COURSE CONTENT

POWER SYSTEM DYNAMICS AND STABILITY								
II Semester: EPS								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BPSD14	**Core**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Power system operation and control								

I. COURSE OVERVIEW:

This course will illustrate to the development of mathematical models for synchronous machine, Exciter, Governor and Prime mover. It will also cover power system dynamic phenomena and the effects of exciter and governor control. This course will also provide the idea of power system stability and help the students to understand methods to improve dynamic stability.

II. COURSES OBJECTIVES:

The students will try to learn

I. Mathematical models for synchronous machine, Exciter, Governor and Prime mover.
II. Power system dynamic phenomena and the effects of exciter and governor control.
III. The methods to improve dynamic stability

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III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1	Illustrate the significance of power system stability and approach for analysis of multi machine system.
CO2	Develop the state space equations, unit conversions, equivalent circuits for mathematical analysis of the synchronous machines.
CO 3	Develop the basic components of digital relay and signal conditioning subsystems for implementation of digital protection.
CO 4	Identify the types of excitation and voltage control configurations to address the effects of voltage changes and reactive power.
CO 5	Explain the methods to enhance the small signal stability of the power system.

IV COURSE CONTENT:

MODULE - I: POWER SYSTEM STABILITY: A CLASSICAL APPROACH (10)

Introduction, requirements of a reliable electrical power service, swing equation, power-angle curve, stability analysis of SMIB system, equal area criteria, classical model of a multi-machine system, shortcomings of the classical model, block diagram of one machine, system response to small disturbances: types of problems studied, the unregulated synchronous machine, modes of oscillation of an unregulated multi-machine system, regulated synchronous machine.

MODULE–II: SYNCHRONOUS MACHINE MODELING-I (10)

Introduction, Park's Transformation, flux linkage equations, voltage equations, formulation of state-space equations, current formulation, per unit conversion, normalizing the voltage and torque equations, equivalent circuit of a synchronous machine, the flux linkage state-space model, load equations, sub-transient and transient inductances and time constants, simplified models of the synchronous machine, turbine generator dynamic models.

MODULE –III: SYNCHRONOUS MACHINE MODELING-II (10)

Steady state equations and phasor diagrams, determining steady state conditions, evaluation of initial conditions, determination of machine parameters.

Digital simulation of synchronous machines, linearization and simplified linear model and state-space representation of simplified model.

MODULE –IV: EXCITATION AND PRIME MOVER CONTROL (10)

Simplified view of excitation control, control configurations, typical excitation configurations, excitation control system definitions, voltage regulator, exciter buildup, excitation system response, state-space description of the excitation system, computer representation of excitation systems, typical system constants, and the effects of excitation on generator power limits, transient stability and dynamic stability of the power system; Prime mover control: Hydraulic turbines and governing systems, steam turbines and governing systems. Introduction to Optimal power flow problem, OPF calculations combining economic dispatch and power flow, OPF using DC power flow, algorithms for solution of the ACOPF, optimal reactive power dispatch.

MODULE –V: EXCITATION AND PRIME MOVER CONTROL (09)

Fundamental concepts of stability of dynamic systems, Eigen properties of the state matrix, small-signal stability of a single-machine infinite bus system, effects of excitation system, power system stabilizer, system state matrix with amortizes, characteristics of small-signal stability problems.

V. TEXTBOOKS:

1. P M Anderson & A A Fouad "Power System Control and Stability", Galgotia, New Delhi, 1st edition, 1981.
2. J Machowski, J Bialek& J R W Bumby, "Power System Dynamics and Stability", John Wiley &Sons, 1st edition, 1997.

VI. REFERENCE BOOKS:

1. P Kundur, "Power System Stability and Control", McGraw Hill Inc., 1st edition, 1994.
2. E WKimbark, "Powersystemstability", Vol.I&III, JohnWiley&Sons, NewYork, 1st edition, 2002
3. L Leonard Grigsby (Ed.); "Power System Stability and Control", Second edition, CRC Press, 1st edition, 2007.

VII. ELECTRONICS RESOURCES:

1. NPTEL Power Systemsstability - NOC: components of digital relay and signal conditioning.
2. NPTELPower System Stability and Control- NOC: Types of excitation and voltage control configurations.
3. NPTEL significance of power system stability- NOC: Small signal stability of the power system.

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Definition and terminology
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations