phase bridge converter and Performance equations abnormal operations of converter.
4. Control of HVDC system, Principle of DC link control, current and Extinction angle control power and reactive power control, alternative inverter control modes.
5. Harmonics and AC/DC filters, Influence of AC system strength on AC/DC system interaction responses to DC and AC system faults. Modelling of HVDC system.

**Reference Books :**

1. Begemudre R.D., “EHVAC Transmission Engineering – Willy Eastern Ltd.
2. P.Kundur “Power System Stability and Control” - Mc Graw Hill Publication.
3. Arrillaga J., “HVDC Transmission” - Peter Peregrinus Pub.
4. Rao S., “EHV AC & HVDC Transmission Systems” - Khanna Pub.
5. Padiyar K.R., “HVDC Power Transmission Systems” – Willy Eastern Ltd.