Program Structure and Syllabus of B. Tech IV-Year (I & II Semesters)

Electrical & Electronics Engineering

R20 Regulations

ANURAG UNIVERSITY

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IV YEAR I SEMESTER **COURSE STRUCTURE**

S. No.	Course Code	Category	Course	Hours per week			Credits
				L	T	P	
1	A57014	PCC	Power System Analysis	3	0	0	3
2	A57015	PCC	Power Semiconductor Drives	3	0	0	3
3	A57016	PEC-III	1. Electrical Distribution Systems	2	0	0	2
	A57017		2. Flexible Alternating Current Transmission System				
	A57018		3. Electromagnetic Waves				
4	A57019	PEC-IV	1. Electrical and Hybrid Vehicles	3	0	0	3
	A57020		2. Power System Dynamics and Control				
	A57021		3. HVDC Transmission Systems				
5	A57022	PEC-V	1. High Voltage Engineering	3	0	0	3
	A57023		2. Smart Grid Technologies				
	A57024		3. AI Techniques in Electrical Engineering				
6	A57025	PEC-VI	1. Utilization of Electrical Energy	3	0	0	3
	A57026		2. Electrical Energy Conservation and Auditing				
	A57027		3. Digital Control Systems				
7	A57203	PCC	Power Systems and Simulation Lab	0	0	3	1.5
8	A57204	PCC	Microprocessor & Microcontroller Lab	0	0	3	1.5
9	A57230	PCC	Industry Oriented Mini Project	0	0	4	2
TOTAL				**17**	**00**	**10**	**22**

IV YEAR II SEMESTER **COURSE STRUCTURE**

S.No	Course Code	Category	Course	Hours per week			Credits
				L	T	P	
1	A58007	OE-II	1. Entrepreneurship Development.	2	1	0	3
	A58008		2. Project Management.				
	A58001		3. Technical and Business Communication.				
2	A58002	OE-III	1. Intellectual Property Rights.	2	1	0	3
	A58009		2. Internet of Things.				
	A58040		3. Nano Science and Nano Technology.				
3	A58201	PROJ	Seminar	0	0	4	2
4	A58202	PROJ	Comprehensive Viva Voce	0	0	0	2
5	A58203	PROJ	Project Work	0	0	20	10
TOTAL				**04**	**02**	**24**	**20**

Power System Analysis

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	Category	Hours / Week			Credits	Marks		
A57014	PCC	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of PSA are:

1. To give idea for the formation of Y-bus by different methods.
2. To provide comprehensive coverage of the power flow solution of an interconnected system using Gauss-Seidal method, NR and Fast Decoupled methods during normal operation.
3. To study fault analysis and symmetrical component theory.
4. To study power system steady state stabilities.
5. To study power system transient state stabilities.

Course Outcomes:

At the end of this PSA course, students will be able to:

1. Formulate different network matrices.
2. Analyze different load flow study methods.
3. Describe different types of faults in power systems and perform short circuit analysis.
4. Explain the concepts of steady state stability and its significance.
5. Analyze the transient stability of power system.

Unit-I:

Power System Network Matrices

Graph theory: Definitions, Bus incidence Matrix, Y_{bus} formation by direct and singular transformation methods, Numerical Problems.

Per unit system representation. Per unit equivalent reactance network of three phase Power System, Numerical Problems.

Unit –II:

Power Flow Studies

Necessity of power flow studies- data for power flow studies- derivation of static load flow equations- load flow solution using Gauss Seidel Method: Acceleration Factor, load flow solution with and without P-V buses, Algorithm and Flowchart, Numerical load flow Solution for Simple Power systems (Max 3- buses): Determination of Bus Voltages, Injected Active and Reactive Powers (one iteration only) and finding line flows and losses for the given Bus Voltages.

Newton Raphson Method in Rectangular and Polar Co-ordinates form: Load flow solution with or without PV busses- Derivation of Jacobian Elements, Algorithm and Flowchart. Decoupled and Fast Decoupled Methods - Comparison of Different Methods

Unit-III:

Short Circuit Analysis

Symmetrical fault Analysis: Short circuit current and MVA Calculations, Numerical Problems.

Symmetrical Component Theory: Symmetrical Component Transformation, Positive, Negative and Zero sequence components: Voltages, Currents and Impedances.

Sequence Networks: Positive, Negative and Zero sequence Networks, Numerical Problems.

Unsymmetrical Fault Analysis: LG, LL, LLG faults with and without fault impedances, Numerical Problems.

Unit-IV:

Power System Steady State Stability Analysis

Elementary concepts of Steady State, Dynamic and Transient Stabilities.

Description of Steady State Stability Power limit, Transfer Reactance, Synchronizing Power Coefficient, Power angle curve and determination of steady state stability and methods to improve steady state stability.

