GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720727
Semester – II
Subject Name: Modeling and Analysis of Electrical Machines

Type of course: Professional Core Course

Prerequisite: NA

Rationale: Transient behavior of electrical power system is very important to understand the system stability and to design appropriate controllers. Transient stability analysis of large power system networks is done through digital computers. In order to simulate/analyze the system using digital computers, it is essential to obtain the mathematical model of the system. This subject deals with the mathematical models of various power system components and their applications for dynamic analysis.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Basic principle for Electrical Machine Analysis:** Introduction, magnetically coupled circuits, electromechanical energy conversion, Machine Windings & Airgap MMF, Winding Inductances & Voltage Equations.	06
2	**Reference frame theory:** Introduction, equations of transformation-change of variables, Stationary circuit variables transformed to the arbitrary reference frame, Commonly used reference frames and transformation between reference frames, transformation of a balanced set, Balanced steady state phasor relationships and voltage equations, Variables observed from various frames of reference.	06
3	**Symmetrical Induction machines:** Voltage and torque equations in machine variables, Equation of transformation for rotor circuits, Voltage & torque equations in arbitrary reference frame variables, Per unit system, Analysis of steady state equations, Free acceleration characteristics viewed from various reference frames, Dynamic model and analysis for sudden change in load torque, Dynamic model & analysis during three phase fault at the machine terminals, Unbalanced operation at symmetrical Induction Machines, Symmetrical component theory and analysis of unbalanced stator voltages, Analysis of steady state operation with unbalanced rotor conditions.	11
4	**Synchronous machines:** Voltage & torque equations in machine variables, Stator voltage equations in arbitrary	10

	reference frame variables, Voltage equations in rotor reference frame variables-Park's equation, Torque equation, rotor angle and angle between rotors, Per unit system, analysis of steady state operation, Dynamic performance during a sudden change in input torque.	
5	**Special Machines:** • Permanent magnet synchronous machine • Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines • Analysis of Switch Reluctance Motors. • Brushless D.C. Motor modelling and analysis	09

Reference Books:

1. Paul C. Krause, Oleg Wasynczuk and Scott D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, New York, 2004.
2. Charles Kingsle,Jr., A.E. Fitzgerald, Stephen D.Umans, "Electric Machinery", Tata Mcgraw Hill
3. R. Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India
4. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press
5. Chee-Mun, "Dynamic Simulation of Electric Machinery using MATLAB", Prentice Hall PTR
6. K. R. Padiyar, "Power System Dynamics Stability and Control", B S Publications
7. P. Kundur, "Power System Stability & Control", Tata Mcgraw hill

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Apply the principles of modeling and analysis of electrical machines	25
CO-2	Analyze the transient behaviour of symmetrical induction machine	25
CO-3	Analyze the transient behaviour of synchronous machine	25
CO-4	Evaluate the performance of special electric machine	25

List of Experiments: Experiments based on above curriculum.

Major Equipment:

List of Open Source Software/learning website:

E-materials available at the website of NPTEL- http://nptel.ac.in/

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