Course Title: Power System II
Course Code: EPEG 413
Credit Hours: 3

Course Description:
This course provides a broad understanding of the performance of modern power systems and the analysis and computation of large three phase systems.

Course Contents:

Unit 1: General Background
Growth of electric power system, Energy production; Transmission and distribution; Load studies, Economic load dispatch, Fault calculations; System protection, Stability studies; Power system engineering.

Unit 2: Introduction
Single and double subscript notation, Power in single-phase AC circuits; Complex power triangle, Direction of power flow; Voltage and current in balanced three phase circuits; Power in balanced three phase circuits; Per unit quantities.

Unit 3: System Modelling
Construction of synchronous machine; Armature reaction and circuit model in a synchronous machine; Effect of synchronous machine excitation; Ideal transformer, Equivalent circuit of practical transformer; Autotransformer, PU impedance in 1-phase transformer circuits, 3-phase transformer; PU impedance of 3 winding transformer; One line diagram, Impedance and reactance diagram; Advantages of PU computing.

Unit 4: Load-Flow Solutions and Control
Data for load- flow studies; Gauss-Seidel method, Newton - Raphson method; Digital - computer studies of load flow; Information obtained in a load flow study, numerical results; Control of power into a network; Specification of bus; Voltage, Capacitor banks, Control by transformer; Optimal load flow solution

Unit 5: Symmetrical Three Phase Faults
Transients in RL series circuits; Short - circuit currents and the reactances of synchronous machines; Internal voltages of loaded machines under transient condition; Bus impedance matrix in fault calculations; Bus impedance matrix equivalent networks; Selection of circuit breakers

Unit 6: Symmetrical Components
Synthesis of asymmetrical phasors from their symmetrical components; Symmetrical components of asymmetrical phasors; Phase shift of symmetrical components in Y-Delta transformer banks; Power in terms of symmetrical components; Unsymmetrical series impedances, Sequence impedances and sequence networks; Sequence networks of unloaded generators, Sequence impedance -positive and negative sequence networks, Zero sequence networks

Unit 7: Unsymmetrical Faults

Single line to ground fault on an unloaded generator; Line to line fault on an unloaded generator; Double line to ground fault of an unloaded generator, Unsymmetrical faults on power systems; Single line to ground fault on power system; Line to line fault on power system; Double line to ground fault on a power system; Interpretation of the interconnected sequence networks; Analysis of unsymmetrical faults using the bus impedance matrix; Fault through impedance, computer calculations of fault currents

Unit 8: Power System Stability

Stability problem, rotor dynamics and the swing equation; Power angle equation, Synchronising power coefficients; Equal area criterion of stability, Further applications of the equal area criterion; Multi-machine stability studies- classical representation; Step by step solution of the swing curve; Transient stability studies, Factor affecting transient stability.

References:

1. W. D. Stevenson, *Elements of Power System Analysis*, 4th Ed., TMH 1982
2. Hadi Saadat, *Power System Analysis*, , McGraw-Hill, 1999
3. C. A. Groues, *Power System Analysis*, Wiley NY 1986