JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA–533003, Andhra Pradesh, India
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE AND SYLLABUS

For

B.TECH – ELECTRICAL AND ELECTRONICS ENGINEERING

(Applicableforbatchesadmittedfrom2020-2021)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

KAKINADA-533003, Andhra Pradesh, India

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IV B.Tech – I Semester

Sl. No	Course Components	Subjects	L	T	P	Credits
1	PEC	Professional Elective – III	3	0	0	3
2	PEC	Professional Elective – IV	3	0	0	3
3	PEC	Professional Elective – V	3	0	0	3
4	OEC	Open Elective- III/Job Oriented Elective-III	3	0	0	3
5	OEC	Open Elective-IV /Job Oriented Elective-IV	3	0	0	3
6	HSMC	Universal Human Values-2: Understanding Harmony	3	0	0	3
7	SC	**Skill Advanced Course** Machine Learning with PythonLab	0	0	4	2
8	PROJ	Industrial / Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII Semester)	0	0	3	3
		Total Credits	**23**			
		Minors Course*	4	0	0	4
		Honors Course*	4	0	0	4

IVB.TechIISemester

Sl. No	Course Components	Subjects	L	T	P	Credits
1	Major Project	Project work, seminar and internship in industry (6 Months)	--	--	--	12
		Total Credits	**12**			

HSMC:Humanities and Social Science Including Management Courses
BSC :Basic Science Courses
ESC:Engineering Science Courses
PCC:Professional Core Courses

PEC : Professional Elective Courses
OEC : Open Elective Courses
PROJ : Internship, Seminar, Project Wok
MC : Mandatory Courses
SC : Skill Oriented Courses

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Professional Elective Subjects offered to EEE Branch Students:

Professional Elective – I:

1. Linear IC Applications
2. Utilization of Electrical Energy
3. Computer Architecture and Organization
4. Optimization Techniques
5. Object Oriented Programming through Java

Professional Elective – II:

1. Signal and Systems
2. Electric Drives
3. Advanced Control Systems
4. Switchgear and Protection
5. Big Data Analytics

Professional Elective –III:

1. Digital Signal Processing
2. Renewable and Distributed Energy Technologies
3. Flexible Alternating Current Transmission Systems
4. Power Systems Deregulation
5. Data Base Management Systems

Professional Elective – IV:

1. Hybrid Electric Vehicles
2. High Voltage Engineering
3. Programmable Logic Controllers and Applications
4. Cloud Computing with AWS
5. Deep Learning Techniques

Professional Elective – V:

1. Power System Operation and Control
2. Switched Mode Power Conversion
3. AI Applications toElectrical Engineering
4. Data Science
5. MEAN Stack Technologies

Open Electives offered by EEE Department for Other Branches (Except EEE Branch)

Open Elective-I:

1. Renewable Energy Sources
2. Concepts of Optimization Techniques
3. Concepts of Control Systems

Open Elective-II:

1. Battery Management Systems and Charging Stations
2. Fundamentals of utilization of Electrical Energy
3. Indian Electricity Act

Open Elective-III:

1. Concepts of Microprocessors and Microcontrollers
2. Fundamentals of Electric Vehicles
3. Concepts of Internet of Things

Open Elective-IV:

1. Concepts of Power System Engineering
2. Concepts of Smart Grid Technologies

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***For Honor's/ Minor Course Fullfillments:**

- The 20 additional Credits need to be acquired, 16/15 credits can be earned by undergoing specified courses listed as pools, with 4/5 courses, each carrying 4/3 credits. The remaining 4/5 credits must be acquired through two online MOOCs (Swayam /NPTEL), which shall be domain specific, with 2/3 credits and with a minimum duration of 8/12weeks as recommended by the Board of Studies.
- Minor Engineering subjects are offered to other branches by EEE Department (except for EEE Students).
- Honors Engineering subjects are offered to EEE Students.
- The head of the department will float the list of allowed MOOC electives in each academic year, based on the list floated by MOOCs (Swayam/NPTEL).

*Honors Engineering Courses offered EEE Branch students

II B.Tech II Semester:

1. Communication Systems
2. Electrical Wiring, Estimation and Costing
3. Electrical Distribution Systems

III B.Tech I Semester:

1. Advanced Computer Networks
2. Power Quality
3. Special Electrical Machines

III B.Tech II Semester:

1. Digital Control Systems
2. Analysis of Power Electronic Converters
3. HVDC Transmission

IV B.Tech I Semester:

1. EHV AC Transmission
2. Smart Grid Technologies
3. Power Electronic Control of Electrical Drives

*Minor Engineering Courses offered by EEE Department for Other Branches (Except EEE Branch)

II B.Tech II Semester:

1. Fundamentals of Electrical Circuits
2. Concepts of Electrical Measurements

III B.Tech I Semester:

1. Analysis of Linear Systems
2. Energy Auditing, Conservation and Management

III B.Tech II Semester:

1. Evolutionary Algorithms
2. Fundamentals of Power Electronics

IV B.Tech I Semester:

1. Neural Networks and Fuzzy Logic
2. Concepts of Electric Drives and Its Applications

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3
DIGITAL SIGNAL PROCESSING (PROFESSIONAL ELECTIVE –III)					

Preamble:
The course has been designed to cater to the needs of electronic industry transforms. This course covers basic concepts of signal processing, various transformation techniques. It provides students to relies about different filter structure and also coding of speech signals.

Course Objectives:

- To explore the basic concepts of digital signal processing.
- To connect the time domain signal to frequency domain signals using fourier transform.
- To understand the basic structures of IRR systems.
- To understand and design FIR Digital filters.
- To explore the concepts of multiple sampling rates for DSP.

UNIT - I
Introduction
Introduction to Digital Signal Processing: Discrete time signals & sequences - Classification of Discrete time systems - stability of LTI systems - Invertability - Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Review of Z-transforms - solution of difference equations using Z-transforms - System function.

UNIT - II
Discrete Fourier Transforms and FFT Algorithms
Discrete Fourier Series representation of periodic sequences -Properties of Discrete Fourier Series - Discrete Fourier transforms: Properties of DFT - linear filtering methods based on DFT - Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms - Inverse FFT.

UNIT - III
Design and Realizations of IIR Digital Filters
Analog filter approximations – Butter worth and Chebyshev - Design of IIR Digital filters from analog filters - Design Examples. Analog and Digital frequency transformations.
Basic structures of IIR systems – Direct-Form Structures - Transposed Structures - Cascade-Form Structures - Parallel-Form Structures Lattice and Lattice-Ladder Structures.

UNIT - IV
Design and Realizations of FIR Digital Filters
Characteristics of FIR Filters with Linear Phase - Frequency Response of Linear Phase FIR Filters - Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique - Comparison of IIR & FIR filters.
Basic structures of FIR systems – Direct-Form Structure - Cascade-Form Structures Linear Phase Realizations - Lattice structures.

UNIT - V
Multirate Digital Signal Processing
Introduction-Decimation –Interpolation-Sampling Rate Conversion by a Rational Factor-Implementation of sampling rate converters-Applications of Multirate Signal Processing-Digital Filter Banks.

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Course Outcomes:

After the completion of the course the student should be able to:

- Know the concepts of Digital signal processing - frequency domain representation &z-transform.
- Compute discrete Fourier transform and fast fourier transforms for different sequences.
- Design IIR filters through analog filter approximation and basic structure of IIR filters.
- Design FIR filters with window techniques and basic structure of FIR filters.
- Learn the concepts of Multirate Signal Processing.

Text Books:

1. Digital Signal Processing - Principles - Algorithms - and Applications: John G. Proakis - Dimitris G.Manolakis - 4th Edition - Pearson Education / PHI - 2007.
2. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer - PHI.
3. Digital Signal Processing: A Computer based approach. Sanjit K Mitra - 4th Edition - TMH - 2014.

Reference Books:

1. Digital Signal Processing: Andreas Antoniou - TATA McGraw Hill - 2006
2. Digital Signal Processing: MH Hayes - Schaum's Outlines - TATA Mc-Graw Hill - 2007.
3. DSP Primer - C. Britton Rorabaugh - Tata McGraw Hill - 2005.
4. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling - Sandra L.Harris - Thomson - 2007.
5. Digital Signal Processing – Alan V. Oppenheim - Ronald W. Schafer - PHI Ed. - 2006.
6. Digital Signal Processing – K Raja Rajeswari - 1st edition - I.K. International Publishing - House - 2014.

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3

RENEWABLE AND DISTRIBUTED ENERGY TECHNOLOGIES
(PROFESSIONAL ELECTIVE – III)

Preamble:
To impart knowledge on various renewable sources such as solar, wind and hydel perspectives.
To know the requirements of various hybrid sources as distributed energy technologies.

