NIRMA UNIVERSITY

Institute:	**Institute of Technology, School of Engineering**
Name of Programme:	**B. Tech. in Electrical Engineering**
Semester:	**VII**
Course Code:	4EE102ME25
Course Title:	**Design of Special Electrical Machines**
Course Type:	**Department Elective-IV**
Year of Introduction:	**2025 – 26**

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Course Learning Outcomes (CLOs):

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

1. examine properties and characteristics of permanent magnet materials (BL4)
2. appraise and discuss constructional & operational aspects of special electrical machines (BL3)
3. analyse characteristics of special electrical machines (BL4)
4. select appropriate machine based on application requirements. (BL3)

Unit	Contents	Teaching hours (Total 45)
Unit-I	**Permanent Magnets** Permanent magnets and magnetic circuits, magnetization characteristics, various grades of permanent magnets, selection of permanent magnets as per application requirements, and latest trends in magnet technology	04
Unit-II	**Design of Permanent Magnet Brushless DC Motors** General introduction, back emf & force, emf constant, torque constant, performance characteristics, rotor variations, stator variations, design considerations, torque to rotor volume constant and its selection, calculation of main dimensions, stator design: selection of the number of stator slots, calculation of stator conductors per slot, slot design, various core materials and characteristics, selection of core material, calculation of stator core dimensions, comparison between slotted motor and slotless motor, rotor design: selection of the number of rotor poles, magnet fraction and its selection, calculation of pole dimensions, selection of the length of an air gap, calculation of rotor core dimensions, design consideration for high-speed applications, performance estimation, performance improvement with design modifications	18
Unit-III	**Design of Switched Reluctance Motors** General introduction, magnetic equivalent circuit, calculation of aligned inductance and unaligned inductance, performance	16

	characteristics, design considerations, various design variables, and their selection, calculation of main dimensions, stator design: selection of the number of stator poles, selection of stator pole arcs and its influence on the performance, calculation of coil dimensions, calculation of height of stator pole, calculation of stator core dimensions, rotor design: selection of the number of rotor poles, selection of rotor pole arc, calculation of rotor pole dimensions, performance estimation, performance improvement with design modifications	
Unit-IV	**Design of Synchronous Reluctance Motors** Introduction, various design variables, and their selection, basic sizing rules, stator design, calculation of air gap length, rotor design: selection of number of barriers and their position, calculation of the size of barriers, calculation of rotor core dimensions, performance estimation, application of permanent magnets for performance improvement	07

Self-Study:

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

Laboratory Work:

This shall consist of at least 06 laboratory experiments (design) / simulations based on the syllabus.

Suggested Readings:

1. T. J. E. Miller, *Brushless PM and Reluctance Motor Drives*, Clarendon Press Oxford.
2. D. C. Hanselman, *Brushless Permanent Magnet Motor Design*, McGraw Hill.
3. R. Krishnan, *Switched Reluctance Motor Drives*, CRC Press.
4. R. Handershot and T. J. E. Miller, *Design of Brushless Permanent Magnet Motors*, Oxford, U.K.
5. Jacek F. Gieras, *Permanent Magnet Motor Technology: Design and Applications*, CRC Press.
6. Latest publications from referred journals.

Suggested List of Experiments:

Sr.	Name of Experiments/Exercises	Hours
1.	Steady-state FE analysis of Electromagnet.	02
2.	Magnetic circuit analysis of Permanent Magnet Brushless DC Motor.	02
3.	Sizing of Permanent Magnet Brushless DC Motor.	04
4.	Validation of design of Permanent Magnet Brushless DC Motor with simulation analysis.	04
5.	To analyse the effect of stator geometry on the back emf waveform of Permanent Magnet Brushless DC Motor.	04
6.	Magnetic circuit analysis of Switched Reluctance Motor.	02
7.	Sizing of Switched Reluctance Motor.	04
8.	Validation of design of Switched Reluctance Motor with simulation analysis.	04