# Nirma University

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| **Institute:** | **Institute of Technology** |
| **Name of Programme:** | **BTech in Electrical Engineering** |
| **Semester:** | **VI** |
| **Course Code:** | **3EE306CC24** |
| **Course Title:** | **Electric Drives** |
| **Course Type:** | **Core** |
| **Year of Introduction:** | **2024 –25** |

| L | T | Practical component | | | | C |
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**Course Learning Outcomes (CLOs):**

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

1. select the appropriate drive based on load dynamics **(BL4)**
2. analyse the performance of electric drives **(BL4)**
3. suggest a suitable control technique for electric drives **(BL4)**
4. design a drive based on application **(BL6)**

**Contents:** **Teaching Hours: 5**

**Unit-I** **Fundamentals of Electric Drives** **05**

Basic concepts, nature and classification of load torque, four quadrant drives, load equalization, steady state stability, selection of motors

**Unit-II** **D.C. Motor Drives** **10**

Analysis of separately excited dc motor with continuous and discontinuous mode of operations, closed loop control of dc motor drives, analysis of dc series motor drives, single-phase and three-phase controlled rectifier fed dc motors, dual converter fed drives, reversible drives, Performance characteristics and analysis of chopper fed dc motors, motoring and braking operations

**Unit-III** **Induction Motor Drives** **15**

Operation with unbalanced source voltages and unbalanced rotor impedances, the effect of time harmonics on the motor performance, stator voltage control of induction motor, variable voltage variable frequency (VVVF) operation, voltage source inverter (VSI) fed induction motor drive, static rotor resistance control, slip power recovery systems, closed loop control of ac drives, space vector control of induction motors, introduction to field-oriented control of ac motors

**Unit-IV** **Synchronous Motor Drives** **05**

Three-phase synchronous motors, variable speed drives, variable frequency control, self-controlled synchronous motor drive employing load commutated thyristor inverter, self-controlled synchronous motor drive employing a cyclo-converter

**Unit-V** **Stepper Motor Drives** **05**

Definitions and types of stepper motors, control of variable reluctance (VR) stepper motors, micro-stepping control of stepper motor, control of permanent magnet (PM) stepper motors, control of hybrid stepper motor, different topologies of converters and motor drivers

**Unit-VI** **Drive Protection** **05**

Standard protection features of motor and associated protection relays: thermal overload, phase-to-phase short circuit, single phasing, earth fault, unbalanced voltages, negative sequence currents, under/over voltages, under frequency, pole slip, stall protection and acceleration time

## Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10 % of the questions will be asked from self-study content.

## Laboratory Work:

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

## Suggested Reading:


1. B.K. Bose, Power Electronics & Variable Frequency Drive, IEEE press.
2. G. K. Dubey, Fundamental of Electrical Drives, Narosa Publication.
3. S. K. Pillai, First Course on Electrical Drives, Wiley Eastern Limited.
4. V. Subramanyam, Electric Drives – Concepts and Applications, Tata McGraw Hill.
5. R. Krishnan, Electric Motor Drives: Modeling, Analysis and Control, Pearson Publications.
6. Latest publications from peer-reviewed journals and renowned conferences.


## Suggested List of Experiments:

| | Title of Experiment | Hrs. |
|---|---|---|
| 1. | Perform the dynamic braking of DC shunt motor | 02 |
| 2. | Perform the plugging of DC shunt motor | 02 |
| 3. | Analyse speed control of dc shunt motor using half-controlled bridge converter | 02 |
| 4. | Performance analysis of hardware based PMDC motor drive | 02 |
| 5. | Simulation based analysis of closed loop speed control of DC motor drive | 02 |
| 6. | Perform the plugging of three phase induction motor. | 02 |
| 7. | Apply pulse width modulation for V/f control of induction motor drive and observe waveforms at different operating speeds. | 02 |
| 8. | Analyse performance of vector-controlled induction motor drive. | 02 |
| 9. | simulate and analyse the closed loop speed control of three phase induction motor. | 02 |
| 10. | Simulate and Analyse speed control of induction motor using SVPWM technique. | 02 |
| 11. | Simulation based analysis of synchronous motor. | 02 |
| 12. | Performance analysis of hardware-based stepper motor drive. | 02 |

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