EEC- 801-SCADA System and Application

Unit – I SCADA and PLC: Data acquisition system, evaluation of SCADA, communication technologies, monitoring and supervisory functions. PLC: Block diagram, programming languages, Ladder diagram, Functional Block diagram, Applications, Interfacing of PLC with SCADA.

Unit II- SCADA system components: Schemes, Remote Terminal Unit, Intelligent Electronic Devices, Communication Network, SCADA server.

Unit III-SCADA Architecture-Various SCADA Architectures, advantages and disadvantages of each system, single unified standard architecture IEC 61850 SCADA / HMI Systems.

Unit IV -SCADA Communication-Various industrial communication technologies- wired and wireless methods and fiber optics, open standard communication protocols.

Unit V-Operation and Control Of Interconnected Power System-Automatic substation control,SCADA configuration, Energy management system, system operating states, system security,state estimation, SCADA applications Utility applications, transmission and distribution sectoroperation, monitoring analysis and improvement. Industries oil gas and water. Case studies,implementation, simulation exercises.

References:

1. Ronald L. Krutz, "Securing SCADA System", Wiley Publications.
2. Stuart A Boyer, "SCADA supervisory control and data acquisition", ISA, 4th Revised
3. Edition
4. Sunil S. Rao, "Switchgear and Protections", Khanna Publications.
5. Gordan Clark, Deem Reynders, "Practical Modern SCADA Protocols", ELSEVIER
6. S. K. Singh, "Computer Aided Process Control", PHI
7. S. Gupta, JP Gupta, "PC interface For Data Acquiring & Process Control", 2nd Ed., Instrument Society of America.
8. John W. Web, Ronald A. Reis, "Programmable Logic Controllers" 5th Edition, PHI
9. Liptak, B. G. (E.d.), "Instrument Engineers Handbook", vol. I to III, Chilton Book Co.
10. Bhatkar, Marshal, "Distributed Computer control & Industrial Automation", Dekker Publication
11. Frank D. Petruzella, "Programmable Logic Controllers", 3rd Edition, McGraw Hill

List of Experiments PLC & SCADA based (Extendable):

SCADA based Experiments

1Experiments on Transmission Module Local Mode for Simulation of Faults

a. Line to Ground Faults (LG)
b. Line to Line Faults (LL) Line to Line to Line Faults (LLL)
c. Line to Line to Ground Faults (LLG)
d. Line to Line to Line to Ground Faults (LLLG)

2 Experiments on Transmission Line Loading

a. Resistive Loading
b. Inductive Loading
c. Resistive and Inductive Loading

3 Experiments on Series Compensation Shunt Compensation

4 Experiments on Sudden Load Rejection Remote Mode for Simulation of Faults

a. Line to Ground Faults (LG)
b. Line to Line Faults (LL) Line to Line to Line Faults (LLL)
c. Line to Line to Ground Faults (LLG)
d. Line to Line to Line to Ground Faults (LLLG)

PLC based Experiments

1. To start a 3 squirrel cage induction motor in star-delta method using PLC.
2. Interfacing of simple I/O devices with PLC for ON & OFF operation
3. DOL starter operation using PLC.
4. Star delta starter operation using PLC.
5. Direction/speed control of a DC motor using PLC
6. Control a conveyer belt using PLC
7. Control a simulated elevator using PLC
8. PLC based thermal ON/OFF control.
9. Interfacing PLC with SCADA, Parameter reading of PLC using SCADA
10. Reporting & trending in SCADA system
11. Project based on PLC

EEC 802 - Asynchronous Machines

Unit I- Induction Machines: Generalized representation, performance equation, equivalent circuit, steady state analysis, transient analysis, phasor diagrams, field distribution of space distributed three-phase winding, concept of rotating field, production and concept of asynchronous and synchronous torques., leakage reactance, effect of rotor circuit resistance, starting torque, cage motors, double cage and deep bar motor, generator action, methods of excitation, space harmonics, estimation of equivalent circuit parameters, effect of voltage injection in rotor circuit of slip ring induction motor, Schrage motor.

Unit II- Reference Frame Theory: Real time model of a two phase induction machine-Transformation to obtain constant matrices-three phase to two phase transformation-Power equivalence.

Unit III- Dynamic Modeling Of Three Phase Induction Machine: Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model synchronously rotating reference frame model-Equations in flux linkages-per unit model

Unit IV- Small Signal Modeling of Three Phase Induction Machine : Small signal equations of Induction machine-derivation-DQ flux linkage model derivation control principle of Induction machine.

