ELECTRICAL ENERGY AND POWER SYSTEMS (EEPS) GROUP

Courses (all are 3 Credit courses)

EEE 6801: Generalized Machine Theory

Introduction to generalized machine theory. Kron's primitive machine: moving to fixed-axis transformation; Park's transformation: three-phase to d-q transformation: variable co-efficient transformation: other transformations. Matrix and tensor analysis of machines. Three phase synchronous and induction machines: two-phase servo motor: single phase induction motor. Smooth-air gap two-phase synchronous machine. Two-phase induction machine. The n-m winding symmetrical machine. Diagonalization by charge of variable. Symmetrical three-phase machine and special limiting cases.

EEE 6802: Special Machines

Current topics on electrical machines and devices. Permanent magnet machines. Hysteresis machine. Eddy current devices: homopolar machines. PAM motors and reluctance machines.

EEE 6803: Advanced Machines Design

Optimized design procedure of electrical machines. Review of standard procedure in design of conventional and special machines. Algorithm of critical path of design. Design economics and safety factors. Applications of computers in modern designs including the operation of the machine in the nonlinear ranges: Magnetic flux-plots and heat transfer process etc. Mechanical design of electrical machinery and relation between mechanical and electrical machine design

EEE 6901: Optimization of Power System Operation

Modeling of generating units (thermal units, combined-cycle units, fuel-switching/blending units, hydro units, pumped-storage units, photovoltaic, wind). Economic dispatch, Security-constrained economic dispatch, multi-area system economic dispatch. Unit commitment. Optimum power flow (OPF). Fuel budgeting and planning, probabilistic production cost modeling, hydrothermal coordination. Reactive power optimization. Optimal load shedding.

EEE 6914: Computational Power Systems

Incidence matrices, primitive networks and formation of impedance and admittance network matrices. Algorithms for formation of network matrices. Three phase load flow. AC-DC Load flow. Short circuit studies using Z_{BUS} and Z_{LOOP}, open circuit fault studies; sequence bus impedance matrices for unsymmetrical faults.

Eigenvalue analysis: QR algorithm, Arnoldi method, Prony method, power system applications.

Applications of sparsity exploitation, model/space decomposition, hierarchical computer and array processor based methods, pattern recognition, artificial neural network (ANN), fuzzy logic and genetic algorithms in power system problems.

EEE 6915: Power System Relaying

Review of characteristics of over current, directional, differential, distance and pilot relays. Transmission line protection: nonpilot overcurrent, nonpilot distance, pilot relaying- voltage and current differential, phase comparison, directional comparison. Series compensated transmission line protection. Numerical relays: orthogonal filters, symmetrical component filters, torque and impedance based algorithms. Relaying based on frequency dynamics. HVDC protection: AC side, DC side, reverse power, torsional interaction, protection of generators near converters. Wide area

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measurements system (WAMS) based protection. Protection system for renewable sources.
EEE 6904: Power System Stability Principles of angular, voltage and frequency stability. Small signal (steady state) stability: state space concepts and dynamic system representation, eigen vectors in dynamic system analysis. Large signal (transient/dynamic) stability: direct methods and indirect methods- time domain simulation, numerical integration of swing equations. Equal area criterion, extended equal area criterion, transient energy function (TEF) methods. Nonlinear system stability- Lyapunov's method. Detailed modeling, simplifications, salient pole synchronous machines and induction machines modeling, static load models. Turbine governor, generator excitation systems, damper winding and their representation in stability models. Power system stabilizers. On line identification and improvement of stability: fast valving, braking resistors, generator tripping, shunt FACTS devices. Model reduction: coherency, aggregation of coherent generators, equivalent model of external system. Voltage stability: various criteria, critical load demand, static analysis (continuation power flow and other methods, indices), dynamic analysis, prevention of voltage collapse.
EEE 6905: Transients in Power Systems Analysis and computation of electrical transients in lumped and distributed power circuits; switching surges, lightning surges, travelling waves. Generator, transformer, motor, converter and breaker switching. Impact of surges on terminal equipment. Insulation coordination; surge protection. Applications of EMTP.
EEE 6906: Reliability of Power System Review of probability theories. Reliability concepts: quantitative and qualitative reliability, adequacy and security, reliability indices, reliability model, deterministic and probabilistic approaches, system hierarchical levels, reliability cost and reliability worth. System reliability: network methods, probability distributions, state space method. Markovian model of generation unit. Probabilistic simulation of generating systems. Loss of load method, loss of energy method, frequency and duration method. Modeling of forecast uncertainty. Reliability of interconnected systems. Reliability of composite transmission and generating system. Substation reliability assessment (fault-tree and event-tree methods)
EEE 6907: Power System Planning Basic objectives of power system planning. Generation expansion planning process. Electrical demand forecasting; current demand forecasting approaches. Generation planning; economic analysis, expected energy generation, expected fuel cost. Booth-Baleriux, cummulant and segmentation methods. Probabilistic simulation of hydro and energy limited units. Expected energy production cost of interconnected systems. Economic aspects of interconnection. Different aspects of load management; effects of load Management on reliability and on production cost. Joint ownership of generation.
EEE 6908: Advanced Power System Control

