SOLID STATE ELECTRIC MOTOR DRIVES

VI Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEE013	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil			Total Classes: 60			

OBJECTIVES:

The course should enable the students to:

I. Demonstrate DC drives through phase controlled rectifiers and choppers.
II. Analyze operating principle of four quadrant DC drives.
III. Illustrate the speed control of induction motors through various parameters.
IV. Outline the separate and self control of synchronous motors.

COURSE OUTCOMES (COs):

CO 1: Analyze the speed control of DC motors with phase controlled rectifiers
CO 2: Describe the four quadrant operation of DC Drive with dual converter and operation of DC drives with choppers
CO 3: Apply the variable voltage and variable frequency operation of induction motors with suitable converters
CO 4: Understand the speed control of induction motor through static rotor resistance control and vector control
CO 5: Demonstrate the speed control of synchronous motor with suitable converters

COURSE LEARNING OUTCOMES (CLOs)

At the end of the course, the student will have the ability to:

1. Understand the speed control of DC motors with single phase controlled rectifiers
2. Analyze the speed control of DC motors with three phase controlled rectifiers
3. Describe the speed torque characteristics of DC motors with variation in firing angle of the controlled rectifiers
4. Demonstrate the motoring and braking operations of DC motor drives
5. Analyze the four quadrant operation of DC Drive with dual converter and closed loop operation
6. Describe the operation of chopper fed DC motors
7. Apply the variable voltage operation of induction motors with AC voltage controllers
8. Analyze the variable frequency operation of induction motors with voltage source inverters and current source inverters
9. Describe the variable frequency operation of induction motors with cycloconverters and closed loop operations
10. Understand the speed control of induction motor through static rotor resistance control
11. Demonstrate the vector control operation of induction motor with direct methods
12. Describe the vector control operation of induction motor with indirect methods
13. Analyze the speed control of synchronous motor with voltage source inverters and current source inverters
14. Understand the speed control of synchronous motor with variable frequency control using cycloconverters
15. Demonstrate the closed loop control of synchronous motors with block diagram
16. Apply the concept of solid state electric drives to solve real time world applications
17. Explore the knowledge and skills of employability to succeed in national and international level competitive examinations

UNIT - I	CONTROL OF DC MOTORS THROUGH PHASE CONTROLLED RECTIFIERS

Introduction to thyristor controlled drives: Single phase semi and fully controlled converters connected to DC separately excited and dc series motors, continuous current operation, output voltage and current waveforms, speed and torque expressions, speed torque characteristics, problems on converter fed DC motors; Three phase semi and fully controlled converters connected to DC separately excited and DC series motors, output voltage and current waveforms, speed and torque expressions, speed torque characteristics and problems.

UNIT - II	SPEED CONTROL OF DC MOTORS

Introduction to four quadrant operation: Motoring operations, electric braking, plugging, dynamic and regenerative braking operations; Four quadrant operation of DC motors by dual converters, closed loop operation of DC motor; Chopper fed DC drives: Single quadrant, two quadrant and four quadrant chopper fed DC separately excited and series excited motors, continuous current operation output voltage and current wave forms, speed torque expressions, speed torque characteristics, problems on chopper fed DC motors and closed loop operation.

UNIT - III	SPEED CONTROL OF INDUCTION MOTORS THROUGH VARIABLE VOLTAGE AND FREQUENCY

Variable voltage characteristics: Control of induction motor by AC voltage controllers, waveforms, speed torque characteristics.

Variable frequency characteristics: Variable frequency characteristics, variable frequency control of induction motor by voltage source and current source inverter and cycloconverters, pulse with modulation control, comparison of voltage source inverter and current source inverter operations, speed torque characteristics, numerical problems on induction motor drives, closed loop operation of induction motor drives.

UNIT - IV	SPEED CONTROL OF INDUCTION MOTORS THROUGH ROTOR RESISTANCE AND VECTOR CONTROL

Static rotor Resistance control: Slip power recovery schemes, static Scherbius drive, static Kramer drive, their performance and speed torque characteristics, advantages and applications, vector control of induction motor drives: Principles of vector control, vector control methods, direct methods of vector control, indirect methods of vector control and problems.

UNIT - V	SPEED CONTROL OF SYNCHRONOUS MOTORS

Separate control and self control of synchronous motors, operation of self controlled synchronous motors by voltage source inverter and current source inverter cyclo converters. Load commutated CSI fed synchronous motor, operation, waveforms, speed torque characteristics, applications, advantages and numerical problems, closed loop control operation of synchronous motor drives (block diagram only), variable frequency control, cycloconverter, PWM, variable frequency inverter and current source inverter.

Text Books:

1. PV Rao, "Power Semiconductor Drives", BS Publications, 1st Edition, 2014.
2. G K Dubey, "Fundamentals of Electric Drives", Narosa Publications, 2nd Edition, 2001.
3. SB Devan, GR Slemon, A Straughen, "Power semiconductor drives", Wiley Pvt. Ltd,. 4th Edition, 2001.
4. B K Bose, "Modern Power Electronics and AC Drives", Prentice Hall India Learning Private Limited, 2005

Reference Books:

1. Vedam Subramanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill Publication, 5th Edition, 2008.
2. John Hindmarsh, Alasdair Renfew", Electrical machines and drive systems", Oxford Butterworth Heinemann, 3rd Edition.
3. Austin Hughes, "Electrical motors and drives Fundamentals Types and Applications", Elsevier, 3rd Edition, 2006.
4. M D Singh, K B Kanchandhani, "Power Electronics", Tata Mc Graw Hill Publishing Company, 2nd Edition, 1998.
5. M H Rashid, "Power Electronics, Circuits, Devices and Applications", Pearson, 3rd Edition, 2001
6. J. Gnanavadivel, "powersemiconductor drives", Anuradha, 2nd Edition, 2007

Web References:

1. https://www.nptel.iitm.ac.in
2. https://www.iare.ac.in
3. https://www.bookboon.com/en/introduction-to-power-electronics-ebook

E- Text Books:

1. https://www.freebookcentre.net
2. https://www.amazon.in/Fundamentals of electrical drives
3. https://www.circuitstoday.com