Unit V- Symmetrical and Unsymmetrical 2 phase Induction Machine: Analysis of symmetrical 2 phase induction machine-voltage and torque equations for unsymmetrical 2 phase induction machine-voltage and torque equations in stationary reference frame variables for unsymmetrical 2 phase induction machine-analysis of steady state operation of unsymmetrical 2 phase induction machine- single phase induction motor - Cross field theory of single-phase induction machine.

References:

1. Electric machinery A.E. Fitzgerald and C. Kingsley.
2. Theory of A.C. machines A.S. Langsdorf.
3. The performance and design of A. C. E.O. Taylor. Commutator Machines.
4. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", IEEE Press, Second Edition.
5. P.S.Bimbra, "Generalized Theory of Electrical Machines" Khanna publications, 5th edition-1995
6. Dynamic simulation of Electric machinery using MATLAB / Simulink –Chee Mun Ong-
7. Prentice Hall.
8. R. Krishnan, "Electric Motor Drives - Modeling, Analysis& control", Pearson Publications,
   1st edition, 2002.

List of Experiments (Extendable)-Matlab based experiments:

1. Construction of Induction motor model using matlab.
2. Construction of Real time model of a two phase induction machine
3. Analysis of symmetrical 2 phase induction machine-voltage and torque equations for unsymmetrical 2 phase induction machine
4. Effect of voltage injection in rotor circuit of slip ring induction motor,
5. Simulation and study of production and concept of asynchronous and synchronous torques
6. Characteristics curves for various speed control techniques of induction motor.
7. Characteristics curves for various braking of induction motor.

EEC-803(A) Coding Theory & Techniques

Unit I Coding: Coding for reliable digital transmission and storage, types of codes, modulation and coding, maximum likelyhood decoding, types of errors, source coding: shannon-fano coding, huffman codes, run-length encoding, Lampel-Ziv codes.

Unit II : Block codes: Important linear block codes, repetition codes, hamming codes, a class of single error-correcting and double-error correcting codes, reed-muller codes, the (24,12) golay code, product codes, interleaved codes.

Unit II : Convolutional codes: Encoding, structural properties, state diagram, code tree diagram, maximum-likelihood decoding, soft decision and hard decision decoding, the viterbi algorithm.

Unit II : Low Density Parity Check codes: Introduction, galleger's method of construction, regular and irregular ldpc codes, other methods of constructing LDPC codes, tanner graphs, decoding of LDPC codes.

Unit V: **BCH and RS codes**: Groups, fields, binary arithmetic, construction of galois fields GF(2m), basic properties of galois fields, introduction to BCH and RS codes.

References:

1. Shu Lin and Daniel J. Costello, Jr. "Error Control Coding," 2/e, Pearson, 2011.
2. K Sam Shanmugum, "Digital and Analog Communication Systems," Wiley, 2010.
3. Simon Haykin, "Digital Communication," TMH, 2009.
4. Bernard Sklar, "Digital Communications-Fundamental and Application", PE.
5. John G. Proakis, "Digital Communications", 5 th Edition, 2008, TMH.
6. Salvatore Gravano, "Introduction to Error Control Codes", Oxford
7. Todd K.Moon, "Error Correction Coding – Mathematical Methods and Algorithms", 2006, Wiley India.
8. Ranjan Bose, "Information Theory, Coding and Cryptography", 2nd Edition, 2009, TMH.

EEC-803(B) Energy Conservation

Unit-I General Energy Problem: Energy use patterns and scope for conservation, energy audit, energy monitoring, energy accounting analysis, and targeting, energy management, types of energy audit, qualities and function of energy managers, language of an energy manager, check list for top management, loss of energy in material flow, energy performance, maximizing system efficiency, input energy requirements, energy auditing instruments, material load energy balance diagram.

Unit- III Thermodynamics of Energy Conservation: Basic principle, irreversibility, second law, efficiency analysis of systems, primary energy sources, optimum use of prime-movers, energy recovery in thermal systems, waste heat recovery techniques, thermal insulation, thermal energy audit in heating, ventilation and air conditioning, friction, lubrication, predictive and preventive maintenance.

Unit-III Load curve analysis: Load curve analysis & load management, DSM, energy storage for power systems (mechanical, thermal, electrical & magnetic), restructuring of electric tariff from energy conservation consideration, economic analysis depreciation method, time value of money, evaluation method of projects, replacement analysis, pay back period, energy economics, cost benefit risk analysis.

Unit-IV Energy Efficient System: Energy efficient electric drives, energy efficient house keeping, energy efficient motors, energy flow networks, simulation & modeling, matrix chart.

