SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES
SCHOOL OF ENGINEERING
Outcome Based Curriculum for
Undergraduate Degree Courses in Engineering & Technology
Department of Electrical Engineering
Syllabus VIII Semester

EEA 801 Power System Dynamics and Control

EEA 801	**Power System Dynamics and Control**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

To determine the dynamic characteristics of power system equipment, to recognize dynamic performance of power systems and to illustrate the system stability and controls. To analyse the model representation .

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the problem of power system stability and its impact on the system.
- Analyse linear dynamical systems and use of numerical integration methods.
- Model different power system components for the study of stability.
- Understand the methods to improve stability.

Unit 1: Introduction to Power System Operations (4 hours)

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

Unit 2 : Analysis of Linear Dynamical System and Numerical Methods (6 hours)

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System, Analysis using Numerical Integration Techniques, Issues in Modeling: Slow and Fast Transients, Stiff System

Unit 3 : Modeling of Synchronous Machines and Associated Controllers (12 hours)

Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Unit 4 : Modeling of other Power System Components (10 hours)

Modeling of Loads. Load Models - induction machine model. HVDC and FACTS controllers, Wind Energy Systems.

Unit 5 : Stability Analysis (10 hours) Angular stability analysis in Single Machine Infinite Bus System.

Angular Stability in multi- machine systems – Intra- plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.

Enhancing System Stability Planning Measures. Stabilizing Controllers (Power System Stabilizers).Operational Measures-Preventive Control. Emergency Control.

References:

1. K.R. Padiyar, " Power System Dynamics, Stability and Control", B. S. Publications,2002.

2. P. Kundur, " Power System Stability and Control", McGraw Hill,1995.

3. P. Sauer and M. A. Pai, " Power System Dynamics and Stability" , Prentice Hall,1997.

EEA 801	**Power System Dynamics and Control**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

1. To develop a program in Matlab for information of Y-bus matrix for N bus system.
2. Load flow solution for 3-bus system using Gauss- Seidel, Newton Raphson and FDLF methods up to 3 iteration.
3. Load flow solution for IEEE 6-bus and 30-bus system in Matlab using Newton Raphson method.
4. Assessment of transient stability of a single machine system.
5. Effect of compensation on voltage profile of IEEE 6-bus system.
6. Study of any software tools (PSCAD,EDSA, Mi POWER, ETAP etc)

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Program Elective – V
EEA-802 (A) Generalized Theory of Electrical Machines

EEA-802 (A)	**Generalized Theory of Electrical Machines**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:
To introduce the concepts of ideal synchronous machines and poly-phase induction machines.
- Applications which will be utilized in the electrical machines with its performance and theory of operation.
- Study of special machines.

Outcomes:
After the completion of the course, the students will be able to:
- Express the revolving field and reference frame theory.
- Develop mathematical model of three-phase AC machines and parameters in different reference frame.
- Simulate the transient performance of three-phase ac machines in different reference frames.
- Investigate the transient performance of different DC machines.
- Select special purpose small machines for different applications.

Unit I Generalized Theory: Conversions, basic two pole machines, transformer with movable secondary, transformer voltage and speed voltage, Kron's primitive machine , analysis of electrical machines, voltage and torque equation.

Unit II Linear Transformations: Invariance of power, transformations from displaced brush axis, three phases to two phase, rotating axes to stationary axes, transformed impedance matrix, torque calculations.

Unit III DC Machines: Generalized representation, generator and motor operation, operation with displaced brushes, steady state and transient analysis, sudden short circuit, sudden application of inertia load ,electric braking of dc motors.

Unit IV Synchronous Machines: Generalized representation, equivalent circuit, steady state analysis, transient analysis , phasor diagrams, electromechanical transients.

Unit V Special Machines: Generalized representation, steady state analysis of reluctance motor, brushless dc motor, variable reluctance motor & single phase series motor.

References:

1. B.Adkins & R.G.Harley, The General theory of AC Machines.
2. P.S.Bhimbra, Generalised theory of Electrical m/c
3. White & Woodson, Electro Mechanical Energy Conversion.
4. D. P. Kothari,B. S. Umre, “Laboratory Manual for Electrical Machines”, IK International New Delhi.

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EEA-802 (B) HVDC Transmission Systems

EEA-802 (B)	**HVDC Transmission Systems**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:
To introduce students with the concept of HVDC Transmission system. To familiarize the students with the HVDC converters and their control system. To expose the students to the harmonics and faults occur in the system and their prevention

Outcomes:
At the end of this course, students will demonstrate the ability to

- Understand the advantages of dc transmission over ac transmission.
- Understand the operation of Line Commutated Converters and Voltage Source Converters.
- Understand the control strategies used in HVDC transmission system.
- Understand the improvement of power system stability using an HVdc system.

