NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**II**
Course Code:	**6EE166**
Course Title:	**Control of Electric Drives**
Course Type:	(□ Core/ □ Value Added Course / √ **Department Elective** / □ Institute Elective/ □ University Elective/ □ Open Elective / □ Any other)
Year of Introduction:	**2022 – 23**

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to-

1. comprehend purpose of electric drives and its control aspects **(BL2)**
2. select appropriate control strategy for given application **(BL6)**
3. integrate schematic blocks to control electric drives **(BL3)**
4. analyze performance of electric drives for applications concerned **(BL4)**

Syllabus: **Teaching Hours: 30**

Unit-1: Introduction to Induction Motor Drives **04**

Role of drive, operation of induction motor using inverters, principle of Soft Starting, Loss minimization techniques in induction motor drives, conventional closed loop control schemes.

Unit-2: Field Oriented Control of Induction Motor **07**

DC drive analogy, Equivalent circuit & phasor diagram, Principle of vector control, Rotor flux oriented control- direct flux control, indirect flux control, Stator flux control, Sensorless control, Adaptive control.

Unit-3: Direct Torque Control of Induction Motor **04**

Concept and operating principle of Direct Torque Control, Advantages and disadvantages of DTC based drive, VSI fed induction motor drive using DTC and its optimum switching table.

Unit-4: Switch Reluctance Motor Drive **06**

Basic of SRM working and its construction , Different converter topologies for SRM , Control of SRM drives using sensor, Sensor less control of SRM drive, Torque pulsations and various methods to reduce torque pulsations in SRM drive.

Unit-5: Permanent Magnet Brushless Motor Drive **09**

Fundamentals of Permanent Magnet Brushless motors, Control Strategies for Permanent Magnet Brushless motors, Schematic block diagram of closed loop control of Permanent Magnet Brushless motor Drive, Sensorless control of Permanent Magnet Brushless motor Drive, Vector

control of the Permanent Magnet Brushless motor drive, Direct torque control of Permanent Magnet Brushless motor drive, Reduction of torque ripple in Permanent Magnet Brushless motor drives, Parameter sensitivity of Permanent Magnet Brushless motor drives.

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 02 of the questions will be asked from self-study contents.

Laboratory Experiments:

This shall consist of at least 10 experiments / simulations based on the above syllabus.

Suggested Reading:

1. G. K. Dubey, Power Semiconductor Controlled Drives, Prentice-Hall.
2. P. Vas, Vector Control of AC Machines, Clarendon Press, Oxford.
3. B. K. Bose, Modern Power Electronics & AC Drives, Prentice-Hall.
4. R. Krishnan, Electric Motor Drives: Modeling Analysis: Modeling, Analysis, and Control, Pearson Education India
5. W. Leonhard, Control of Electrical Drives, Springer
6. N. Mohan, Electrical Machines and Drives- A First Course, Wiley
7. D.W. Novotny and T. A. Lipo, Vector Control and Dynamics of AC Drives, Clarendon Press
8. T. Wildi, Electrical Machines, Drives and Power Systems, Pearson Education
9. T. J. E. Miller, Brushless PM and Reluctance Motor Drives, Clarendon Press, Oxford.
10. B. Drury, Control Techniques Drives and Controls Handbook, IET
11. Latest publications from peer reviewed journals and renowned conferences.

Suggested List of Experiments (not restricted to the following):
(Only for Information)(04 hours each)

1. Develop a MATLAB program, to plot torque-slip characteristics of polyphase induction motor.
2. Develop a MATLAB program, to plot torque-speed characteristics of stator voltage-controlled induction machine.
3. Develop a MATLAB program, to plot torque-speed characteristics of Variable voltage variable frequency-controlled induction machine.
4. Analyze the open loop control of stator voltage control of induction motor drive using MATLAB Simulink.
5. Analyze the open loop VVVF controlled induction motor drive using PWM inverter using MATLAB Simulink.
6. Analyze the closed loop simulation of Switched Reluctance Motor (SRM) operated by Asymmetric converter using MATLAB Simulink.
7. Analyze the closed loop simulation of Switched Reluctance Motor (SRM) operated by Mid-point converter using MATLAB Simulink.
8. Simulate and analyze implementation of direct vector control scheme for induction motor using MATLAB Simulink.
9. Simulate and analyze implementation of indirect vector control scheme for induction motor using MATLAB Simulink.
10. Analyze and simulate closed loop operation of PMBLDC motor using MATLAB Simulink.
11. Develop a universal control circuit for electric drive systems using MATLAB.

L = Lecture, T = Tutorial, P = Practical, C = Credit