Unit-V Energy conservation: Energy conservation policy, energy conservation task before industry, energy conservation equipment's , co-generation, energy conservation process, energy conservation in transportation system in electric vehicle industry, sugar, textiles, cement industries, electrical energy conservation in building, heating, lighting & domestic gadgets .

References:

1. Energy Management – W.R. Murphy & G. Mckey Butler worths.

2. Energy Management Head Book- W.C. Turner, John Wiley.

3. Energy Management Principles- Craig B. Smith, Pergamon Press.

4. Energy Conservation- Paul O Callagan- Pergamon Press.

5. Design & Management of energy conservation. Callaghan.

6. Elect, Energy Utilization & Conservation. Dr. Tripathi S.C.

EEC-803(C) Reactive Power Control & FACTS

Unit-1: Introduction: Facts basic concepts and general system considerations, power flow in ac system, definitions on facts, types of facts controllers, benefits from facts Technology, static var compensator (SVC): principle of operation and control strategy, Thyristor controlled phase angle regulator (TCPAR): principle of operation and control strategy.

Unit-2: Transient Stability Analysis: Analysis of Power systems installed with FACTS devices **Control with FACTS:** Power Transmission Control using UPFC, Power Transmission Control using Phase Shifting Transformer (PST), Power Transmission Control using SSSC.

Unit-3: **Oscillation Stability Analysis and Control with FACTS**: Linearised model of power systems installed with FACTS based Stabilizers, Heffron-Phillips model of a SMIB system installed with SVC, TCSC and TCPS, Heffron-Phillips model of a SMIB system with UPFC, Heffron-Phillips model of a Multi-machine system installed with SVC, TCSC and TCPS.

Unit-4: **Design of FACTS Based Stabilizers**: Analysis of damping torque contribution by FACTS based stabilizers installed in SMIB systems, Selection of installing locations and feedback signal for FACTS based stabilizers, Dynamic Voltage restorer.

Unit-5: Power Flow Controller: Unified Power Flow Controller (UPFC): Principle of operation, configuration and control, Simulation of UPFC, Steady state model of UPFC, Interline Power Flow Controller (IPFC): Principle of operation, configuration and control, Static compensator (STATCOM): principle of operation and control, Application for mitigation of ssr.

References:

1. "Understanding FACTS Devices" N.G. Hingorani and L. Guygi. IEEE Press Publications 2000.
2. Flexible AC Transmission System: Y.H.Song and A.T.Jhons, IEE, 1996(A Book)
3. Dr Ashok S & K S Suresh Kumar "FACTS Controllers and applications" course book for STTP, 2003.
4. Ned Mohan et.al, Power Electronics, John Wiley and Sons.
5. K. R. Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International, First Edition.
6. T J E Miller, John Wiley, Reactive Power Control in Power Systems, Wiley India Pvt Ltd 28 January 2010 2. J Arriliga and N R Watson, Wiley, Computer modeling of Electrical Power Systems, Wiley India Pvt Ltd, 2009
7. R Mohan Mathur and Rajiv K Varma, Thyristor based FACTS controller for electrical transmission system, Wiley-IEEE Press, 12 August 2011

EEC-804(A) High Voltage Engineering

Unit –I Introduction: Basics of HV technology, advantages of transmitting electrical power at high voltages, need for generating high voltages in laboratory, applications of high voltage.

Unit –II Insulation & Breakdown: Classification of HV insulating media, its properties, gaseous dielectrics, ionizations, Townsend's theory & its limitations, streamer's theory breakdown in non uniform fields, corona discharges, Paschen's law and its significance, time lags of breakdown, breakdown in solid dielectrics, intrinsic breakdown, avalanche breakdown, thermal breakdown, and electro mechanic breakdown, breakdown of liquids dielectric, suspended particle theory, electronic breakdown, electro convection breakdown, cavity breakdown (bubble's theory).

Unit –III High Voltage AC DC : HV AC transformer, need for cascade connection, working of transformers units connected in cascade, series resonant circuit, principle of operation and advantages, tesla coil, HV DC voltage doubler circuit, Cock Croft- Walton type high voltage DC set.

Unit –IV: Impulse Voltage and current Introduction to standard lightning and switching impulse voltages, analysis of single stage impulse generator, expression for output impulse voltage, multistage impulse generator, its components, triggering of impulse generator by three electrode gap arrangement, triggering gap, oscillograph time sweep circuits, generation of switching impulse voltage, generation of high impulse current.

Unit –V High Voltage Tests on Electrical Apparatus: tests on isolators, circuit breakers, cables insulators and transformers. Electrostatic voltmeter, generating voltmeter, series resistance micro ammeter, HV DC measurements, standard sphere gap measurements of HV AC & HVDC, potential dividers, resistance dividers, capacitance dividers, mixed RC potential dividers, surge current measurement.

