Approval: 13th Senate Meeting

IIT Mandi
Proposal for a New Course

Course Number	: EE528
Course Name	: Modelling and Analysis of Electrical Machines
Credits	: **3-0-0-3**
Prerequisites	:EE 201 and EE201P - Electromechanics Theory and Labor Instructor Consent
Intended for	: BTech Final year/M.Tech./MS/PhD
Distribution	: Core course for M. Tech. in Power Electronics and Drives, Elective for Final year BTech Electrical Engineering, MS, PhD
Semester	: Odd/Even

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1. Course Preamble:

This is a fundamental modelling and analysis course for electrical machines. This course will focus on design-oriented analysis of conventional and advanced electrical machines. Analytical concepts discussed in the course are intended to strengthen thefundamental understanding of electromechanical systems, and also to provide a basic framework for control of electric drives. This course will be helpful for students interested in doing projects in this field. It is recommended that the students opting for this course should have the basic knowledge of Electromechanics.

2. Course Modules with quantitative lecture hours:

- **Basic Principles of Electric Machine Analysis** **(3 hours)**
  - Review on basic magnetic circuits and electromagnets including analysis of magnetic circuits with airgap and permanent magnets.
  - Principle of Electromagnetic Energy Conversion
  - Basic Two pole DC Machine – primitive 2 axis machine -Voltage and Current relationship – Torque equation
- **DC Machine Modeling** **(9 hours)**
  - Mathematical modeling of D.C. Machine (Separately Excited, shunt and series type)
  - Linearization of machine equations and state space modeling of the machine
- **Induction Machine Modeling** **(14 hours)**
  - Distributed Winding in AC Machinery, winding function, air gap mmf, rotating mmf. Calculation of self and mutual inductances

- Reference frame theory, stator and rotor voltage equations and torque equation in different reference frames, Linearized machine equations and Eigenvalue analysis, Derivation of model for steady-state analysis
- Derivation of induction motor model in rotor fluxand stator flux oriented reference frame

- **Synchronous machine Modeling** **(8 hours)**
  - Voltage and torque equations of salient pole synchronous machine including damper winding in stator and rotor reference frames
  - Derivation of steady state model
- **Permanent Magnet Machine Modeling** **(8 hours)**
  - Modeling of sine-wave and square-wave machines
  - Voltage and torque equations of surface-mounted permanent magnet machine in stator and rotor reference frames
  - Derivation of steady state model

3. Textbooks

1. Paul C. Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electric Machinery and drive systems" John Wiley and Sons, 2nd Edition, 2006.
2. C.V. Jones, "Unified Theory of Electrical Machines" Butterworths Publishers, Dec.1967.
3. Bimbhra P.S., "Generalized Circuit Theory of Electrical Machines", Khanna Publishers Limited, 5th Edition, 4th Reprint, New Delhi, 2000.

4. Reference books

1. J. Meisel, "Principles of Electromechanical Energy Conversion" McGraw Hill, 1966.
2. John Salmon "Applications of General Theories to Electrical Machines Contributions to their Design and Performance", Troubador Publishing Ltd, Leicester, 2008.
3. P.Vas, Vector Control of A.C. Machines, Clarendon Press, Oxford 1990.
4. R Krishnan, "Electric Motor Drives – Modelling, Analysis and Control", PHI Learning private Ltd.
5. K R Padiyar, "Power System Dynamics – Stability and Control", B S publications.

5. Similarity Content declaration with existing courses: About 5-10% with EE203