

# RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

## New Scheme Based On AICTE Flexible Curricula

### Electrical Engineering, VIII-Semester

#### Course: EE 801 Power Quality Improvement & Mitigation Technique

#### COURSE CONTENTS

##### UNIT-I

Introduction, power quality -voltage quality, power quality evaluations procedures term and definition: general classes of power quality problem, causes & effect of power quality disturbances.

##### UNIT-II

Loads that causes power quality problems, State of art on Passive shunt and series compensation, Classification and working of passive shunt and series compensation, Classification, Principle and control of active shunt compensator: DSTATCOM, Active series compensators, working and its control.

##### UNIT-III

Introduction to unified power quality compensators, classification, working and operation of UPQC.

##### UNIT-IV

Voltage sags and interruption: sources of sags and interruption, estimating voltages sag performance, fundamental principles of protection, monitoring sags. Transients over voltages: sources of transient over voltages, principles of over voltages protection, utility capacitor switching transients, fundamentals of harmonics and harmonics distortion, harmonics sources from commercial load and from industrial loads.

##### UNIT-V

Applied harmonics : harmonics distortion evaluations, principles for controlling harmonics, harmonics studies devices for controlling harmonic distortion, Shunt active and passive filters, their operation and control.

#### **Reference Books:**

1. Power Quality- by R.C. Duggan
2. Power System harmonics –by A.J. Arrillga
3. Power electronic converter harmonics –by Derek A. Paice

#### **List of experiments:**

1. Simulation showing the effect of power quality problems.
2. Simulation of reactive power compensation of linear load.
3. Simulation of harmonic analysis of balanced non-linear loads.
4. Simulation of harmonic analysis of un-balanced non-linear loads.
5. Simulation of active shunt filters for harmonics compensation.
6. Simulation of compensation device showing power factor correction.
7. Simulation of compensation device showing voltage regulation.
8. Simulation of hybrid filter as a combination of active series and passive shunt filters.
9. Simulate the effect of neutral current.
10. Simulate the effect of dynamic load connected to 3-phase system.

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**Electrical Engineering, VIII-Semester**

**Departmental Elective EE 802 (A) Advanced Electrical Drives**

**COURSE CONTENTS**

**UNIT-I**

Review of electric motors & Solid state converters: Speed control techniques of DC, Induction & synchronous motor, Converters, inverters, chopper and cyclo converter operation, Effects of power electronic equipments on load side & supply side.

**UNIT-II**

Review of closed loop controllers, sensors & transducers : PI, PID, Variable structure. AC, DC & Pulse tacho- generators. DC Drives : Converter & chopper fed DC drive, Reversing, Starting, Regenerative breaking, Four quadrant operation, High power application.

**UNIT-III .**

AC Drive: Inverter & cyclo converter fed drive, Vector control, Sensor less operation, Linear electrical motor concept, Synchronous motor Drive. Special Drives: Switched reluctance & permanent magnet brushless DC Operation, Converters, Characteristics & Control, PLC based drives.

**UNIT-IV**

Servo drives & stepper motor- AC & DC Servomotor, Stepper motor, Control techniques, Controllers, Microstepping, Sensorless operation.

**UNIT-V**

Power Quality & energy Conservation- Line Side pollution, standards, Harmonic elimination techniques in converter, Filters, Energy efficient electric motors, Pay back periods, Energy conservation through solid state control.

## Reference:

- Ned Mohan, T.M. Undeland, W.P. Robbins, Power Electronics-Converters, Applications and design", John Wiley & Sons.
- J.M.D. Murphy, F.O. Turnbull, "Power Electronic Control of AC motors", Pergamon Press.
- P.C. Sen, D.C. drive, Pergamon Press
- Sivanagaraju–Power Semiconductor Drives –PH Learning
- B.K. Bose, Power Electronics & AC drive prentice Hall.
- Dubey G.K. "Power semi Conductor controller drives, Prentice Hall. Vedam Subramanyam, "Electrical Drives".
- T.J.E. Miller, Switched Reluctance & P.M. B.L. DC motor, Pergamon Press
- P.V. Rao, "Power semiconductor Drives", BS Publications.