References:

1. E. Kuffel and W.S. Zaengl, "High voltage engineering fundamentals", 2nd edition,
2. Elsevier, press, 2005.
3. M.S.Naidu and Kamaraju, "High Voltage Engineering", 3rd edition, THM, 2007.
4. L. L. Alston, "High Voltage technology", BSB Publication, 2007..
5. Rakosh Das Begamudre, Extra High voltage AC transmission engineering, Wiley Easternlimited, 1987.
6. Transmission and distribution reference book-Westing House.
7. C.L.Wadhwa, High voltage engineering, New Age International Private limited, 1995.

EEC-804(B) Special Machines

Unit I-Stepper Motor Introduction, Types, Hybrid stepper motor- construction, principle of operation, two phases energized at a time, conditions for operation, different configurations, VR Stepper motor- single stack and multi stack, Drive systems and circuit for open loop and Closed loop control of stepping motor, Dynamic characteristics ,Single phase stepper Motor, Expression of voltage, current and torque for stepper motor and criteria for synchronization.

Unit II - Switched Reluctance Motor: Constructional features, principle of operation, Design Aspects and profile of the SRM, Torque equation, Power converters and rotor sensing mechanism, expression of torque and torque-speed characteristics.

Unit III - Permanent Magnet synchronous motor: Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

.

Unit IV - Permanent Magnet Brushless DC Motor: Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessor based controller.

Unit V - Synchronous Reluctance Motors: Constructional features: axial and radial air gap Motors, Operating principle, reluctance torque, phasor diagram, motor characteristics – Linear induction machines.

References:-

1. Vekatratnam, "Special Electrical Machines", Universities Press
2. Fitzerald and Kingsley," Electrical Machines" McGraw Hill. Miller. T. J. E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
3. Kenjo. T and Nagamori. S, "Permanent Magnet and Brushless DC Motors", Clarendon Press, Oxford, 1989.
4. Kenjo. T, "Stepping Motors and their Microprocessor Control", Clarendon Press, Oxford, 1989
5. Krishnan R, "Switched Reluctance Motor Drives", Modelling, Simulation, Analysis, Design and applications, CRC press

EEC-804(C) Optical Instrumentation & Measurement

Unit I Light Sourcing, Transmitting and Receiving Concept of Light: Classification of different phenomenon based on theories of light, basic light sources and its characterization, polarization , coherent and incoherent sources, grating theory ,application of diffraction grating, electro-optic effect, acousto-optic effect and magneto-optic effect.

Unit II Opto –Electronic devices and Optical Components : Photo diode, PIN, photo-conductors, solar cells, ,phototransistors, materials used to fabricate LEDs and lasers design of LED for optical communication, response times of LEDs ,LED drive circuitry, lasers classification :ruby lasers, neodymium lasers, He- Ne Lasers, CO2 lasers, dye lasers, semiconductors lasers, lasers applications.

Unit III Interferometry :Interference effect, radio-metry, types of interference phenomenon and its application, michelson's interferometer and its application fabry-perot interferometer, refractometer, rayleigh's interferometers, spectrographs and monochromators, spectrophotometers, calorimeters, medical optical instruments

Unit IV Holography: Principle of Holography, on-axis and off axis holography, application of holography, optical data storage. optical fiber sensors: active and passive optical fiber sensor, intensity modulated, displacement type sensors, multimode active optical fiber sensor (micro bend sensor)single mode fiber sensor-phase modulates and polarization sensors

Unit III Interferometry Interference effect, radio-metry, types of interference phenomenon and its application, michelson's interferometer and its application fabry-perot interferometer, refractometer, rayleigh's interferometers, spectrographs and monochromators, spectrophotometers, calorimeters, medical optical instruments.

Unit V Fiber optic fundamentals and Measurements: Fundamental of fibers, fiber optic communication system, optical time domain reflectometer (OTDR), time domain dispersion measurement, frequency domain dispersion measurement, laser doppler velocimeter,

References:-

1. J. Wilson & J. F. B. Hawkes, "Optoelectronics: An Introduction" PHI/ Pearson
2. Rajpal S. Sirohi "Wave Optics and its Application", Hyderabad, Orient longman Ltd.
3. Yariv, "Optical Electronics", C. B. S. Collage Publishing, New York, 1985.

EEC-805(A) Digital Image Processing

Unit-I Digital Image Processing-Elements of a digital image processing system, structure of the human eye, image formation and contrast sensitivity, sampling and quantization, neighbours of a pixel, distance measures, photographic file structure and exposure, filem characteristics, linear scanner, video camera, image processing applications.

