**ADVANCE POWER ELECTRONICS**

**PEM 101**

**L-T-P=3-1-0**

**Course Outcomes (CO):**

Upon successful completion of this course, students should be able to:

**CO1:** To introduce different techniques of dealing with sparse matrix for large scale power systems.

**CO2:** To impart in-depth knowledge on different methods of power flow solutions.

**CO3:** To apply energy function method for analysis of transient stability in power system.
**CO4:** To Illustrate different numeric al integration methods and factors influencing transient stability.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | ✓ | | ✓ | ✓ | | | | | ✓ | |
| CO2 | ✓ | | ✓ | | ✓ | ✓ | | | ✓ | | | |
| CO3 | ✓ | | ✓ | | | | | ✓ | ✓ | ✓ | ✓ | |
| CO4 | ✓ | | ✓ | | | ✓ | ✓ | | | | | ✓ |

## Course Contents:

**Unit 1**

Phase Controlled Converters: Performance measures of single and three-phase converters and Semi convertors with discontinuous load current for R, RL and RLE loads. Effect of source inductance for single and three-phase converters.

**Unit 2**

**Choppers:** Basic of choppers configurations, Steady state analysis of different type a Chopper-Minimum and Maximum Currents, Ripple and average load current. Commutation in Chopper Circuits.

**Unit 3**

**Inverters:** Analysis of inverters and its characteristics of Performance parameters, voltage control of different inverters with including three phase inverters-Sinusoidal PWM, Third

Harmonic PWM, 60 degree PWM and 120 degree PWM and Space Vector Modulation, Harmonic reductions.

**Unit 4**

**AC Voltage Controllers:** principle of integral cycle control, Single, Three Phase AC Controllers and bi-directional controllers with resistive load. AC Voltage Controller with PWM Control.

**Unit 5**

**Cyclo-converters:** Basic of cyclo-converters, output equation, control circuit, Reduction in Output Harmonics. Single phase and three phase cyclo-convertors, Matrix Converter, step up and step down cyclo-converter.

**Recommended Books: -**


1. *P.S Bimbhra: Power electronics, Khanna Publishers.*
2. *M.H. Rashid: Power Electronics, Circuits Devices and applications, prentice-Hall, 1988.*
3. *V Subrahmanysm: Power Electronics, New Age Inc.Publishers, New Delhi.*
4. *P.C. Sen: Power Electronics, Tata McGraw-Hill, India.*
5. *C W Lander Power Electronics, Mc Graw-Hill.*
6. *M D Singh and KB Khanchandani Power Electronics, TMH Publishing Company, New Delhi.*

## ELECTRIC DRIVES AND THEIR CONTROL

**PEM 102**

**L-T-P=4-0-0**

**Course Outcomes (CO):**

Upon successful completion of this course, students should be able to:

**CO1:** Acquire the knowledge of selection of drives as per practical operational industrial requirement.

**CO2:** Apply their knowledge to prepare control schemes as per different types of motors used in industries

**CO3:** Estimate & solve harmonic and power factor related problems in controlling AC and DC drives.

**CO4:** Acquire the knowledge of Characteristic of dc motors, three phase induction motors and synchronous motors.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | | | |
| CO2 | ✓ | ✓ | ✓ | | ✓ | ✓ | | | ✓ | | | |
| CO3 | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | | | |
| CO4 | ✓ | ✓ | ✓ | | | ✓ | ✓ | | | | | |

## Course Contents:

**Unit-1 CHARACTERISTICS OF ELECTRIC MOTORS:**

Characteristic of dc motors, three phase induction motors and synchronous motors.

**Unit-2 DYNAMICS OF ELECTRIC DRIVES:**

Fundamental torque equations, speed-torque conventions and multiquadrant operation, equivalent values of drive parameters, components of load torques, nature and classification of load torques, calculation of time and energy loss in transient operation, steady state stability, load equalization.

**Unit-3 INDUCTION DRIVES:**

Induction motor drives: Basic principle of operation, stator voltage control, rotor voltage control, frequency control, voltage and frequency control, current control. Voltage, current and frequency control. Close-loop control.

**Unit-4 SYNCHRONOUS DRIVE:**

Synchronous motor drives: Cylindrical rotor, salient pole, reluctance, permanent magnet and switch reluctance motors. Close loop control of synchronous motors. Brushless dc and ac drives.

**Unit-5 DC DRIVES:**

study of efficiency, power factor, size and cost starting and speed control of motors. Electric braking, Plugging, Rheostatic braking, regenerative braking. Behaviour of motor during starting, acceleration, braking and reversing operations. Speed-time relations, Load equalization. Use of flywheels. Determination of motor rating for intermittent loads. Drives for machine tools, lift and cranes, paper mills, printing machinery, rolling for intermittent loads.