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**Electrical Engineering, VIII-Semester**

**Departmental Elective EE 802 (B) Special Machine**

UNIT- I Stepper Motors: Discretisation of angular position by stepper structures, stepping angle and frequency of excitation. VR and PM rotor structures and their torque production, torque angle characteristics. The hybrid structure and torque production by permanent magnet and excitation fluxes. Power electronic converters for stepper motors, control by load angle.

UNIT - II Switched reluctance motor, static torque production, partition of energy and the effects of saturation, Dynamic torque production, torque speed characteristics, shaft position sensing, solid rotors.

UNIT- III BrushLess DC Motor construction and principle, speed control, basic concept of torque, outer and inner rotor, magnetic circuit concept, electrical analogy, winding pattern series and parallel, Thermal consideration.

UNIT- IV Permanent magnet materials and circuits; Characteristics, parameters, properties, classification and calculations, Permanent magnet motors, D.C. brushed motors, design analysis and control and applications.

UNIT- V PM synchronous motors, rotor construction, theory, operation, control and applications. PM step motors, hybrid step motors, sensorless control, reduction of torque pulsations; Case studies such electric vehicles, industrial drives, PV fed water pumping.

**Reference Books:**

1. Brushless Permanent Magnet & Reluctance Motor Drives – T.J.E.Miller
2. Principles of Electric Machines & Power Electronics – P.C.Sen
3. Electric Drives – G.K.Dubey
4. Permanent magnet synchronous & brushless DC motor drives- R Krishnan, CRC Press, 2004

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**Electrical Engineering, VIII-Semester**

**Departmental Elective EE 802 (C) EHV A.C. and D.C. Transmission**

**COURSE CONTENTS**

**UNIT-I**

Constitution of EHV a.c. and d.c. links, Kind of d.c. links, Limitations and Advantages of a.c. and d.c. transmission, Principal application of a.c. and d.c. transmission, Trends in EHV a.c. and d.c. transmission, Power handling capacity. Converter analysis garetz circuit, Firing angle control, Overlapping.

**UNIT-II**

FACTS devices, basic types of controller, series controller, static synchronous series compensator(SSSC), thyristor-controlled series capacitor(TCSC), thyristor controlled series reactor(TCSR), shunt controller (STATCOM), static VAR compensator(SVC),series-seriescontroller,combinedseries-shuntcontroller,unified power flow controller(UPFC), thyristor controlled phase shiftingtransformer(TCPST).

**UNIT-III**

Components of EHV d.c. system, converter circuits, rectifier and inverter valves, Reactive power requirements, harmonics generation, Adverse effects, Classification, Remedial measures to suppress, filters, Ground return. Converter faults & protection harmonics misoperation, Commutation failure, Multiterminal D.C. lines.

**Unit-IV**

Control of EHV d.c. system desired features of control, control characteristics, Constant current control, Constant extinction angle control. Ignition Angle control. Parallel operation of HVAC & DC system. Problems & advantages.

**Unit-V**

Travelling waves on transmission systems, Their shape, Attenuation and distortion, effect of junction and termination on propagation of traveling waves. Over voltages in transmission system. Lightning, switching and temporary over voltages: Control of lightning and switching overvoltages

**Reference:**

1. S. Rao,- "EHV AC &DC Transmission" Khanna pub.
2. Kimbark,-"HVDC Transmission" John Wiley & Sons pub.
3. Arrillaga,- "HVDC Transmission" 2<sup>nd</sup> Edition , IEE London pub.
4. Padiyar, -"HVDC Transmission" 1<sup>st</sup> Edition , New age international pub.
5. T.K. Nagsarkar, M.S. Sukhiza, -"Power System Analysis",  
Oxford University
6. Narain.G. Hingorani, I. Gyugyi-"Understanding of FACTS concept and  
technology", John Wiley & Sons
7. P.Kundur- "H.V.D.C. Transmission" McGraw Hill Pub.

# RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

## New Scheme Based On AICTE Flexible Curricula

### Electrical Engineering, VIII-Semester

#### Departmental Elective EE 802 (D) Application of IOT in Electrical Engineering

##### Unit 1:

Introduction: Definition, Characteristics of IOT, IOT Conceptual framework, IOT Architectural view, Physical design of IOT, Logical design of IOT, Machine-to-machine (M2M), SDN (software defined networking) and NFV(network functi virtualization) for IOT, data storage in IOT.