Unit-II Image Transforms- Introduction to Fourier transform-DFT, properties of two dimensional FT, separability, translation, periodicity, rotation, average value, FFT algorithm, walsh transform, hadamard transform, discrete cosine transform.

Unit-III Image Enhancement- Definition, spatial domain methods, frequency domain methods, histogram modification technique, neighborhood averaging, media filtering, lowpass filtering, averaging of multiple images, image sharpening by differentiation and high pass filtering.

Unit-IV-Image Restoration-Definition, Degradation model, discrete formulation, circulant matrices, block circulant matrices, effect of diagnolization of circulant and block circulant matrices, unconstrained and constrained restorations , inverse filtering, wiener filter, restoration in spatial domain.

Unit-VImage Encoding-Objective and subjective fidelity criteria, basic encoding process, mapping, quantizer, coder, differential encoding, contour encoding, run length encoding, image encoding relative to fidelity criterion, differential pulse code modulation.

References:

1. Rafael, C. Gonzlez., and Paul, Wintz, "Digital Image Processing", Addison-Wesley PublishingCompany.
2. Jain Anil K., "Fundamentals of Digital Image Processing", Prentice Hall.
3. Sosenfeld, and Kak, A.C., "Digital Image Processing", Academic Press.
4. William K. Pratt., "Digital Image Processing", John Wiley and Sons.

EEC-805(B) Optimization Techniques

Unit I Linear Programming: Introduction - formulation of linear programming model-graphical solution–solving lpp using simplex algorithm – revised simplex method

Unit II Advances In LPP : Dualit theory- dual simplex method - sensitivity analysis–-transportation problems– assignment problems-traveling sales man problem -data envelopment analysis

Unit III Non Linear Programming : Classification of non linear programming – lagrange multiplier method – karush – kuhn tucker conditions–reduced gradient algorithms–quadratic programming method – penalty and barrier method.

Unit IV Interior Point Methods : Karmarkar's algorithm–projection scaling method–dual affine algorithm–primal affine algorithm barrier algorithm.

Unit V Dynamic Programming : formulation of multi stage decision problem–characteristics–concept of sub-optimization and the principle of optimality–formulation of dynamic programming–backward and forward recursion– computational procedure–conversion offinal value problem in to initial value problem.

References:

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000.
2. R.Panneerselvam, "Operations Research", PHI, 2006.
3. Hamdy ATaha, "Operations Research –An Introduction", Prentice Hall India, 2003.Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2002.
4. Ronald L.Rardin, "Optimization in Operation Research" Pearson Education Pvt. Ltd.New Delhi, 2005.

EEC-805(C) Power Controller

Unit I Various Power Semiconductor Devices: SCR, GTO, MOSFET, BJT, IGBT & MCT's & their protection, series-parallel operation, Heat sink calculations, Design of firing circuit for converters, choppers & inverters.

Unit II- Analysis & Design: 1-φ bridge converter, 3-φ bridge converter with and without freewheeling diode, effect of source impudence, power factor improvement techniques, and pulse width modulated converters, Dual converters, converter for HVDC application & DC drives.

Unit III-Analysis & Design: voltage commutated, current commutated and load commutated choppers, multiquadrant choppers, chopper for traction application. Resonant choppers, SMPS.

Unit IV-VSI & CSI : 1-φ VSI, 3-φ VSI (180° mode, 150° mode & 120° mode of conduction), various inverter commutation circuits, harmonic reduction techniques, PWM inverters, Inverters for HVDC application & AC drives. Advantages & limitation of current source inverters over VSI, 1-phase and 3-phase CSI. Resonant inverters.

Unit V- Cycloconverter:1-φ to 1-φ, 3-φ to 3-φ cycloconverter circuits, circulating current scheme, non-circulating current operation, Mean output voltage, harmonics in supply current waveform & input-power factor. Concept of power quality

References:

1. Thyristorised Power Controllers - G.K.Dubey, Doradla, Joshi, Sinha
2. Power Electronics - C.W.Lander
3. Power Electronics - Rashid
4. Thyristorised power controlled converters & cycloconverters - B.R.Pelly
5. Power Electronics - N.Mohan
6. Power Electronics Application - Vithyathil.

EEC- 806- Industrial Training Project - II

Industrial Training Project - II should be the outcome of the training done/performed during 7^{th} semester .It should be submitted in hardware form (proto type)or simulation form along with proper data and certificates issued during project training. It should cover the electrical engineering aspects learned during training. A Power point presentation should also be submitted at the time of submission. It can be in the form of major project.