Unit 1:Dc Transmission Technology (6 hours)
Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVdc Systems. Components of a HVdc system. Line Commutated Converter and Voltage Source Converter based systems.

Unit 2: Analysis of Line Commutated and Voltage Source Converters (10 hours)
Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links. Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

Unit 3: Control of HVdc Converters: (10 hours)
Principles of Link Control in a LCCHVdc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Unit 4: Components of HVdc systems: (6 hours)
Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Monopolar Operation. Ground Electrodes.

Unit 5 :Stability Enhancement using HVdc Control (10 hours)

Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems. MTdc Links Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTdc systems using LCCs. MTdc systems using VSCs. Modern Trends in HVdcTechnology. Introduction to Modular Multi-level Converters.

References:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.

EEA-802 (C) Advanced Electric Drives

EEA-802 (C)	**Advanced Electric Drives**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

To give unified treatment of advance electrical drive systems with power electronic converters, including the mechanical parts, electrical machines, and power converters and control.

Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the operation of power electronic converters and their controlstrategies.
2. Understand the vector control strategies for ac motordrives 3. Understand the implementation of the control strategies using digitalsignal processors.

Unit 1: Power Converters for AC drives (10 hours)

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Qdrive.

Unit 2: Induction motor drives (10 hours)

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).

Unit 3: Synchronous motor drives (6 hours)

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

Unit 4: Permanent magnet motor drives (6 hours)

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

Unit 5: Switched reluctance motor drives (10 hours)

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM. DSP based motion control (6hours) Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motioncontrol.

References:

1. B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia,2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons,2013.
3. H. A. Taliyat and S. G. Campbell, “DSP based Electromechanical Motion Control”, CRC press,2003.
4. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press,2009.

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Open Core Elective-IV

EEA 803(A) Cyber Law and Ethics

EEA 803(A)	**Cyber Law and Ethics**	**3 L:0 T:0 P**	**3 credits**	**3Hrs/Week**

Preambles:
Understanding the Real Approach, Cyber Ethics, Cyber Jurisdiction, Cyber Laws of other rules.

Outcomes:
Students identify and analyze statutory, regulatory, constitutional, and organizational *laws* that affect the information technology professional.Students locate and apply case *law* and common *law* to current *legal* dilemmas in the technology field.

UNIT I History of Information Systems and its Importance, (10 hHrs)
basics, Changing Nature of Information Systems, Need of Distributed Information Systems, Role of Internet and Web Services, Information System Threats and attacks, Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Laptops Security Basic Principles of Information Security, Confidentiality, Integrity Availability and other terms in Information Security, Information Classification and their Roles.

UNIT II Security Threats to E Commerce, (10 hHrs)
Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Physical Security- Needs, Disaster and Controls, Basic Tenets of Physical Security and Physical Entry Controls, Access Control- Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems, Interoperability Issues, Economic and Social Aspects, Legal Challenges

UNIT III Model of Cryptographic Systems, (6 hHrs)

Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls, Design and Implementation Issues, Policies Network

Unit IV Security- (6 hHrs)
Basic Concepts, Dimensions, Perimeter for Network Protection, Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion Detection Virtual Private Networks- Need, Use of Tunneling with VPN, Authentication Mechanisms, Types of VPNs and their Usage, Security Concerns in VPN

UNIT V Security metrics- (10 hHrs)
Classification and their benefits Information Security & Law, IPR, Patent Law, Copyright Law, Legal Issues in Data mIning Security, Building Security into Software Life Cycle Ethics- Ethical Issues, Issues in Data and Software Privacy Cyber Crime Types & overview of Cyber Crimes

References:

1. Godbole,— Information Systems Security‖, Wille
2. Merkov, Breithaupt, — Information Security‖, Pearson Education
3. Yadav, —Foundations of Information Technology‖, New Age, Delhi 4. Schou, Shoemaker, — Information Assurance for the Enterprise‖, Tata McGraw Hill
5. Sood,—Cyber Laws Simplified‖, Mc Graw Hill
6. Furnell, —Computer Insecurity‖, Springer 7. IT Act 2000

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EEA-803 (B) Project Management

EEA-803 (B)	**Project Management**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

1. To make them understand the concepts of Project Management for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.
4. Make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Outcomes:

On completion of this course, the students will be able to:

1. Understand project characteristics and various stages of a project.
2. Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic.
3. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
4. Apply the risk management plan and analyse the role of stakeholders.
5. Understand the contract management, Project Procurement, Service level Agreements and productivity.