Course Objectives:
- To understand the basic concepts on wind energy systems with concept on aerodynamics, horizontal and vertical axis wind turbines.
- To understand the various relations between speed, power and energy in the wind systems.
- It provides the knowledge in fundamentals of solar energy systems, various components of solar thermal systems, applications in the relevant fields and design of PV systems.
- To understand the Hydel system components and their design concepts. To get an idea on different other sources like tidal, geothermal and gas based units.
- To understand the use of various renewable sources as distributed generators.

UNIT – I
Brief idea on renewable and distributed sources - their usefulness and advantages; Wind Energy Systems: Estimates of wind energy potential - wind maps - Instrumentation for wind velocity measurements - Aerodynamic and mechanical aspects of wind machine design - Conversion to electrical energy - Aspects of location of wind farms.

UNIT – II
Wind speed and energy - Speed and power relations - Power extraction from wind - Tip speed ratio (TSR) - Functional structure of wind energy conversion systems - Pitch and speed control - Power-speed-TSR characteristics - Fixed speed and variable speed wind turbine control - Power optimization - Electrical generators - Self-Excited and Doubly-Fed Induction Generators operation and control.

UNIT – III
Solar PV Systems: Present and new technological developments in photovoltaic - estimation of solar irradiance - components of solar energy systems - solar-thermal system applications to power generation - heating - Types of PV systems - Modelling of PV cell - current-voltage and power-voltage characteristics - Effects of temperature - Solar array simulator - Sun tracking - Peak power operations - PV system - MPPT techniques - Effects of partial shading on the characteristic curves and associated MPPT techniques - Solar park design outline.

UNIT – IV
Hydel Power: Water power estimates - use of hydrographs - hydraulic turbine - characteristics and part load performance - design of wheels - draft tubes and penstocks - plant layouts; Brief idea of other sources viz. - tidal - geothermal - gas-based - etc.

UNIT - V
Requirements of hybrid/combined use of different renewable and distributed sources - Need of energy storage; Control of frequency and voltage of distributed generation in Stand-alone and Grid-connected mode - use of energy storage and power electronics interfaces for the connection to grid and loads - Design and optimization of size of renewable sources and storages.

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Course Outcomes:

After the completion of the course the student should be able to:

- Illustrate basic concepts of renewable and distributed sources
- Demonstrate the components of wind energy conversion systems.
- Model PV systems and analyse MPPT Techniques.
- Illustrate the concept of Energy Production from Hydro - Tidal and Geothermal.
- Distinguish between standalone and grid connected DG systems and design hybrid renewable energy systems.

Text Books & Reference Books:

1. Math J. Bollen - Fainan Hassan 'Integration of Distributed Generation in the Power System' - IEEE Press - 2011.
2. Loi Lei Lai and Tze Fun Chan 'Distributed Generation: Induction and Permanent Magnet Generators' - Wiley-IEEE Press - 2007.
3. Studies' Craig Anderson and Rudolf I. Howard 'Wind and Hydropower Integration: Concepts - Considerations and Case - Nova Publisher - 2012.
4. Amanda E. Niemi and Cory M. Fincher 'Hydropower from Small and Low-Head Hydro Technologies' - Nova Publisher - 2011.
6. D. Yogi Goswami - Frank Kreith and Jan F. Kreider 'Principles of Solar Engineering' - Taylor & Francis 2000.
7. G. N. Tiwari 'Solar Energy Technology' - Nova Science Publishers - 2005.
8. Math J. Bollen - Fainan Hassan 'Integration of Distributed Generation in the Power System' - IEEE Press - 2011.
9. S. Heier and R. Waddington 'Grid Intergration of Wind Energy Conversion Systems' – Wiley - 2006.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS (PROFESSIONAL ELECTIVE – III)					

Preamble:
Flexible Alternating Current Transmission System controllers have become a part of modern power system. It is important for the student to understand the principle of operation of series and shunt compensators by using power electronics. As the heart of many power electronic controllers is a voltage source converter (VSC), the student should be acquainted with the operation and control of VSC. The modern power electronic controllers are also introduced.

Course Objectives:
- To learn the basics of power flow control in transmission lines using FACTS controllers
- To explain operation and control of voltage source converter.
- To learn the method of shunt compensation using static VAR compensators.
- To learn the methods of compensation using series compensators
- To explain operation of Unified Power Flow Controller (UPFC) and Interline Power flow Controller (IPFC).

UNIT - I
Introduction to FACTS
Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high power devices – Voltage and current rating – Losses and speed of switching – Parameter trade–off devices.

UNIT - II
Voltage source and Current source converters
Voltage source converter (VSC) – Single phase full-wave bridge converter – Square wave voltage harmonics for a single–phase bridge converter – Three–phase full-wave bridge converter - Transformer connections for 12 pulse operation.
Current Source Converter (CSC)-Three–phase current source converter – Comparison of current source converter with voltage source converter.

UNIT - III
Shunt Compensators
Objectives – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping.

Variable Impedance Type VAR Generator: Thyristor Switched/Controlled Reactor (TSR/TCR) – Thyristor Switched Capacitor (TSC) – Fixed Capacitor–Thyristor Controlled Reactor (FC-TCR) - Thyristor Switched Capacitor and Thyristor Controlled Reactor (TSC–TCR) - Switching Converter type VAR generator.
Principle of operation and comparison of SVC and STATCOM.

UNIT - IV
Series Compensators
Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements. Variable Impedance type series compensators – GTO Thyristor controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC) - Switching Converter type Series Compensation – Static Synchronous Series Compensator.

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UNIT - V

Combined Compensators

Schematic and basic operating principles of unified power flow controller (UPFC) and Interline power flow controller (IPFC) – Controller applications of transmission lines.

Course Outcomes:

After the completion of the course the student should be able to:

- Know the concepts of facts controller and power flow control in transmission line.
- Demonstrate operation and control of voltage source converter and know the concepts current source converter.
- Analyse compensation by using different compensators to improve stability and reduce power oscillations in the transmission lines.
- Know the concepts methods of compensations using series compensators.
- Analyse operation of Unified Power Flow Controller (UPFC) and Interline power flow controller (IPFC).

Text Books:

1. "Understanding FACTS" N.G.Hingorani and L.Guygi, IEEE Press.Indian Edition is available:— Standard Publications, 2001.

Reference Books:

1. "Flexible ac transmission system (FACTS)" Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
2. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R. Mohan Mathur and Rajiv K.Varma, Wiley.

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3

POWER SYSTEM DEREGULATION
(PROFESSIONAL ELECTIVE – III)

Preamble:
This aim of this course is to enhance competition and bring consumers new choices and economic benefits. The electricity industry is evolving into a distributed and competitive industry in which market forces drive the price of electricity and reduce the net cost through increased competition. The process has, obviously, necessitated reformulation of established models of power system operation and control activities.

Course Objectives:
- To provide in-depth knowledge of operation of deregulated electricity market systems.
- To calculate Available Transfer Capability (ATC) using different mechanisms
- To examine typical issues in electricity markets and how these are handled world –wide in various markets.
- To learn importance effects and classification of congestion management methods.
- To know the information about various ancillary services and markets in national international scenario

UNIT – I
Need and conditions for deregulation. Introduction of Market structure - Market Architecture - Spot market - forward markets and settlements. Review of Concepts marginal cost of generation - least-cost operation - incremental cost of generation. Power System Operation - Power Exchange.

UNIT – II
Electricity sector structures and Ownership /management - the forms of Ownership and management. Different structure model like Monopoly model - Purchasing agency model - wholesale competition model - Retail competition model - Definition of Available Transfer Capability (ATC) - computation of ATC.

UNIT – III
Framework and methods for the analysis of Bilateral and pool markets - LMP based markets.
Auction models and price formation - price based unit commitment - country practices.

UNIT – IV
Transmission network and market power. Power wheeling transactions and marginal costing - transmission costing. Congestion management methods- market splitting - counter-trading; Effect of congestion on LMPs- country practices.

UNIT – V
Ancillary Services and System Security in Deregulation. Classifications and definitions - AS management in various markets- country practices. Technical - economic - & regulatory issues involved in the deregulation of the power industry.

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Course Outcomes:

After the completion of the course the student should be able to:

- Know the essential and operation of deregulated electricity market systems.
- Learn about the different structure model.
- Analyze various types of electricity market operational and control issues using new mathematical models.
- Analyse LMP's wheeling transactions and congestion management.
- Analyze impact of ancillary services.

Text Books:

1. Power System Economics: Designing markets for electricity - Steven Stoft - wiley publishers - 2002.
2. Operation of restructured power systems - K. Bhattacharya - M.H.J. Bollen and J.E. Daalder – Springer - 2012.