**TEXT/REFERENCES:**


1. G K Dubey Fundamentals of Electrical Drives,Narosa Publishing House, New Delhi,1995.
2. V Subrahmanyam:Thyristor control of electric Drives,Tata McGraw Hill, New Delhi, 1988.
3. V Subrahmanyam:Electric Drives-Concepts and Applications,Tata McGraw Hill,New Delhi.
4. S K Pillai:A first course on electrical Drives,Wiley Eastern limited,India.
5. B K Bose:Power electronics and A. C. Drives,Prentice Hall.

**LINEAR SYSTEMS THEORY**

**PEM 103**

**L-T-P=4-0-0**

**Course Outcomes (CO):**

Upon successful completion of this course, students should be able to:

**CO1:** Ability to represent the time-invariant systems in state space form as well as analyze, whether the system is stabilizable, controllable, observable and detectable**.**

**CO2:** Ability to design state feedback controller and state observers

**CO3:** Design a suitable compensator (lead/lag/lead-lag) for the given system

**CO4:** To Illustrate different numeric al integration methods and factors influencing transient stability.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | | | | ✓ | ✓ | | | | | ✓ | |
| CO2 | ✓ | ✓ | ✓ | | ✓ | ✓ | | | ✓ | | | |
| CO3 | ✓ | ✓ | ✓ | | | | | ✓ | ✓ | | ✓ | |
| CO4 | ✓ | | ✓ | | | ✓ | ✓ | | | | | ✓ |

## Course Contents:

**Unit 1**

**Linear spaces**, linear independence, linear operators, inverse and adjoint of an operator, bounded ness, eigenvalues & eigenvectors of an operator, generalized eigenvectors, Functions of a square matrix, range and null space, Concepts of Norms.

**Unit 2**

**Input-output and state variable description of systems**, Solution of state equation, properties of state transition matrix, Stability of linear systems, Lyapunov stability, positive and bounded realness, Absolute stability.

**Unit 3**

**Controllability and Observability**, grammians, duality, Kalman decomposition, Hidden modes, stabilizability and detectability, Elementary transformations, column & row degrees.

**Unit 4**

**Smith-McMillan form**, Transmission and invariant zeros, Rank properties, Singular values, SVD, Functional spaces of rational matrices $RH_\infty$, $RH_2$. Linear fractional representation of systems, Basic linear fractional transformations.

**Unit 5**

**Model Reduction**, time-domain and frequency domain methods, balanced realization approach, Singular perturbation approach. Linear state feedback, output injection and observers.

**Recommended Books**


*1*. W.J. Rugh, "Linear System Theory", Prentice-Hall Int. Inc. N.J.

2. T. Kailath, "Linear Systems", Prentice Hall Inc., N.J. 1980

3. F.M. Callier & C.E. Desoer, "Linear System Theory", Narosa Publications,1991.

4. C.T. Chen, "Linear System Theory & Design", Oxford University Press, 1984.

**ADVANCE POWER ELECTRONICS LAB**

**PEM 191**

**L-T-P=0-0-3**

**Course Outcomes (CO):**

Upon successful completion of this course, students should be able to:

CO1: Ability in understanding semi and full converters.

CO2: Know-how of control mechanism utilized in DC-DC converters.

CO3: Proficiency in understanding inverters using semiconductor devices.

CO4: Competency in Designing AC-AC converters.

**Mapping of Course Outcomes (CO) and Program Outcomes (PO):**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | ✓ | ✓ | ✓ | | | ✓ | | | | | ✓ | |
| CO2 | ✓ | ✓ | ✓ | | | ✓ | | | | | ✓ | |
| CO3 | ✓ | ✓ | ✓ | | | ✓ | | | | | ✓ | |
| CO4 | ✓ | ✓ | ✓ | | | ✓ | | | | | ✓ | |

## Course Contents:

1. Study the single-phase inverter.
2. Study ac regulator using triac, anti parallel thyristor and triac & diac.
3. Study single-phase PWM inverter.
4. Study buck, boost and buck-boost regulators.
5. Study the forced commutated circuits.
6. Determine the dv/dt limitation of given SCR.
7. Study and test the triggering circuit of three phase half controlled bridge converter.
8. Study and test three phase half controlled bridge converter.
9. Study and test the triggering circuit of three-phase fully controlled bridge converter.
10. Study and test three-phase filly controlled bridge converter.