

## **PS5005 ADVANCED POWER SYSTEM DYNAMICS**

### **DETAILED SYLLABUS**

#### **UNIT I TRANSIENT STABILITY ANALYSIS**

Review of numerical integration methods: Euler and Fourth Order Runge-Kutta methods, Numerical stability and implicit methods, Interfacing of Synchronous machine (variable voltage) model to the transient stability algorithm (TSA) with partitioned – explicit and implicit approaches – Interfacing SVC with TSA-methods to enhance transient stability

#### **UNIT II UNIFIED ALGORITHM FOR DYNAMIC ANALYSIS OF POWER SYSTEMS**

Need for unified algorithm- numerical integration algorithmic steps-truncation error-variable step size – handling the discontinuities- numerical stability- application of the algorithm for transient. Mid-term and long-term stability simulations

#### **UNIT III SUBSYNCHRONOUS RESONANCE (SSR) AND OSCILLATIONS**

Subsynchronous Resonance (SSR) – Types of SSR - Characteristics of series – Compensated transmission systems –Modeling of turbine-generator-transmission network- Self-excitation due to induction generator effect – Torsional interaction resulting in SSR –Methods of analyzing SSR – Numerical examples illustrating instability of subsynchronous oscillations – time-domain simulation of subsynchronous resonance – EMTD with detailed synchronous machine model- Turbine Generator Torsional Characteristics: Shaft system model – Examples of torsional characteristics – Torsional Interaction with Power System Controls: Interaction with generator excitation controls – Interaction with speed governors – Interaction with nearby DC converters

#### **UNIT IV TRANSMISSION, GENERATION AND LOAD ASPECTS OF VOLTAGE STABILITY ANALYSIS**

Review of transmission aspects – Generation Aspects: Review of synchronous machine theory – Voltage and frequency controllers – Limiting devices affecting voltage stability – Voltage-reactive power characteristics of synchronous generators – Capability curves – Effect of machine limitation on deliverable power – Load Aspects

For Notes, Question Papers, Syllabus & Many More

– Voltage dependence of loads – Load restoration dynamics – Induction motors – Load tap changers – Thermostatic load recovery – General aggregate load models.

### **UNIT V ENHANCEMENT OF TRANSIENT STABILITY AND COUNTER MEASURES FOR SUB SYNCHRONOUS RESONANCE**

Principle behind transient stability enhancement methods: high-speed fault clearing, reduction of transmission system reactance, regulated shunt compensation, dynamic braking, reactor switching, independent pole-operation of circuit-breakers, single-pole switching, fast-valving, high-speed excitation systems; NGH damper scheme.

### **REFERENCES**

- 1 R.Ramnujam," Power System Dynamics Analysis and Simulation", PHI Learning Private Limited, New Delhi, 2009
- 2 T.V. Cutsem and C.Vournas, "Voltage Stability of Electric Power Systems", Kluwer publishers,1998
- 3 P. Kundur, "Power System Stability and Control", McGraw-Hill, 1993.
- 4 H.W. Dommel and N.Sato, "Fast Transient Stability Solutions," IEEE Trans., Vol. PAS-91, pp, 1643-1650, July/August 1972.
- 5 Roderick J . Frowd and J. C. Giri, "Transient stability and Long term dynamics unified", IEEE Trans., Vol 101, No. 10, October 1982.
- 6 M.Stubbe, A.Bihain,J.Deuse, J.C.Baader, "A New Unified software program for the study of the dynamic behaviour of electrical power system" IEEE Transaction, Power Systems, Vol.4.No.1,Feb:1989 Pg.129 to 138