Reference Books:

1. Power generation - operation and control - -J. Wood and B. F. Wollenberg - Wiley – 1998.
2. Market operations in electric power systems - M. Shahidehpour - H. Yaminand Z. Li – Wiley - 2003.
3. Fundamentals of power system economics - S. Kirschen and G. Strbac - Wiley - 2nd edition - 2018.
4. Optimization principles: Practical Applications to the Operation and Markets of the Electric Power Industry - N. S. Rau - IEEE Press series on Power Engineering.
5. "Competition and Choice in Electricity" by Sally Hunt and Graham Shuttleworth - Wiley publishers - 1997.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
DATA BASE MANAGEMENT SYSTEMS (Professional Elective –III)					

Course Objectives:
To learn the principles of systematically designing and using large scale Database Management Systems for various applications.

UNIT-I
Overview of Database System
Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Informational Retrieval, Specialty Databases, Database Users and Administrators, History of Database Systems**. [Text Book -2]**

UNIT-II
Introduction to Database Design
Database Design and ER Diagrams, Entities, Attributes and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design with the ER Model, Extended ER features **[Text Book -1]**

UNIT-III
Relational Model
Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity Constraints, Querying Relational Data, Logical Database Design: ER to Relational, Introduction to Views, Destroying/Altering Tables and Views **[Text Book -1]**

UNIT-IV
SQL: Queries, Constraints, Triggers
The Form of a Basic SQL Query, UNION, INTERSECT and EXCEPT, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers, Exceptions, Procedures, Functions **[Text Book -1]**

UNIT-V
Normal Forms
Introduction to Schema Refinement, Functional Dependencies, Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization. **[Text Book -1]**

Course Outcomes: At the end of the course, student will be able to

- Illustrate the concept of databases, database management systems, database languages, database structures and their work
- Apply ER modeling and Relational modeling for designing simple databases.
- Summarize the concepts related to relational model and SQL and Write database queries using relational algebra and structured query language.
- Design and develop databases from the real world by applying the concepts of Normalization.
- Outline the issues associated with Transaction Management and Recovery, Tree Structured Indexing

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Text Books:

1. Data base Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke, Mc Graw-Hill
2. Data base System Concepts, 6/e, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Mc Graw-Hill

Reference Books:

1. Database Systems, 6/e Ramez Elmasri, Shamkant B. Navathe, Pearson
2. Introduction to Database Systems, 8/e, C J Date, Pearson
3. Database Systems, 9/e, Carlos Coronel, Steven Morris, Peter Rob, Cengage

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3
HYBRID ELECTRIC VEHICLES (PROFESSIONAL ELECTIVE –IV)					

Preamble:
This course aims to study and understand merits of electric and hybrid electric vehicles. It also deals with different power electronic converters and battery storage systems for electric and hybrid electric vehicles.

Course Objectives:
- To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
- To know various architectures of hybrid electric vehicles.
- To understand the power management of plug in electric vehicles.
- To study and understand different power converters used in electrical vehicles.
- To familiarize with different batteries and other storage systems.

UNIT - I
Introduction
Fundamentals of vehicle - components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; History of hybrid vehicles - advantages and applications of Electric and Hybrid Electric Vehicles.

UNIT - II
Hybridization of Automobile
Architectures of HEVs - series and parallel HEVs - complex HEVs. Plug-in hybrid vehicle(PHEV) - constituents of PHEV - comparison of HEV and PHEV; Extended range hybrid electric vehicles(EREVs) - blended PHEVs - Fuel Cell vehicles and its constituents.

UNIT - III
Special Machines for EV and HEVs
Characteristics of traction drive - requirement of electric motors for EV/HEVs. Induction Motor drives - their control and applications in EV/HEVs. Permanent magnet Synchronous motor: configuration - control and applications in EV/HEVs. Brushless DC Motors: Advantages - control of application in EV/HEVs. Switch reluctance motors: Merits limitations - converter configuration - control of SRM for EV/HEVs.

UNIT - IV
Power Electronics in HEVs
Boost and Buck-Boost converters - Multi Quadrant DC-DC converters - DC-AC Inverter for EV and HEV applications - Three Phase DC-AC inverters - Voltage control of DC-AC inverters using PWM - EV and PHEV battery chargers.

UNIT - V
Energy Sources for HEVs
Energy Storage - Battery based energy storage and simplified models of battery - fuel cells - their characteristics and simplified models - super capacitor based energy storage - its analysis and simplified models - flywheels and their modeling for energy storage in EV/HEV - Hybridization of various energy storage devices.

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Course Outcomes:

After the completion of the course the student should be able to:

- Know the concept of electric vehicles and hybrid electric vehicles.
- Familiar with different configuration of hybrid electric vehicles.
- Choose an effective motor for EV and HEV application
- Understand the power converters used in hybrid electric vehicles
- Know different batteries and other energy storage systems.

Text Books

1. Ali Emadi - Advanced Electric Drive Vehicles - CRC Press - 2014.
2. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2003.

Reference Books:

1. MehrdadEhsani - YimiGao - Sebastian E. Gay - Ali Emadi - Modern Electric - Hybrid Electric and Fuel Cell Vehicles: Fundamentals - Theory and Design - CRC Press - 2004.
2. James Larminie - John Lowry - Electric Vehicle Technology Explained - Wiley - 2003.
3. H. Partab: Modern Electric Traction - DhanpatRai& Co - 2007.

Research Books:

1. Pistooa G. - “Power Sources - Models - Sustanability - Infrstructure and the market” - Elsevier 2008
2. Mi Chris - Masrur A. - and Gao D.W. - “ Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives” 1995.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
HIGH VOLTAGE ENGINEERING (PROFESSIONAL ELECTIVE – IV)					

Preamble:
With the growth of power, HV power transmission has become an important subject. The performance of generating equipment requires knowledge of different phenomena occurring at higher voltage. Thus evaluations of various insulating materials are required for protection of HV equipments. Keeping this in view the course is designed to understand various phenomena related to breakdown study and withstand characteristics of insulating materials. The course also describes the generation and measurement of DC, AC and Impulse voltages.

Course Objectives:
- To understand HV breakdown phenomena in gases.
- To understand the breakdown phenomenon of liquids and solid dielectrics.
- To acquaint with the generating principle of operation and design of HVDC, AC voltages.
- To understand the generating principles of Impulse voltages & currents.
- To understand various techniques for AC, DC and Impulse measurements of high voltages and currents.

UNIT - I
Break down phenomenon in Gaseous:
Insulating Materials: Types - applications and properties. Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases and its limitations – Streamers Theory of break down – Paschen's law- Paschens curve.

UNIT - II
Break down phenomenon in Liquids:
Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquids.
Break down phenomenon in Solids:
Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown –Breakdown of composite solid dielectrics.

UNIT - III
Generation of High DC voltages:
Voltage Doubler Circuit - Voltage Multiplier Circuit – Vande- Graaff Generator.
Generation of High AC voltages:
Cascaded Transformers – Resonant Transformers –Tesla Coil

UNIT - IV
Generation of Impulse voltages:
Specifications of impulse wave – Analysis of RLC circuit only- Marx Circuit.
Generation of Impulse currents:
Definitions – Circuits for producing Impulse current waves – Wave shape control - Tripping and control of impulse generators.

UNIT - V
Measurement of High DC & AC Voltages:
Resistance potential divider - Generating Voltmeter - Capacitor Voltage Transformer (CVT) - Electrostatic Voltmeters – Sphere Gaps.

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Measurement of Impulse Voltages & Currents:
Potential dividers with CRO - Hall Generator - Rogowski Coils.

Course Outcomes:
After the completion of the course the student should be able to:

- Recognise the dielectric properties of gaseous materials used in HV equipment.
- Differentiate the break down phenomenon in liquid and solid dielectric materials.
- Acquaint with the techniques of generation of high AC and DC voltages
- Acquaint with the techniques of generation of high Impulse voltages and currents.
- Getting the knowledge of measurement of high AC - DC - Impulse voltages and currents.

Text Books:

1. High Voltage Engineering: Fundamentals by E.Kuffel - W.S.Zaengl - J.Kuffel by Elsevier - 2nd Edition.
2. High Voltage Engineering and Technology by Ryan - IET Publishers - 2nd edition.

Reference Books:

1. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications - 3rd Edition.
2. High Voltage Engineering by C.L.Wadhwa - New Age Internationals (P) Limited – 1997.
3. High Voltage Insulation Engineering by RavindraArora - Wolfgang Mosch - New Age International (P) Limited - 1995.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
PROGRAMMABLE LOGIC CONTROLLERS AND APPLICATIONS (PROFESSIONAL ELECTIVE –IV)					

Preamble:
Technological advances in recent years have resulted in the development of the programmable logic controllers (PLCS) and a consequence resolution of control engineering. This course is an introduction topic and aims to ease the tasks of students coming first into constant in the PLCs. It addresses the different nomenclature and programs forms with examples**.**

Course Objectives:
- To understand the various components of PLC systems and ladder diagrams.
- To know the programming instructions and registers in the PLC.
- To understand the use and applications of timer and counter functions.
- To familiar the data handling function and this application.
- To understand and implementation of analog operations and PID modules.

