Approval: 8th Senate Meeting

Course Number: Special Electrical Machines

Course Name: EE 513

Credit: 3-0-0-3

Prerequisites: EE 201 Electromechanics

Students intended for: UG/PG

Elective or Compulsory: Elective

Semester: Odd/Even

Preamble: Special eletrical machines are finding ever-increasing applications, typically in position control systems, robotics and mechatronics, electric vehicles, and high speed transportation. A particular feature of this course is that it does not stop at the basic principles of these complex machines but goes on to cover recent developments and current research, making it useful for senior graduate students and research scholars in the field of electrical machines and drives.

Course Outline: The basic objective of this course is to introduce the theory, construction, design, control electronics, and in-depth analysis of several non-traditional machines such as stepper motors, switched reluctance motors, permanent magnet synchronous motors and brushless DC machines. Modeling and simulation will be introduced for these special machines in suitable software. The students will be able extend these fundamental principles into a way of thinking for problem solving in real time applications.

Course Modules:

Permanent Magnet Brushless D.C. Motors [9 Lectures]

Fundamental equations – EMF and Torque equations – Torque speed characteristics – Rotor position sensing – Sensorless motors – Motion control

Permanent Magnet Synchronous Motors [9 **Lectures**]

Construction - Principle of operation – EMF and torque equations – Starting – Rotor configurations – Dynamic model

Synchronous Reluctance Motors [8 **Lectures**]

Constructional features – axial and radial flux motors – operating principle – characteristics

Switched Reluctance Motors [8 Lectures]

Constructional features – principle of operation – torque production – characteristics – power controllers

Stepping Motors [8 Lectures]

Features – fundamental equations – PM stepping motors – Reluctance stepping motors – Hybrid stepping motors – Torque and voltage equations – characteristics

Text Books:

1. Miller, T. J. E., Brushless Permanent Magnet and Reluctance Motor Drives, Oxford Science Publications, 1989.
2. Kenjo, T., and Sugawara, A., Stepping Motors and their Microprocessor Controls, Oxford Science Publications, 1984.
3. Venkataratnam K., Special Electrical Machines, CRC Press, 2009.

Reference Books:

1. Krishnan, R., "Permanent Magnet and BLDC Motor Drives", CRC Press, 2009.
2. Chang-liang, X., "Permanent Magnet Brushless DC Motor Drives and Controls", Jun 2012.