##### Unit 2:

Design Principles for Web Connectivity: Web Communication Protocols for connected devices, Message Communication Protocols for connected devices, SOAP, REST, HTTP Restful and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IOT, Media Access control.

##### Unit 3:

Sensor Technology , Participatory Sensing, Industrial IOT and Automotive IOT , Actuator, Sensor data Communication Protocols ,Radio Frequency Identification Technology, Wireless Sensor Network Technology.

##### Unit 4:

IOT Design methodology: Specification -Requirement, process, model, service, functional & operational view.IOT Privacy and security solutions, Raspberry Pi & arduino devices. IOT Case studies: smart city streetlights control & monitoring.

##### Unit 5:

IoT applications to Industries, IoT applications to Power System , IoT applications to Renewable energy, IoT applications to Power Electronics, Benefits to IoT in electrical field.

##### Reference Book:

1. Rajkamal,"Internet of Th ings", Tata McGraw Hill publication
2. Vijay Madisetti and Arshdeep Bahga, "Internet of things(A-Hand-on-Approach)" 1st Edition ,Universal Press
3. Hakima Chaouchi "The Internet of Things: Connecting Objects", Wiley publication.
4. Charless Bell "MySQL for the Internet of things", Apress publications.
5. Francis dacosta "Rethinking the Internet of things:A scalable Approach to connecting everything", 1st edition, Apress publications 2013.
6. Donald Norris"The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black", McGraw Hill publication

# RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

## New Scheme Based On AICTE Flexible Curricula

### Electrical Engineering, VIII-Semester

#### Open Elective EE 803 (A) Artificial Intelligence

##### Course Objectives

##### After studying this course, students will be able to

1. learn about importance of AI techniques. Adoption of Artificial Intelligence (AI) technologies is widely expanding in our society. Applications of AI include: self-driving cars, personal assistants, surveillance systems, robotic manufacturing, machine translation, financial services, cyber security, web search, video games, code analysis and product recommendations.
2. Know the exact application of AI Techniques. Such applications use AI techniques to interpret information from a wide variety of sources and use it to enable intelligent, goal-directed behavior.
3. understand the working of Modern AI based systems. It often involves self-learning systems that are trained on massive amounts of data, and/or interacting intelligent agents that perform distributed reasoning and computation.
4. Know about sensors used in AI based systems. AI connects sensors with algorithms and human-computer interfaces, and extends itself into large networks of smart devices.
5. know the opportunities after having knowledge of AI techniques. The knowledge of Artificial Intelligence opens career opportunities in companies that are building the next generation of intelligence and language understanding for their products: for example intelligent personal assistants, opinion mining systems, customer support system, biomedical applications, computer games, smart adaptive devices, robots, smart planning systems.

##### Syllabus

##### Unit 1: Introduction to Artificial Intelligence

Main components and characteristics of AI (Feature Engineering, ANN, Deep Learning), Applications of AI, Advantages and disadvantages of AI, Goals of AI, Comparison of Programming of a System with AI and without AI, Challenges in AI, Programming languages preferably used in AI, Techniques/Algorithms used in AI, AI Software platforms, Future of AI

**Unit 2: Various types of production systems and search techniques:** Types of production systems, Characteristics of production systems, Study and comparison of breadth first search and depth first search. Techniques, other Search Techniques like hill Climbing, Best first Search. A\* algorithm, AO\* algorithms etc, and various types of control strategies.

**Unit 3: Knowledge Representation and Probabilistic Reasoning:** Problems in representing knowledge, knowledge representation using propositional and predicate logic, comparison of propositional and predicate logic, Resolution, refutation, deduction, theorem proving, inferencing, monotonic and nonmonotonic reasoning. Probabilistic reasoning, Baye's theorem, semantic networks, scripts, schemas, frames, conceptual dependency, fuzzy logic, forward and backward reasoning.



**Unit 4: Game playing techniques:** Minimax procedure, alpha-beta cut-offs etc, planning, Study of the block world problem in robotics, Introduction to understanding and natural languages processing.

**Unit 5: Introduction to learning ,ANN:** Various techniques used in learning, introduction to Artificial neural networks, common sense, reasoning, Convolution Neural Network, Feedforward Neural Network, Recurrent Neural Network, Multilayer perceptron, Architecture / Three Layers in Artificial Neural Networks, Implementation of ANN, Applications of ANN in images, signals and languages some example of expert systems.