UNIT – I
Introduction to PLC systems
I/O modules and interfacing - CPU processor - programming Equipment - programming formats - construction of PLC ladder diagrams - Devices connected to I/O Modules. Digital logic gates - programming in the Boolean algebra system - conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings - ladder diagram construction and flowchart for spray process system.

UNIT – II
PLC Programming: Input instructions - outputs - operational procedures - programming examples using contacts and coils. Drill press operation.
PLC Registers: Characteristics of Registers - module addressing - holding registers - Input Registers - Output Registers.

UNIT – III
PLC Functions: Timer functions & Industrial applications - counters - counter function industrial applications - Arithmetic functions - Number comparison functions - number conversion functions.

UNIT – IV
Data Handling functions: SKIP - Master control Relay - Jump - Move - FIFO - FAL - ONS - CLR & Sweep functions and their applications. Bit Pattern and changing a bit shift register - sequence functions and applications - controlling of two-axis & three axis Robots with PLC - Matrix functions.

UNIT – V
Analog PLC operation: Analog modules & systems - Analog signal processing - Multi bit Data Processing - Analog output Application Examples - PID principles - position indicator with PID control - PID Modules - PID tuning - PID functions.

Course Outcomes:
After the completion of the course the student should be able to:
- Illustrate I/O modules of PLC systems and ladder diagrams
- Demonstrate various types registers and programming instructions.
- Examine various types of PLC functions and its applications.
- Assess different data handling functions and its applications.
- Describe the analog operations and PID modules.

Text books:

1. Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss - Fifth Edition - PHI
2. Programmable Logic Controllers- Programming Method and Applications –JR.Hackworth &F.D Hackworth Jr. –Pearson - 2004

Reference Books:

1. Introduction to Programmable Logic Controllers- Gary A. Dunning - 3rd edition - Cengage Learning - 2005.
2. Programmable Logic Controllers –W.Bolton - 5th Edition - Elsevier publisher - 2009.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
CLOUD COMPUTING WITH AWS **(PROFESSIONAL ELECTIVE –IV)**					

Course Objectives:

This course is intended to analyze the basics of cloud computing, and make aware students with diversified technologies working for cloud architecture. Course will be focusing on architecture, service models, privacy & security in cloud.

UNIT-I

Introduction of Cloud Computing: What is Cloud Computing, How it works, Types of Cloud, Goals & Challenges, Leveraging Cloud Computing, Cloud Economics and Total Cost of Ownership

UNIT-II

Cloud Service Models Software as a Service (SaaS): Introduction, Challenges in SaaS Model, SaaS Integration Services, Advantages and Disadvantages. Infrastructure As a Services (IaaS): Introduction, Virtual Machines, VM Migration Services, Advantages and Disadvantages. Platform As a service (PaaS): Introduction, Integration of Private and Public Cloud, Advantages and Disadvantages.

UNIT-III

Virtualization and Abstraction: What is Virtualization and how abstraction is provided in cloud? Advantages and Disadvantages, Types of Hypervisor, and Load balancing.

UNIT-IV

Amazon Web Services Getting started with AWS, AWS Compute, Storage, and Networking, AWS Security, Identity, and Access Management, AWS Database Options, AWS Elasticity and Management Tools

UNIT-V

Architecting on AWS Introduction to System Design: AWS Essentials Review and System Design for High Availability, Automation and Serverless Architectures: Event-Driven Scaling, Well-Architected Best Practices: Security, Reliability, Performance Efficiency, Cost Optimization and Deployment and Implementation: Design Patterns and Sample Architectures

Course Outcomes:

Upon completion of this course, the students will be able to

- Understand and analyze the architecture of Cloud (Analyze).
- Identify and apply deployment and management options of AWS Cloud Architecture (Apply).
- Design architectures to decouple infrastructure and reduce interdependencies (Create).

Text books:

1. Judith Hurwitz, R Bloor, M.Kanfman, F.Halper “Cloud Computing for Dummies”, Wiley India Edition, First Edition
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, ”Cloud Computing: Principles and Paradigms”, Wiley Publication, 2011

Reference Books:

1. Tim Mather, SubraKumara swamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'ReillyMedia Inc, 2009
2. Mickey Iqbal 2010, " IT Virtualization Best Practices: A Lean, Green Virtualized Data Center Approach", MC Press
3. Frank H. P. Fitzek, Marcos D. Katz, "Mobile Clouds: Exploiting Distributed Resources in Wireless, Mobile and Social Networks", Wiley Publications, ISBN: 978-0-470- 97389-9, Jan 2014.

e-Books:

1. https://www.manning.com/books/exploring-cloud-computing (Paid Version)

Supplementary Resources:

1. NPTEL online course : https://onlinecourses.nptel.ac.in/noc17_cs23/preview
2. MOOC : https://www.edx.org/micromasters/cloud-computing
3. Coursera: https://www.coursera.org/specializations/cloud-computing
4. AWS Academy: AWS Cloud Computing Architecture at https://aws.amazon.com/training/awsacademy/cloud-computing-architecture/

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
DEEP LEARNING TECHNIQUES (PROFESSIONAL ELECTIVE –IV)					

Course Objectives: At the end of the course, the students will be expected to:

- Learn deep learning methods for working with sequential data,
- Learn deep recurrent and memory networks,
- Learn deep Turing machines,
- Apply such deep learning mechanisms to various learning problems.
- Know the open issues in deep learning, and have a grasp of the current research directions.

UNIT-I
Fundamentals of Deep Learning
Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines, **Fundamentals of Machine Learning:** Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Underfitting. **[Text Book 2]**

UNIT-II
Introducing Deep Learning
Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks. **[Text Book3]**

UNIT-III
Neural Networks
Anatomy of Neural Network, Introduction to Keras: Keras, TensorFlow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying Movie Reviews: Binary Classification, Classifying newswires: Multiclass Classification. **[Text Book 2]**

UNIT-IV
Convolutional Neural Networks
Nerual Network and Representation Learing, Convolutional Layers, Multichannel Convolution Operation, **Recurrent Neural Networks:** Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch. **[Text Book 3]**

UNIT-V
Interactive Applications of Deep Learning
Machine Vision, Natural Language processing, Generative Adversial Networks, Deep Reinforcement Learning. **[Text Book 1]**
Deep Learning Research: Autoencoders**,** Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines, Deep Belief Networks. **[Text Book 1]**

Course Outcomes: After the completion of the course, student will be able to

- Demonstrate the fundamental concepts learning techniques of Artificial Intelligence, Machine Learning and Deep Learning.
- Discuss the Neural Network training, various random models**.**
- Explain the Techniques of Keras, TensorFlow, Theano and CNTK
- Classify the Concepts of CNN and RNN
- Implement Interactive Applications of Deep Learning.

Text Books:

1. Deep Learning- Ian Goodfellow, Yoshua Bengio and Aaron Courvile, MIT Press, 2016
2. Deep Learning with Python - Francois Chollet, Released December 2017, Publisher(s): Manning Publications, ISBN: 9781617294433
3. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence - Jon Krohn, Grant Beyleveld, Aglaé Bassens, Released September 2019, Publisher(s): Addison-Wesley Professional, ISBN: 9780135116821
4. Deep Learning from Scratch - Seth Weidman, Released September 2019, Publisher(s): O'Reilly Media, Inc., ISBN: 9781492041412

Reference Books:

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., and Van Loan,C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

Web Link:

1. Swayam NPTEL: Deep Learning: https://onlinecourses.nptel.ac.in/noc22_cs22/preview

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
POWER SYSTEM OPERATION AND CONTROL (PROFESSIONAL ELECTIVE –V)					

Preamble:
This subject deals with economic operation of Power Systems, Hydrothermal scheduling and modeling of turbines, generators and automatic controllers. It emphasizes on single area and two area load frequency control and reactive power control.

Course Objectives:
- To understand optimal dispatch of generation with and without losses.
- To understand the optimal scheduling of hydro thermal systems.
- To understand the optimal unit commitment problem.
- To understand the load frequency control for single area system with and without controllers
- To understand the load frequency control for two area system with and without controllers
- To understand the reactive power control and compensation of transmission lines.

UNIT - I
Economic Operation of Power Systems
Optimal operation of Generators in Thermal power stations - – Heat rate curve – Cost Curve – Incremental fuel and Production costs – Input–output characteristics – Optimum generation allocation with line losses neglected – Optimum generation allocation including the effect of transmission line losses – Loss Coefficients – General transmission line loss formula.

