Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NEEC514	Modeling of Electrical Machines	3	1	0	4

Course Objective

- To develop the mathematical models of various electrical machines that can be used for their steady state and transient analysis. The modeling of electrical machines emphasizes on the basic similarities of all machines for developing their mathematical model to carry out the computer simulation and experimental analysis.

Learning Outcomes

Upon successful completion of this course, students will develop:

- Principle of energy conversion,
- Two-pole machines and Kron's primitive machine,
- Mathematical modeling for analysis of different electrical machine,
- Examine the transient behavior of the machine and
- Current trend in machine control in industry.

Unit No.	Topics to be Covered	Lecture + Tutorial Hours	Learning Outcome
1	**Principles of electromagnetic energy conversion**: Generalized representation of electro-mechanical energy conversion device. Modelling of electro-mechanical systems: expression for torque. Singly excited, Doubly excited system.	6L+2T	This section deals with the principles of electro-mechanical energy conversion devices and their modeling.
2	**Kron's primitive machine:** Voltage equations in matrix form, Resistance, inductance, impedance and motional inductance matrices, Development of generalized torque expression.	6L+2T	This topic gives knowledge about the essential elements of the generalized theory and also helps in understanding how to derive the general equations of voltage and torque for all types of rotating machines.
3	**Different methods of linear transformations:** Arbitrary reference frame,Transformation from three-phase to two-phase and vice-a-versa. Transformation from rotating to stationary frame and vice-a-versa. Park's Transformation and its physical significance.	6L+2T	Transformation of machine variables from rotating reference frame to stationary reference frame to develop the transient equations will be discussed.
4	**DC machines:** Voltage-current relationship of different types of dc machine such as separately excited dc machine, DC machine with interpole winding, Cumulative compound DC machine, Differential compound DC machine, Dynamic equations of DC machines, Small signal model of DC machine, Transient and steady state analysis.	9L+3T	The methods of developing the transient equations for different used as generator and motor will be learn in this chapter.
5	**Induction machines:** Induction machine in two-phase reference frame. Induction machine in pseudo-stationary reference frame. Induction machine equations in arbitrary, synchronous reference frames and small signal modelling; Voltage-current relationship of 3-phase and single-phase induction machine; Steady state equivalent circuit of 3-phase induction motor; Introduction to field-oriented control of induction machines; Space vector formulation of induction machine equations; Steady state models of induction machine.	9L+3T	The matrix equation of polyphase induction machine, its equivalent circuit, vector control, torque-slip and power-slip characteristics will be discussed.
6	**Synchronous Machines:** Development of basic performance equations: field self-inductance, armature to field mutual inductance, armature self-inductance, voltage equations, operational equivalent circuit. Balanced steady state and transient analysis. Derivation of Park's equation; Operational equivalent circuit of synchronous machine; steady state operation, phasor and block diagram representation of synchronous machine; Short circuit analysis of synchronous machine; ANSYS based computer analysis of synchronous machine; Capacitive loading of synchronous machine; Pull in operation; Divided winding rotor synchronous machine; Synchronous machine analysis for power system application such as unbalance short circuit study.	6L+2T	This chapter deals with the steady state and transient analysis, ANSYS based computer analysis, capacitive loading and power system applications of synchronous machine.
	Total Contact Hours	**42L+14T**	

Text Books:

1. B. Adkins & R.G. Harley, Generalized Theory of AC Machines, Springer Publishers.
2. P.S. Bhimbra, Generalized Theory of Electrical Machines, Khanna Publishers.

Reference Books:

1. A Fitzgerald, Charles Kingsley, Stephen Umans; Electric Machinery, Mc Graw Hill Say M.G.,
2. The performance and Design of Alternating Current Machines, CBS Publishers and Distributors Pvt. Ltd.
3. A.E. Clayton & N N Hancock, The Performance and Design of Direct Current Machines, CBS Publishers and Distributors Pvt. Ltd.