Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NEED503	Power System Dynamics	3	0	0	3

Course Objective

- The Syllabus is concerned with understanding, modelling, analysing power system dynamics and mitigating stability problems. Such stability related problems constitute very important considerations in the planning, design and operation stages of modern power systems. However, strong fundamental knowledge about power system analysis, operation and network theorems are the prerequisite for the course.

Learning Outcomes

Upon successful completion of this course:

- The student will have good grasp on model development for power generation system models, both for synchronous and asynchronous, for power system dynamic studies and analysis.
- They would be able to interpret various parameters and constants in various dynamic blocks in power system simulation software.
- They will have developed the skill to understand and validate generation system dynamic response through time domain and frequency domain analysis such as state space, Eigen-value analysis etc. as their further effort.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	**Basic concepts and definitions:** Rotor angle stability; Voltage stability and voltage collapse; Mid-term and long-term stability.	2L	Basic concepts of stability in the Power system will be delivered.
2	**Modelling of synchronous machines:** Review of basic equations of synchronous machine; The dq0 transformation; Equivalent circuits for direct and quadrature axes; Steady state analysis: Voltage, current and flux linkages relationships; PU system representation; Steady-state equivalent circuit, Procedure for computing steady state values; Electrical transient performance characteristics; Equations of motion: Swing equation, Its representation in system studies; Synchronous machine representation in stability study: approximated models for large-scale studies; Constant flux linkage models.	10L	The student will have good grasp on model development for power generation system models both synchronous and asynchronous for power system dynamic studies and analysis. They will also learn the concepts through numerical problems.
3	**Modelling of excitation systems:** Elements of an excitation system and their functions; PU representation of Exciters; Modelling of different components of DC excitation system; AC excitation systems; and static excitation systems.	6L	Discussion on different type of excitation and its role in the power system stability will be discussed. They will also learn the concepts through numerical problems.
4	**Small signal stability:** Fundamental concept: State-space representation; stability of a dynamic system; Eigen properties of state matrix; Modes; Small signal stability of a single machine infinite bus (SMIB) system; Effect of Power System Stabilizer (PSS) in SMIB.	8L	Linearization model of the power system elements and validate generation system dynamic response through Eigen-value analysis will be discussed. The students will also learn the concepts through numerical problems.
5	**Transient stability:** An elementary view on different methods; Transient stability of a large system; Lyapunov Function; Direct method of analysis of transient stability.	8L	To study stability analysis and improvement for Angle stability, Small-signal angle stability, Transient (large disturbances) angle stability. They will also learn the concepts through numerical problems.
6	**Voltage stability:** Basic concept of voltage stability; Role of reactive power on voltage stability; P-V and Q-V profiles; Mechanism and causes of voltage collapse; Prevention of voltage collapse; Different voltage stability indicators; Reactive compensation methods; Methods of improving voltage stability.	8L	To study stability analysis and improvement for Voltage stability, Short-term voltage stability, Long-term voltage stability. They will also learn the concepts through numerical problems.
	Total Contact Hours	**42L**	

Text Books:

1. Prabha Shankar Kundur, Power System Stability and Control, TATA McGraw-Hill Inc.
2. K. R. Padiyar, Power System Dynamics: Stability and Control, BS Publications, Second Edition, 2008.

Reference Books:

1. P. Sauer and M. Pai, "Power system dynamics and stability", Prentice Hall, 1998 Roger S. Pressman