UNIT - II
Hydrothermal Scheduling
Mathematical Formulation – Solution Technique.
Unit Commitment
Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming.

UNIT – III
Load Frequency Control-I
Modelling of steam turbine – Generator – Mathematical modelling of speed governing system – Transfer function – Necessity of keeping frequency constant. Definitions of Control area – Single area control system – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case. Proportional plus Integral control of single area and its block diagram representation – Steady state response.

UNIT - IV
Load Frequency Control-II
Block diagram development of Load Frequency Control of two area system uncontrolled case and controlled case – Tie-line bias control – Load Frequency Control and Economic dispatch control.

UNIT - V
Compensation in Power Systems
Overview of Reactive Power control – Reactive Power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation – Specifications of load compensator – compensated transmission lines. Introduction of FACTS devices – Need of FACTS controllers – Types of FACTS devices.

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Course Outcomes:

After the completion of the course the student should be able to:

- Compute optimal load scheduling of Generators.
- Formulate hydrothermal scheduling and unit commitment problem..
- Analyse effect of Load Frequency Control for single area systems
- Analyse effect of Load Frequency Control for two area systems
- Describe the effect of reactive power control for transmission lines.

Text Books:

1. Power Generation - Operation and Control by Allen J Wood - Bruce F WollenBerg 3rd Edition - Wiley Publication 2014.
2. Electric Energy systems Theory – by O.I.Elgerd - Tata McGraw–hill Publishing Company Ltd. - Second edition.
3. Modern Power System Analysis – by I.J.Nagrath&D.P.Kothari Tata McGraw Hill Publishing Company Ltd - 2nd edition.

Reference Books:

1. Power System Analysis and Stability by S.S.Vadhera - Khanna Publications - 4th edition - 2005.
2. Power System Analysis by Grainger and Stevenson - Tata McGraw Hill.
3. Power System Analysis by HadiSaadat – – Tata McGraw–Hill 3rd edition - 2010.
4. Power System stability & control - Prabha Kundur - TMH - 1994.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
SWITCHED MODE POWER CONVERSION (PROFESSIONAL ELECTIVE –V)					

Preamble:
This course is highly relevant to students who are interested in analysis, design and control of switch mode converters.

Course Objectives:
- To illustrate CCM and DCM modes of operation of non-isolated switched mode converters.
- To illustrate the working of isolated switched mode converters.
- To analyze ZVS and ZCS operation of buck, boost converters.
- To learn about the control schemes & design aspects of transformers, inductors and capacitors.
- To model the converters and design controller for closed loop operation of switched mode converters.

UNIT – I
Non-Isolated Switch Mode Converters
Control of DC-DC converters: Buck converters - Boost converters - Buck-Boost converter - CUK Converter - continuous and discontinuous operation - Converter realization with non-ideal components.

UNIT – II
Isolated Switched Mode Converters
Forwarded converter - flyback converter - push-pull converter - half-bridge converter - full bridge converter.

UNIT – III
Resonant Converters
Basic resonant circuit concepts - series resonant circuits - parallel resonant circuits - zero current switching quasi-resonant buck converter - zero current switching quasi-resonant boost converter - zero voltage switching quasi-resonant buck converter - zero voltage switching quasi-resonant boost converter.

UNIT – IV
Control Schemes of Converters and Magnetic Design
Voltage mode control - Current mode control - Current control mode instability.
Magnetic Design: Transformer design - inductor and capacitor design.

UNIT – V
Modelling of Converters and Controller Design Based on Linearization:
Formulation of large signal models for buck and boost converters using state space analysis-derivation of averaged large signal model using circuit averaging method-small signal model derivation- average switch modelling technique to obtain small signal models of buck and boost converters- Transfer function of converters-Controller design based on linearization.

Course Outcomes:
After the completion of the course the student should be able to:
- Design and analyse the operation of non-isolated switch mode converters.
- Analyze the operation of isolated switch mode converters.
- Illustrate the operation of resonant converters.
- Analyse the control schemes of converters and design transformer and inductor.
- Model the converters and design controller for closed loop operation.

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Text Books:

1. Fundamentals of Power Electronics- Erickson - Robert W. - Maksimovic - Dragan - Springer - 2011.
2. Power switching converters- Simon Ang - Alejandro Oliva - CRC Press - 2010.
3. Power Electronics: Essentials & Applications- L. Umanand, S.P. Bhat, John Wiley & Sons Australia, 1992.

Reference Books:

1. Switching Power Supply Design- Abraham I. Pressman - McGraw-Hill Ryerson - Limited - 1991.
2. Power Electronics: converters Applications & Design – Mohan - Undeland - Robbins-Wiley publications.
3. Design of Magnetic Components for Switched Mode Power Converters- Z Umanand - S.P. Bhat - John Wiley & Sons Australia - 1992.
4. Elements of Power Electronics – Philip T. Krein - Oxford University press - 2014.

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3

AI APPLICATIONS TO ELECTRICAL ENGINEERING
(PROFESSIONAL ELECTIVE – V)

Preamble:
This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. Also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.

Course Objectives:
- To understand artificial neuron models & learning methods of ANN.
- To utilize different algorithms of ANN.
- To distinguish between classical and fuzzy sets.
- To illustrated different modules of fuzzy controller.
- To analyze applications of neural networks and fuzzy logic.

UNIT – I
Introduction
Artificial Neural Networks (ANN) – Humans and computers – Biological neural networks – ANN Terminology – Models of Artificial neuron – activation functions – typical architectures – biases and thresholds – learning strategy(supervised - unsupervised and reinforced) – Neural networks learning rules. Single layer feed forward neural networks: concept of pattern and its types - perceptron training and classification using Discrete and Continuous perceptron algorithms– linear separability- XOR function.

UNIT – II
Multi-layer feed forward networks
Generalized delta rule– Back Propagation algorithm– Radial Basis Function (RBF) network - Kohonen's self-organizing feature maps (KSOFM) - Learning Vector Quantization (LVQ) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

UNIT – III
Classical Sets and Fuzzy Sets
Introduction to classical sets- properties - Operations and relations - Fuzzy sets - Operations - Properties - Fuzzy relations - Cardinalities - Membership functions.

UNIT – IV
Fuzzy Logic Modules
Fuzzification - Membership value assignment - development of rule base and decision making system - Defuzzification to crisp sets - Defuzzification methods.

UNIT – V
Applications
Neural network applications: Load flow studies - load forecasting - reactive power control.
Fuzzy logic applications: Economic load dispatch - speed control of DC motors - single area and two area load frequency control.

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Course Outcomes:

After the completion of the course the student should be able to:

- Analyse different models of artificial neuron & Use learning methods of ANN.
- Evaluate different paradigms of ANN.
- Classify between classical and fuzzy sets.
- Illustrate different modules of Fuzzy logic controller.
- Apply Neural Networks and fuzzy logic for real-time applications.

Text Books:

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda - Jaico Publishing House - 1997.
2. Neural Networks - Fuzzy logic - Genetic algorithms: synthesis and applications by Rajasekharanand Pai – PHI Publication.

Reference Books:

1. Artificial Neural Network – B.Yegnanarayana - PHI - 2012.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – Mc Graw Hill Inc - 1997.
3. Introduction to Neural Networks using MATLAB 6.0 – S N Sivanandam - SSumathi - S N Deepa TMGH
4. Introduction to Fuzzy Logic using MATLAB – S N Sivanandam - SSumathi - S N Deepa Springer - 2007.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
DATA SCIENCE **(PROFESSIONAL ELECTIVE –V)**					

Course Objectives:
From the course the student will learn

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science;
- Produce Python code to statistically analyze a dataset;
- Critically evaluate data visualizations based on their design and use for communicating stories from data

UNIT-I
Introduction to Core Concepts and Technologies
Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

UNIT-II
Data Collection and Management
Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources.

UNIT-III
Data Analysis
Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

UNIT-IV:
Data Visualization
Introduction, Types of data visualization, Data for visualization- Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

UNIT-V
Applications of Data Science
Technologies for visualization, Bokeh (Python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

Course Outcomes:
By the end of the course, student will be able to

- Acquire the knowledge and expertise to become a proficient data scientist
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- Explain how data is collected, managed and stored for data science
- Interpret the key concepts in data science, including their real-world applications and the toolkit used by data scientists
- Illustrate data collection and management scripts using MongoDB

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Text Books:

1. "The Art of Data Science", 1st edition, Roger D. Peng and Elizabeth matsui, Lean Publications, 2015
2. "Algorithms for Data Science", 1st edition, Steele, Brian, Chandler, John, Reddy, Swarna, springers Publications, 2016

Reference Books:

1. Doing Data Science: Straight Talk From The Frontline, 1st edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013
2. Mining of Massive Datasets, 2nd edition, Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, v2.1, Cambridge University Press, 2014

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
MEAN STACK TECHNOLOGIES **(PROFESSIONAL ELECTIVE –V)**					

Course Objectives:

- To Learn the basics of Web Designing using HTML, DHTML, and CSS
- To learn the basics about Client side scripts and Server side scripts

UNIT I
HTML & DHTML
Introduction, HTML Formatting, Hyper-Links, Lists, Tables, Images, Forms, Frames, Cascading Style sheets, Types, XML, Document type definition, XML Schemas, Document Object model, HTML and Scripting Access, Rollover Buttons, Moving objects with DHTML, Ramifications of DHTML.