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Wide area monitoring system and Control based on PMU and GPS. Operational load forecast. Generation control: primary, secondary, tertiary. AGC implementation: features, NERC generation control criteria. Frequency instability: inertia, spinning reserve, response of generators and loads, interconnected systems, under frequency load shed, islanding, coordination between AGC and series FACTS devices in tie-lines. Security analysis: generation outages, transmission outages, power transfer, voltage collapse. Security constrained and electricity market oriented generation scheduling and optimal power flow.
EEE 6916: Energy Conversion Technologies Energy conversion processes; energy sources, principles or conservation of energy balance equations. Direct electrical energy conversion: magnetohydronamic (MHD): fuel cell: thermoelectrostatic: ferro-electric: photo-electric: photovoltaic, electrostatic and piezoelectric energy conversions: characteristics including efficiency, power densities, terminal properties and limitations. Electromechanical energy conversion: general introduction of electrical to mechanical, mechanical to electrical and electrical to electrical conversions. Bulk energy conversion devices. General formulations of equations; co-ordinate transformation and terminal characteristics
EEE 6911: HVDC Embedded Power System Characteristics of HVDC and economics; 6-pulse and 12- pulse converters and control; load flow models considering HVDC links. Interaction between DC systems and AC systems: synchronous generators, subsynchronous torsional interaction, FACTS devices. Fault analysis: protection by control actions. DC Circuit breaker. CSC (current source converter), VSC (voltage source converter): two and multi-level, CCC (capacitor commutated converters), controlled series capacitor converter (CSCC), multi-terminal HVDC.
EEE 6912: Smart Grid Operation Distributed energy resources (DERs), two way communications and demand response. Various storage devices and systems; micro grids. Control of distribution system interfaced photovoltaic generators, micro/mini-hydros and wind turbines. V2G (vehicle to grid) system: multi-agent charging of plug-in hybrid electric vehicles, frequency regulation, reserve and reactive power support. Fault current limiters. Feeder reconfiguration. D-STATCOM for voltage compensation and load balancing. Demand response for blackout prevention.
EEE 6913: Electricity Market Operation Market design in Restructured Power Systems, Spot market, day ahead generation dispatch. Electricity price forecasting, Price based unit commitment, Market power analysis, volatility in power markets. Asset valuation and risk analysis, hedging tools for managing risks. Independent System Operator (ISO)/Regional Transmission Organization (RTO). Auction mechanisms, Ancillary services auction market, Power transmission pricing, Locational Marginal Price (LMP). Power pool model, bilateral contracts, stranded costs, electric utility markets in the United States and abroad, OASIS (Open Access Same Time Information System), tagging electricity transactions, electric energy trading. Total and available transfer capability (TTC/ATC), transaction management system (TMS), transaction information system (TIS), congestion management, transmission loading relief (TLR). Transmission loss evaluation and loss cost distribution. Deregulation and reliability
EEE 6006: Nuclear Power Safety

Courses (all are 3 Credit courses)
Review of Nuclear power generation, reactors and their control, Radiation protection, Safety characterization and safety features of nuclear power plants, fuel depletion and related effects, Reactor safety principles and criteria, design-basis and beyond-design-basis events, Emergency core cooling and containment performance, deterministic safety analysis, probabilistic safety analysis, accident modeling, safety goals and risk informed decision making, analysis of operation transients, analysis of accidents, Case histories, Incorporation of safety analysis in operation, emergency operation, accident management, safety culture, IAEA regulatory issues. Fuel cycle and radioactive waste storage, transportation and reprocessing.
EEE 6301: Power Semiconductor Circuits*   Static switching devices, characteristics of SCR, BJT, MOSFET, IGBT, SIT, GTO, MCT. Classifications of static power converters and their application. Control circuits for static power converters. Pulse width modulation; PWM control of static power converters. Switch mode DC to DC converters, resonant converters, Fourier analysis of static converter waveforms, HD, THD, pf, ZVS and ZCS of static converters. Hysteresis current of AC drives.   ***This course also belongs to the Interdisciplinary group**
EEE 6302: Design of Power Semiconductor Circuits and Drives*   Design of SCR communication circuits, base and gate drive circuits of static switching devices, snubber circuits, switching losses and heat sink. Input/output filter design of static power converters. Design of protection circuits for static power converters. Scalar and vector control of AC machines using static power converters. Design of microcomputer controllers for static power converter switching.   ***This course also belongs to the Interdisciplinary group**
EEE 6003: Solar Photovoltaic Systems*   Solar cell technologies. PV modules. Balance of system components: batteries and charge controllers, inverters, sun tracker. MPPT and its various methods. System design and integration. Location issues and Irradiance modeling; Stand-alone system design; Grid integration issues; Grid-connected system design; Economics of solar PV: Solar energy cost; Grey energy; Energy payback time; Yield factor.   ***This course also belongs to the Interdisciplinary group**
EEE 6009:Energy Planning*   Energy and its types. Energy Landscape in Bangladesh. Global Energy Perspectives: World Energy Consumption. Sources of Energy: fossil types – coal, oil, gas, and other hybrids. Sources of Energy: Renewables – wind, solar, tidal, hydro. Nuclear power and its Future. Long term forecast of energy requirements and availability: Bangladesh and global perspectives. Energy Economics and econometric models. Climate Change and the Energy scenario. Carbon management and Low emission Technologies. Future Trends: hydrogen economy, smart storages, future strategy. Energy Strategy, Innovation, and Entrepreneurship. Energy Pricing issues. Energy Policy in Bangladesh.   ***This course also belongs to the Interdisciplinary group**