**References:-**

1. Rich E and Knight K, "Artificial Intelligence", TMH, New Delhi.
2. Nilsson N.J., "Principles of Artificial Intelligence", Springer Verlag, Berlin.
3. Stuart Russell, Artificial Intelligence: A Modern Approach, (3rd Edition), Peter Norvig, PHI, ISBN-13: 978-0136042594, ISBN-10: 0136042597
4. B. Yegnanarayana, Artificial Neural Networks, PHI
5. Schalkoff, Artificial Neural Networks. Mc Graw HILL Education

**Evaluation:**

Evaluation will be continuous and integral part of the class as well as through external assessment

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## **New Scheme Based On AICTE Flexible Curricula**

### **Electrical Engineering, VIII-Semester**

#### **Open Elective EE 803 (B) Power Electronics Converters for Renewable Energy**

UNIT- I Introduction to renewable sources: world energy scenario, Wind, solar, hydro, geothermal, availability and power extraction. Introduction to solar energy: Photovoltaic effect, basics of power generation, P-V & I-V characteristics, effect of insolation, temperature, shading; Modules, connections, ratings; Power extraction (MPP), tracking and MPPT schemes; standalone systems, grid interface, storage, AC-DC loads.

Unit-II Power converters for solar: Micro converter, DC-DC buck/boost/buck-boost /flyback /forward/cuk, bidirectional converters; Inverters: 1ph, 3ph inverters Multilevel Neutral point clamp, Modular multilevel, CSI; Control schemes: unipolar, bipolar.

Unit- III Single phase and three-phase back Controllers. Triggering techniques for power factor and harmonic controls. Design and analysis of phase control circuits. Solid state transfer switches. Concept of three-phase to single phase and single phase to three-phase cyclo-converter. Effect of source inductance. Concept of PWM techniques single and multiple pulse form. Working of STATCON, SVC, UPS, SMPS.

Unit- IV Intro to wind energy: P-V, I-V characteristic, wind power system: turbine-generator-inverter, mechanical control, ratings; Power extraction (MPP) and MPPT schemes. PLL and synchronization, power balancing / bypass, Parallel power processing; Grid connection issues: leakage current, Islanding mode, harmonics, Mitigation of harmonics, filters, passive filters, Active filters, active/reactive power feeding, unbalance.

Unit-V Generators for wind: DC generator with DC to AC converters; Induction generator with & w/o converter; Synchronous generator with back to back controlled/ uncontrolled converter; Doubly fed induction generator with rotor side converter topologies; permanent magnet based generators. Battery: Types, charging discharging.

References:

1. Sudipta Chakraborty, Marcelo G. Sim303265es, and William E. Kramer. Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Chetan Singh Solanki, Solar Photovoltaics: fundamentals, Technologies and Applications, Prentice Hall of India, 2011.
2. N. Mohan, T.M. Undeland & W.P. Robbins, Power Electronics: Converter, Applications & Design, John Wiley & Sons, 1989
3. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley and Sons, Ltd., 2011.

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**Electrical Engineering, VIII-Semester**

**Open Elective EE 803 (C) SCADA Systems & Applications**

Unit I Introduction to SCADA and PLC: SCADA: 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. SCADA system components: Schemes, Remote Terminal Unit, Intelligent Electronic Devices, Communication Network, SCADA server.

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

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

Unit IV Operation and control of interconnected power system-Automatic substation control, SCADA configuration, Energy management system, system operating states, system security, state estimation.

Unit V: SCADA applications Utility applications, transmission and distribution sector operation, monitoring analysis and improvement. Industries oil gas and water. Case studies, implementation, simulation exercises.

Reference Books:

1. Stuart A Boyer: SCADA supervisory control and data acquisition.
2. Gordan Clark, Deem Reynders, Practical Modem SCADA Protocols.
3. Sunil S. Rao, Switchgear and Protections, Khanna Publication.