UNIT II
Introduction to Client Side scripting
JavaScript, Control statements, Functions, Arrays, Objects, Events, Dynamic HTML with Java Script, AJAX: Ajax Client Server Architecture, XML Http Request Object, Call Back Methods.

UNIT III
Web Application
Web servers, IIS (XAMPP, LAMPP) and Tomcat Servers, Server Side Scripting, Java Servlets, Java Server Pages, Java Server Faces, JSF Components, Session Tracking, Cookies.

UNIT- IV: PHP Programming
Basic Syntax, Defining variable and constant, PHP Data types, Operator and Expression, Operator Precedence, Decisions and Loop, Functions & Recursion, String Processing and Regular Expressions, Form Processing, Working with file and Directories, Cookies.

UNIT- V
JDBC
Database Connectivity with MySQL, Servlets, JSP, PHP, MongoDB, NOSQL Database, Fundamentals of JQuery and Bootstrap.
Case Studies - Student information system, Health Management System

Course Outcomes: At the end of the course, student will be able to

- Describe basics of Web Designing using HTML, DHTML, and CSS
- Build real world applications using client side and server side scripting languages
- Design and develop applications using web servers
- Analyze the basics of PHP programming
- Apply Database connectivity with case study for student Information System and Health Management system

Text Books:

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet & World Wide Web How to Program”, Fifth Edition, Deitel Series, 2012.
2. Jason Gilmore, “Beginning PHP and MySQL from Novice to Professional”, Fourth Edition, Apress Publications, 2010.

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Reference Books:

1. Brown, Ethan, "Web Development with Node and Express: Leveraging the JavaScript Stack", O'Reilly Media, 2019. CSE Dept. Flexible Curriculum NITTUGCSE19 95.
2. Anthony, Accomazzo, Murray Nathaniel, Lerner Ari, "Fullstack React: The Complete Guide to React JS and Friends", Fullstack.io, 2017.
3. Kozlowski, Pawel, "Mastering Web Application Development with Angular JS", Packt Publishing Ltd., 2013.
4. Robert W. Sebesta, "Programming with World Wide Web", Fourth Edition, Pearson, 2008.
5. David William Barron, "The World of Scripting Languages", Wiley Publications, 2000.
6. Dayley B., "Node.js, MongoDB, and AngularJS Web Development", Addison-Wesley Professional, 2014.
7. Vainikka J., "Full-Stack Web Development using Django REST Framework and React", 2018

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3
CONCEPTS OF MICROPROCESSORS AND MICROCONTROLLERS (OPEN ELECTIVE –III)					

Preamble:
Microprocessor and Microcontroller have become important building blocks in digital electronics design. It is important for student to understand the architecture of a microprocessor and its interfacing with various modules. 8086 microprocessor architecture, programming, and interfacing is dealt in detail in this course. Interfacing, PIC, architecture, programming in C.

Course objectives:
- To understand the organization and architecture of Microprocessor.
- To understand addressing modes to access memory.
- To understand the interfacing of Microprocessor with I/O as well as other devices
- To understand 8051 micro controller architecture
- To understand interfacing of 8051 and their applications.

UNIT – I
Introduction to Microprocessor Architecture
Introduction and evolution of Microprocessors – Architecture of 8086 – Memory Organization of 8086 – Register Organization of 8086– Introduction to 80286 - 80386 - 80486 and Pentium (brief description about architectural advancements only).

UNIT – II
Minimum and Maximum Mode Operations
Instruction sets of 8086 - Addressing modes – Assembler directives - General bus operation of 8086 – Minimum and Maximum mode operations of 8086 – 8086 Control signal interfacing – Read and write cycle timing diagrams.

UNIT – III
Microprocessors I/O Interfacing
8255 PPI– Architecture of 8255–Modes of operation – Interfacing I/O devices to 8086 using 8255 – Interfacing A to D converters – Interfacing D to A converters – Stepper motor interfacing– Static memory interfacing with 8086.

UNIT – IV
8051 Microcontroller
Overview of 8051 Microcontroller – Architecture – Signal description – Register set – Memory and I/O addressing.

UNIT - V
8051 Interfacing and Applications
Instruction set – I/O ports and Interrupts – Timers and Counters – Serial Communication – Interfacing of peripherals – Applications of microcontrollers.

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Course Outcomes:

After the completion of the course the student should be able to:

- Know the concepts of the Microprocessor capability in general and explore the evaluation of microprocessors.
- Analyse the instruction sets - addressing modes - minimum and maximum modes operations of 8086 Microprocessors
- Analyse the Microcontroller and interfacing capability.
- Describe the architecture and interfacing of 8051 controller.
- Know the concepts of PIC micro controller and its programming.

Text Books:

1. Ray and Burchandi - "Advanced Microprocessors and Interfacing" - Tata McGraw–Hill - 3rd edition - 2006.
2. Kenneth J Ayala - "The 8051 Microcontroller Architecture - Programming and Applications" - Thomson Publishers - 2nd Edition.

Reference Books:

1. Microprocessors and Interfacing - Douglas V Hall - Mc–Graw Hill - 2nd Edition.
2. R.S. Kaler - "A Text book of Microprocessors and Micro Controllers" - I.K. International Publishing House Pvt. Ltd.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
UNIVERSAL HUMAN VALUES-2: UNDERSTANDING HARMONY					

Course objective: To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence, to understand (or developing clarity) of the harmony in the human being, family, society and nature/existence, to strengthen self-reflection and to develop the commitment and courage to act.

UNIT-1:
Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1) Purpose and motivation for the course, recapitulation from Universal Human Values-I
2) Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3) Continuous Happiness and Prosperity- A look at basic Human Aspirations
4) Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5) Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6) Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT- 2:
Understanding Harmony in the Human Being - Harmony in Myself!

1) Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2) Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3) Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4) Understanding the characteristics and activities of 'I' and harmony in 'I'
5) Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6) Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT-3:
Understanding Harmony in the Family and Society- Harmony in Human Relationship

1) Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2) Understanding the meaning of Trust; Difference between intention and competence
3) Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4) Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5) Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

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UNIT-4:

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1) Understanding the harmony in the Nature
2) Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self regulation in nature
3) Understanding Existence as Co-existence of mutually interacting units in allpervasive space
4) Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT-5:

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1) Natural acceptance of human values
2) Definitiveness of Ethical Human Conduct
3) Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4) Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5) Case studies of typical holistic technologies, management models and production systems
6) Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
7) Include practice: Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

TEXT BOOKS:

1) Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS:

1) Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2) Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3) The Story of Stuff (Book).
4) The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5) Small is Beautiful - E. F Schumacher.
6) Slow is Beautiful - Cecile Andrews.
7) Economy of Permanence - J C Kumarappa .
8) Bharat Mein Angreji Raj - PanditSunderlal .
9) Rediscovering India - by Dharampal .
10) Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
11) India Wins Freedom - Maulana Abdul Kalam Azad.
12) Vivekananda - Romain Rolland (English).
13) Gandhi - Romain Rolland (English).

Course outcome: Students will be able to discuss a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence, to explain (or developing clarity) of the harmony in the human being, family, society and nature/existence, to strengthen self-reflection and to judge the commitment and courage to act.

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IV Year –I SEMESTER		L	T	P	C
		0	0	4	2
SKILL ADVANCED COURSE **MACHINE LEARNING WITH PYTHON LAB**					

Course Objectives:
This course will enable students to learn and understand different Data sets in implementing the machine learning algorithms.

Requirements: Develop the following program using Anaconda/ Jupiter/ Spider and evaluate ML models.

Experiment-1:
Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

Experiment-2:
For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

Experiment-3:
Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Experiment-4:
Exercises to solve the real-world problems using the following machine learning methods: a) Linear Regression b) Logistic Regression c) Binary Classifier

Experiment-5: Develop a program for Bias, Variance, Remove duplicates , Cross Validation
Experiment-6: Write a program to implement Categorical Encoding, One-hot Encoding

Experiment-7:
Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

Experiment-8:
Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

Experiment-9: Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Experiment-10:
Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

Experiment-11: Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

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Experiment-12: Exploratory Data Analysis for Classification using Pandas or Matplotlib.