Unit 1 Concepts of Project Management:(6Hrs) Meaning, definition and characteristics of a project, technical and socio-cultural dimensions, project life cycle phases, project planning, graphic presentation, work breakdown structure, manageable tasks, size of network, blow down NW, identity and logic dummy activity, Fulkerson rule for numbering NW, time-scaled NW

Unit-2 NW analysis (6Hrs): PERT network, mean time and variances, probability to complete PERT project in specified time, CPM network, Event Occurrence Time (EOT), activity start/ finish times, forward and reverse path calculations, concept and calculation of floats, resource allocation and critical-chain.

Unit-3 Project Duration And Control (10Hrs): Importance and options to accelerate project completion, timecost tradeoff, fixed variable and total costs, use of floats and cost optimization, project performance measures, project monitoring info and reports, project control process, Gant chart and control chart, cost-schedule S-graph, planned cost of work schedule (PV), budgeted/ earned cost of work completed (EV) and actual cost of work completed (AC), schedule and cost variances (SV, CV) forecasting final project costs.

Unit-4 Project Organization, Culture And Leadership(10Hrs): Projects within functional organization, dedicated project/ task-force teams, staff, matrix and network organization, choosing appropriate project organization, Organization culture, ten characteristics, cultural dimensions supportive to projects, social network and management by wandering around (MBWA), different traits of a manager and leader, managing

project teams, five stage team development model, shared vision, conflicts, rewards, rejuvenating project teams, project stakeholders, concept of project partnering.

Unit-5 Strategic Planning and Project Appraisal(10Hrs): Capital allocation key criteria, Porters competitive strategy model, BCG matrix, Strategic Position Action Evaluation (SPACE), time value of money, cash flows, payback period, IRR, cost of capital, NPV, social cost benefit analysis, UNIDO approach, project risks and financing.

References:

1. Prasana Chandra: Projects: planning Implementation control, TMH.
2. Gray Clifford F And Larson EW, Project The managerial Process, TMH
3. Panneerselven and Serthil kumar, Project management, PHI
4. Burke , Project Management-Planning and control technics, Wiley India
5. Kamaraju R, Essentials of Project Management, PHI Learning
6. Jack R. Meredith, Project Management: a managerial approach, Wiley.
7. Choudhary ,Project Management, TMH
8. Srinath LS, PERT And CPM Principles and Appl, East West Press
9. Richman L, Project Management: Step By Step, PHI Learning

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EEA-803 (C) Big data Analysis

EEA-803 (C)	**Big data Analysis**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles :

- Understand the Big Data Platform and its Use cases
- Provide an overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide hands on Hodoop Eco System
- Apply analytics on Structured, Unstructured Data.
- Exposure to Data Analytics with R.

Outcomes:

The students will be able to:

- Identify Big Data and its Business Implications.
- List the components of Hadoop and Hadoop Eco-System
- Access and Process Data on Distributed File System
- Manage Job Execution in Hadoop Environment
- Develop Big Data Solutions using Hadoop Eco System
- Analyze Infosphere BigInsights Big Data Recommendations.

UNIT I : Introduction To Big Data And Hadoop (8 Hrs)

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

UNIT II : HDFS (Hadoop Distributed File System) (4 Hrs)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT III :Map Anatomy (10 Hrs)

Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit IV : Hadoop Eco System Pig (10 Hrs)

: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction

UNIT V : Data Analytics with R Machine Learning : (10 Hrs)

Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

References:

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
4. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
5. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
6. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
7. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012. • Glen J. Myat, "Making Sense of Data", John Wiley & Sons, 2007
8. Pete Warden, "Big Data Glossary", O'Reily, 2011.
9. Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
10. ArvindSathi, "BigDataAnalytics: Disruptive Technologies for Changing the Game", MC Press, 2012
11. Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012.

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EEA 804 Project Stage-II

EEA 804	**Project Stage-II**	**0L:0T:8P**	**8 credits**	**16Hrs/Week**

Preambles:

The object of Project Stage-II is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work.

Outcomes:

At the end of this course students will demonstrate the ability to

- Design and validate real life industrial based projects
- Analyze the dynamic response and the calibration of few instruments
- Learn about various measurement devices, their characteristics, their operation and theirlimitations
- understand statistical data analysis
- Understand computerized data acquisition.
- Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
- Design, implement and test the prototype/algorithm in order to solve the conceived problem.
- Able to write comprehensive report on major project work.

Under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EEP1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.