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## New Scheme Based On AICTE Flexible Curricula

### Electrical Engineering, VIII-Semester

#### Open Elective EE 803 (D) Data Analytics

##### Course Objectives:

Data Analytics is the science of analyzing data to convert information to useful knowledge. This knowledge could help us understand our world better, and in many contexts enable us to make better decisions. While this is broad and grand objective, the last 20 years has seen steeply decreasing costs to gather, store, and process data, creating an even stronger motivation for the use of empirical approaches to problem solving.

This course will enable you with a wide range of data analytic techniques and is structured around the broad contours of the different types of data analytics, namely, descriptive, inferential, predictive, and prescriptive analytics.

##### Pre-requisites:

This course requires that you are familiar with high-school level linear algebra, and calculus. Knowledge of probability theory, statistics, and programming is desirable

##### UNIT-I

DESCRIPTIVE STATISTICS :Probability Distributions, Inferential Statistics ,Inferential Statistics through hypothesis tests Regression & ANOVA ,Regression ANOVA(Analysis of Variance).

##### UNIT-II

INTRODUCTION TO BIG DATA: Big Data and its Importance, Four V's of Big Data, Drivers for Big Data, Introduction to Big Data Analytics, Big Data Analytics applications.

BIG DATA TECHNOLOGIES: Hadoop's Parallel World, Data discovery, Open source technology for Big Data Analytics, cloud and Big Data, Predictive Analytics, Mobile Business Intelligence and Big Data, Crowd Sourcing Analytics, Inter- and Trans-Firewall Analytics, Information Management.

##### UNIT-III

PROCESSING BIG DATA: Integrating disparate data stores, Mapping data to the programming framework, Connecting and extracting data from storage, Transforming data for processing, subdividing data in preparation for Hadoop Map Reduce.

##### UNIT-IV

HADOOP MAPREDUCE: Employing Hadoop Map Reduce, Creating the components of Hadoop Map Reduce jobs, Distributing data processing across server farms, Executing Hadoop Map Reduce jobs, monitoring the progress of job flows, The Building Blocks of Hadoop Map Reduce Distinguishing Hadoop daemons, Investigating the Hadoop Distributed File System Selecting appropriate execution modes: local, pseudo-distributed, fully distributed.

## **UNIT-V**

**BIG DATA TOOLS AND TECHNIQUES:** Installing and Running Pig, Comparison with Databases, Pig Latin, User- Define Functions, Data Processing Operators, Installing and Running Hive, Hive QL, Querying Data, User-Defined Functions, Oracle Big Data.

### **Reference Books and Study Materials:**

1. Hastie, Trevor, et al. ♦The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger. ♦Applied statistics and probability for engineers. John Wiley & Sons, 2010
3. NPTEL Video Course :Introduction to Data Analytics by Dr. Balaraman Ravindran Department of Computer Science and Engineering IIT Madras and Dr. Nandan Sudarsanam Department of Management Studies IIT Madras.

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**Electrical Engineering, VIII-Semester**

**EE 804 SIMULATION LAB**

1. Study of various Electrical Toolbox i.e Power System, Power Electronics, Control system, Electrical Measurement, Flexible AC Transmission.
2. Developing Simulation Models for single and three phase Rectifier, Inverter, and Converter for different load models.
3. Developing Simulation Models using FACTS Devices i.e STATCOM, SVC, TCSC, SSSC, IPFC, UPFC in power system transmission lines.
4. Developing Simulation Models of power electronics-based AC & DC Electrical Drives.

Note: -All Experiments based on MATLAB, SCILAB & other SIMULATION software.

REFERENCE

1. Shailendra Jain "Modeling and Simulation using MATLAB Simulink" wileyindia& sons
2. <https://www.scilab.org/>
3. <https://www.mathworks.com/products/matlab.html>

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**Electrical Engineering, VIII-Semester**

**EE 805 Major Project**

**COURSE GUIDELINES**

The objectives of the course 'Major Project' are

To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.

To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.

To give students an opportunity to do some thing creative and to assimilate real life work situation in institution.

To adapt students for latest developments and to handle independently new situations.

To develop good expressions power and presentation abilities in students.

The focus of the Major Project is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write-up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis, market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any).

The faculty and student should work according to following schedule:

- i) Each student undertakes substantial and individual project in an approved area of the subject and supervised by a member of staff.
- ii) The student must submit outline and action plan for the project execution (time schedule)

And the same be approved by the concerned faculty.

At all the steps of the project, students must submit a written report of the