Experiment-13:
Write a Python program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set

Experiment-14:
Write a program to Implement Support Vector Machines and Principle Component Analysis

Experiment-15:
Write a program to Implement Principle Component Analysis

Course Outcomes (Cos): At the end of the course, student will be able to

- Implement procedures for the machine learning algorithms
- Design and Develop Python programs for various Learning algorithms
- Apply appropriate data sets to the Machine Learning algorithms
- Develop Machine Learning algorithms to solve real world problems

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IV Year –I SEMESTER		L	T	P	C
		0	0	0	3

INDUSTRIAL / RESEARCH INTERNSHIP 2 MONTHS (MANDATORY)
AFTER THIRD YEAR (TO BE EVALUATED DURING VII SEMESTER)

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3
EHVAC TRANSMISSION **(Honors Engineering Course)**					

Preamble:
This course gives the essence in the basic concepts of extra high voltage AC transmission. It also emphasis on the behavior of the line parameters for extra high voltages. The voltage gradients of the transmission line conductors gradients, the effect of corona, electrostatic field calculation, travelling wave theory concept, voltage control when the lines carriers extra high voltages and also to minimize power quality issues by using reactive power compensation.

Course Objectives:
- To calculate the transmission line parameters.
- To calculate the field effects on EHV and UHV AC lines.
- To have knowledge of corona, RI and audible noise in EHV and UHV lines.
- To have knowledge of voltage control in EHV and UHV transmission systems.
- To have knowledge of various reactive power compensating systems in EHV lines.

UNIT – I:
E.H.V. A.C. Transmission, line trends and preliminary aspects, standard transmission voltages – power handling capacities and line losses – mechanical aspects. Calculation of line resistance and inductance: resistance of conductors, temperature rise of conductor and current carrying capacity. Properties of bundled conductors and geometric mean radius of bundle, inductance of two conductor lines and multi conductor lines, Maxwell's coefficient matrix. Line capacitance calculation. capacitance of two conductor line, and capacitance of multi conductor lines, potential coefficients for bundled conductor lines, sequence inductances and capacitances and diagonalization.

UNIT – II:
Calculation of electro static field of AC lines - Effect of high electrostatic field on biological organisms and human beings. Surface voltage Gradient on conductors, surface gradient on two conductor bundle and cosine law, maximum surface voltage gradient of bundle with more than 3 sub conductors, Mangolt formula.

UNIT – III:
Corona : Corona in EHV lines – corona loss formulae – attenuation of traveling waves due to corona – Audio noise due to corona, its generation, characteristics and limits, measurement of audio noise.

UNIT – IV:
Power Frequency voltage control : Problems at power frequency, generalized constants, No load voltage conditions and charging currents, voltage control using synchronous condenser, cascade connection of components : Shunt and series compensation, sub synchronous resonance in series – capacitor compensated lines

UNIT – V:
Reactive power compensating systems: Introduction, SVC schemes, Harmonics injected into network by TCR, design of filters for suppressing harmonics injected into the system, Introduction to STATCOM.

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Course Outcomes:
After the completion of the course the student should be able to:

- Calculate the transmission line parameters.
- Calculate the field effects on EHV and UHV AC lines.
- Determine the corona, RI and audible noise in EHV and UHV lines.
- Analyze voltage control and compensation problems in EHV and UHV transmission systems.
- Understand reactive power compensation using SVC and TCR

Text Books:

1. Extra High Voltage AC Transmission Engineering – Rakesh Das Begamudre, Wiley Eastern ltd., New Delhi – 1987.
2. EHV Transmission line reference book – Edison Electric Institute (GEC) 1986.

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3
SMART GRID TECHNOLOGIES **(Honors Engineering Course)**					

Preamble:
The make radical transformation with the need to decarbonize electricity supply and to replace ageing assets to harness new information for better power system reliability and efficient.

Course Objectives:
- To understand concept of smart grid and their basic developments.
- To understand smart grid technologies and its usage in applications of introduction to smart grid technologies for electric vehicles.
- To have knowledge on smart substations, feeder automation and application for monitoring and protection.
- To have knowledge on micro grids and distributed energy resources.
- To deal power quality aspects in smart grid with information and communication technology.

UNIT - I
Introduction to Smart Grid
Evolution of Electric Grid - Concept of Smart Grid - Definitions - Need of Smart Grid - Functions of Smart Grid - Opportunities & Barriers of Smart Grid - Difference between conventional & smart grid - Concept of Resilient & Self-Healing Grid - Present development & International policies on Smart Grid. Case study of Smart Grid.

UNIT - II
Smart Grid Technologies: Part 1
Introduction to Smart Meters - Real Time Pricing - Smart Appliances - Automatic Meter Reading(AMR) - Outage Management System(OMS) - Plug in Hybrid Electric Vehicles(PHEV) - Vehicle to Grid - Smart Sensors - Home & Building Automation - Phase Shifting Transformers - Net Metering.

UNIT - III
Smart Grid Technologies: Part 2
Smart Substations - Substation Automation - Feeder Automation. Geographic Information System (GIS) - Intelligent Electronic Devices (IED) & their application for monitoring & protection.
Smart storage like Battery Energy Storage Systems (BESS) - Super Conducting Magnetic Energy Storage Systems (SMES) - Pumped Hydro - Compressed Air Energy Storage (CAES) - Wide Area Measurement System (WAMS) - Phase Measurement Unit (PMU).

UNIT - IV
Micro grids and Distributed Energy Resources
Concept of micro grid - need & applications of microgrid - formation of microgrid - Issues of interconnection - protection & control of microgrid - Integration of renewable energy sources - Demand Response.

UNIT - V
Power Quality Management in Smart Grid
Power Quality & EMC in Smart Grid - Power Quality issues of Grid connected Renewable Energy Sources - Power Quality Conditioners for Smart Grid - Web based Power Quality monitoring - Introduction to Power Quality Audit.

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Information and Communication Technology for Smart Grid
Advanced Metering Infrastructure (AMI) - Home Area Network (HAN) - Neighborhood Area Network (NAN) - Wide Area Network (WAN).

Course Outcomes:
After the completion of the course the student should be able to:

- Know the concept of smart grid and analyse the smart grid policies and developments in smart grids.
- Develop concepts of smart grid technologies in hybrid electrical vehicles etc.
- Know the concepts of smart substations - feeder automation - Battery Energy storage systems etc.
- Analyse micro grids and distributed generation systems.
- Analyse the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.

Text Books:

1. Integration of Green and Renewable Energy in Electric Power Systems - by Ali Keyhani - Mohammad N. Marwali - Min Dai Wiley - 2009.
2. The Smart Grid: Enabling Energy Efficiency and Demand Response - by Clark W. Gellings - Fairmont Press - 2009.
3. Smart Grid: Technology and Applications - by Janaka B. Ekanayake - Nick Jenkins - Kithsiri Liyanage - Jianzhong Wu - Akihiko Yokoyama - Wiley publishers - 2012.
4. Smart Grids by Jean-Claude Sabonnadière - NouredineHadjsaïd - Wiley publishers - 2013.
5. Smart Power: Climate Changes - the Smart Grid - and the Future of Electric Utilities - by Peter S. Fox Penner - Island Press; 1st edition - 8 Jun 2010
6. Microgrids and Active Distribution Networks by S. Chowdhury - S. P. Chowdhury - P.Crossley - Institution of Engineering and Technology - 30 Jun 2009
7. Smart Grids (Power Engineering)by Stuart Borlase CRC Press.

Reference Books:

1. The Advanced Smart Grid: Edge Power Driving Sustainability:1 by Andres Carvallo - John Cooper - Artech House Publishers July 2011
2. Control and Automation of Electric Power Distribution Systems (Power Engineering) by James Northcote - Green - Robert G. Wilson - CRC Press - 2017.
3. Substation Automation (Power Electronics and Power Systems) by MladenKezunovic - Mark G. Adamiak - Alexander P. Apostolov - Jeffrey George Gilbert - Springer - 2010.
4. Electrical Power System Quality by R. C. Dugan - Mark F. McGranghan - Surya Santoso - H. Wayne Beaty - McGraw Hill Publication - 2nd Edition.
5. Communication and Networking in Smart Grids by Yang Xiao - CRC Press - 2012.

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3
POWER ELECTRONIC CONTROL OF ELECTRIC DRIVES **(Honors Engineering Course)**					

Preamble:
This course covers in detail advanced speed control techniques of induction motor, PMSM, BLDC & SRM motors.

Course Objectives:
- To learn principles of vector control of induction motor drive.
- To illustrate sensor less control technique for speed control of induction motor drive.
- To illustrate the concepts of direct control of induction motor drive.
- To learn the modeling aspects and control strategies of PMSM and BLDC motors.
- To learn the basics of SRM control.

UNIT - I
Vector Control of Induction Motor Drive:
Principle of scalar and vector control, direct vector control, indirect vector control, rotor flux oriented control, stator flux oriented control, air gap flux oriented control, decoupling circuits.

UNIT - II
Sensor less Control of induction Motor Drive:
Advantages of speed sensor less control, voltage current based speed sensor less control, MRAS-model reference adaptive systems, Extended Kalman filter observers.

UNIT - III
Direct Torque Control of Induction Motor Drive:
Principle of Direct torque control (DTC), concept of space vectors, DTC control strategy of induction motor, comparison between vector control and DTC, applications, space vector modulation based DTC of induction motors.

UNIT - IV
Control of Permanent Magnet Synchronous Machines (PMSM) and Brushless DC (BLDC) Motor Drives:
Advantages and limitations of Permanent magnet machines, operating principle of PMSM, modeling of PMSM, operating principle BLDC motor, modeling of BLDC motor, similarities and difference between PMSM and BLDC motors , need for position sensing in BLDC motors, control strategies for PMSM and BLDC, methods of reducing torque ripples of BLDC motor.

UNIT - V
Control of Switched Reluctance Motor (SRM) Drive:
SRM structure, Merits and limitations, stator excitation, converter topologies, SRM waveforms, Torque control schemes, speed control of SRM, torque ripple minimization, instantaneous -torque control using current controllers and flux controllers

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Course Outcomes:

After the completion of the course the student should be able to:

- Understand the concepts of vector control methods for Induction Motor drive systems.
- Understand the principle of sensor less control of Induction Motor drive.
- Understand the principle of DTC of Induction Motor drive.
- Learn the modeling & control aspects of PMSM and BLDC Motor drives.
- Understand the construction operation and control aspects of SRM.

Text Books:

1. Bose B. K., "Power Electronics and Variable Frequency Drives",IEEE Press, Standard Publisher Distributors. 2001.
2. Power electronic converters applications and design-Mohan, Undeland, Robbins-Wiley publications

Reference Books:

1. Krishnan R., “Electric Motor Drives – Modeling, Analysis and Control”, Prentice Hall of India Private Limited.
2. Switched Reluctance Motors and Their Control- T. J. E. Miller, Magna Physics, 1993.

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II Year – II SEMESTER		L	T	P	C
		3	0	0	3
FUNDAMENTALS OF ELECTRICAL CIRCUITS (Minors Engineering Course)					

Preamble:
Electrical circuit analysis is one of the most vital aspects of electrical & electronics engineering. Understanding how components work individually and collectively is the basis for designing electrical & electronics circuits. This course covers the aspects of various circuit components, laws, network theorems and analysis of single phase & three phase AC systems.

Course Objectives
- To learn about passive elements, sources, node and mesh analysis.
- To understand the basic concepts of single-phase AC systems.
- To learn network theorems and their applications to analyze electrical circuits.
- To analyze three-phase balanced and unbalanced circuits
- To perform transient analysis of RL, RC & RLC circuits

UNIT - I
Introduction to Electrical Circuits
Basic Concepts of passive elements of R, L, C and their V-I relations, Sources (dependent and independent), Kirchoff's laws, Network reduction techniques (series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis to DC networks with dependent and independent voltage and current sources.

UNIT - II
Single Phase A.C Systems
Periodic waveforms (determination of rms, average value and form factor), concept of phasor, phase angle and phase difference – waveforms and phasor diagrams for lagging, leading networks, complex and polar forms of representations-node and mesh analysis.

Steady state analysis of R, L and C circuits, power factor and its significance, real, reactive and apparent power, waveform of instantaneous power and complex power .

UNIT - III
Network theorems (DC & AC Excitations)
Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem.

UNIT - IV
Balanced and Unbalanced Three phase circuits
Analysis of three phase balanced circuits:
Phase sequence, star and delta connection of sources and loads, relation between line and phase voltages and currents, analysis of balanced three-phase circuits, measurement of active and reactive power.
Analysis of three phase unbalanced circuits:
Loop method, Star-Delta transformation technique, two wattmeter method for measurement of three phase power.

UNIT - V
Transient Analysis in DC & AC Circuits
Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using Laplace transforms.

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3
NEURAL NETWORKS AND FUZZY LOGIC (Minors Engineering Course)					

Preamble:
This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. Also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.

Course Objectives:
- To understand artificial neuron models & learning methods of ANN.
- To utilize different algorithms of ANN.
- To distinguish between classical and fuzzy sets.
- To illustrated different modules of fuzzy controller.
- To analyze applications of neural networks and fuzzy logic.

UNIT - I
Introduction
Artificial Neural Networks (ANN) – Humans and Computers – Biological Neural Networks – ANN Terminology – Models of Artificial Neuron – activation functions – typical architectures – biases and thresholds – learning strategy(supervised - unsupervised and reinforced) – Neural networks learning rules.

UNIT - II
Feed Forward Networks:
Single Layer Feed Forward Neural Networks: Concept of Pattern And Its Types - Perceptron Training and Classification Using Discrete and Continuous Perceptron Algorithms– Linear Separability- XOR Function.

UNIT - III
ANN Paradigms
Multi-layer feed forward networks –Generalized delta rule– Back Propagation algorithm – Radial Basis Function (RBF) network - Kohonen's self-organizing feature maps (KSOFM) – Bidirectional Associative Memory (BAM).

UNIT - IV
.Classical and Fuzzy Sets
Introduction to classical sets- properties - Operations and relations;
Fuzzy sets - Operations - Properties - Fuzzy relations - Cardinalities - Membership functions.

UNIT - V
Fuzzy Logic Modules
Fuzzification - Membership value assignment - development of rule base and decision making system - Defuzzification to crisp sets - Defuzzification methods.

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Course Outcomes:

After the completion of the course the student should be able to:

- Analyse different models of artificial neuron.
- Illustrate training and classification using perceptron algorithms.
- Evaluate different paradigms of ANN.
- Classify between classical and fuzzy sets.
- Analyse various modules of Fuzzy logic controller.

Text Books:

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda - Jaico Publishing House - 1997.
2. Neural Networks -Fuzzy logic - Genetic algorithms: synthesis and applications by Rajasekharan and Pai – PHI Publication.

Reference Books:

1. Artificial Neural Network – B.Yegnanarayana - PHI - 2012.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – Mc Graw Hill Inc - 1997.
3. Introduction to Neural Networks using MATLAB 6.0 – S N Sivanandam – S. Sumathi - S N Deepa TMGH
4. Introduction to Fuzzy Logic using MATLAB – S N Sivanandam – S. Sumathi - S N Deepa Springer - 2007.

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3

CONCEPTS OF ELECTRIC DRIVES AND ITS APPLICATIONS
(Minors Engineering Course)

Preamble:
This course covers in detail the basic speed control techniques of DC and AC motors using power electronic converters.

Course Objectives:
- To learn the fundamentals of electric drive & different electric braking methods.
- To analyse the operation of phase controlled converter fed DC motor drives.
- To analyze the operation of DC-DC converter fed DC motor drives.
- To illustrate the speed control of induction motor by stator and rotor side control.
- To learn the speed control mechanism of synchronous motors.

UNIT – I
Fundamentals of Electric Drives
Electric drive and its components– Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods**:** Dynamic – Plugging – Regenerative methods.

UNIT – II
Controlled Converter Fed DC Motor Drives
3-phase half and fully-controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics -Numerical problems.

UNIT – III
DC–DC Converters Fed DC Motor Drives
Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current mode of operation - Output voltage and current waveforms – Speed–torque expressions and characteristics.

UNIT – IV
Stator and Rotor side control of 3-phase Induction motor Drive
Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter. Static rotor resistance control– Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics.

UNIT - V
Control of Synchronous Motor Drives
Separate control of synchronous motor – self-control of synchronous motor employing load commutated thyristor inverter - closed loop control of synchronous motor drive (qualitative treatment only).

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Course Outcomes:

After the completion of the course the student should be able to:

- Explain the fundamentals of electric drive and different electric braking methods.
- Analyze the operation of Three-phase converter fed dc motors and four quadrant operations of dc motors using dual converters.
- Describe the DC-DC converter control of dc motors in various quadrants of operation
- Understand `the concept of speed control of induction motor by using AC voltage controllers, voltage source inverters and rotor side control.
- Understand the speed control mechanism of synchronous motors.

Text Books:

1. Fundamentals of Electric Drives – by G K Dubey - Narosa Publications - 2nd edition 2002.
2. Power Semiconductor Drives - by S.B.Dewan - G.R.Slemon - A.Straughen - Wiley-India - 1984.