Unit-V:

Power System Transient State Stability Analysis

Derivation of Swing Equation, Determination of Transient Stability by Equal Area Criterion. Application of EAC, Critical Clearing Angle calculation. Solution of swing equation, Point by point method, Methods to improve transient state stability.

Text Books:

1. Modern Power System Analysis- I. J. Nagrath and D. P. Kothari, Tata McGraw-Hill Publishing Company, 2nd edition, 2003.
2. Computer Techniques in Power System Analysis - M. A. Pai, TMH Publications, 2nd edition, 2006.
3. Electrical power systems - by C. L. Wadhwa, New Age International (P) Limited Publishers, 1998.

Reference Books:

1. Computer Methods in Power System Analysis - G. W. Stagg & A. H. El-Abiad, International Student Edition, 1968.
2. Power System Analysis - Grainger and Stevenson, Tata McGraw-Hill Publishing Company, 1st Edition, 2003.
3. Power System Analysis - Hadi Saadat, Tata McGraw-Hill Publishing Company, 2nd Edition, 2002.

Power Semiconductor Drives

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	Category	Hours / Week			Credits	Marks		
A57015	PCC	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of PSD are:

1. To learn DC Drives control by 1-Φ and 3-Φ controlled converters.
2. To understand four quadrant operation of DC drives using Dual converters and choppers.
3. To know control of Induction Motors from stator side.
4. To learn about the control of Induction Motors from rotor side.
5. To gain knowledge about control of Synchronous Motor drive using various Inverters.

Course Outcomes:

At the end of this PSD course, students will be able to:

1. Explain the principle of operation of 1-Φ and 3-Φ rectifier fed separately excited DC motor with necessary equations and wave forms.
2. Describe the four quadrant operation of DC drives when driven by dual converters and choppers.
3. Illustrate the concepts of speed control of induction motor from stator and rotor side.
4. Explain the concepts of speed control of induction motor from rotor side.
5. Describe the speed control of Synchronous motor through self and separate control.

Unit – I:

Control of DC Motors by Single Phase Converters

DC Motors and their performance characteristics, Four quadrant operation a drive- Introduction to Thyristor controlled Drives, 1-Φ Semi and Fully controlled converters connected to separately excited D.C Motor – continuous current operation - Output Voltage and Current waveforms, Voltage, Speed and Torque expressions, Speed - Torque Characteristics- numerical Problems.

Control of DC Motors by Three Phase Converters

3-Φ Semi and Fully controlled converters connected to separately excited D.C Motor – continuous current operation - Output Voltage and Current waveforms, Voltage, Speed and Torque expressions, Speed - Torque Characteristics- numerical Problems.

Unit – II:

Four Quadrant Operation of DC Motors by Dual Converters & Choppers

Introduction to phase controlled four quadrant operation – Four quadrant operation of D.C motors by Dual Converters – Closed loop operation of DC motor in motoring mode (Block Diagram Only). Single quadrant, two quadrant and four quadrant chopper fed separately excited dc motors – Continuous current operation, Output voltage and current wave forms, Voltage, Speed and torque expressions, speed - torque characteristics – numerical Problems.

Unit – III:

Control of Induction Motors-From stator side: Variable Voltage Control of Induction Motor by 3-Φ AC Voltage Controllers – Motoring and Braking modes of Operation, Introduction to V/f control of Induction motors, V/f Control of Induction Motors by Voltage Source Inverter and Current Source Inverter, numerical problems.

UNIT-IV:

Control of Induction Motors-From rotor side: Static Rotor resistance control- Slip power recovery Schemes – Static Scherbius and Static Kramer Drives.

Unit – V:

Control of Synchronous Motors

Separate & Self-control of Synchronous Motors, Operation of self-controlled synchronous motors by Voltage Source Inverter and Current Source Inverter – Load commutated CSI fed Synchronous Motor Operation, Output Voltage and Current Waveforms, Speed - Torque characteristics, Applications and Advantages.

Text Books:

1. Fundamentals of electric Drives – G K Dubey, Narosa publications, 2nd edition, 2002.
2. Elements of Electric Drives – J. B. Gupta, Rajeev Manglik and Rohit Manglik, S. K. Kataria and Sons, 2011.

Reference Books:

1. Electric Motor Drives – Modeling, Analysis and Control – R. Krishnan, Pearson Prentice Hall, 2007.
2. Power Electronics Circuits, Devices and applications - M. H. Rashid, Pearson Education - Third Edition – First Indian reprint 2004.
3. Modern Power Electronic and AC Drives - B. K. Bose, Pearson Publications - 1st Edition.

Electrical Distribution Systems

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A57016	PEC-III	L	T	P	C	CIE	SEE	Total
		2	0	0	2	40	60	100

Course Objectives:

Course Objectives of EDS are:

1. To Know the principles of design and operation of electric distribution systems and feeders.
2. To understand the basic design of distribution substations.
3. To gain knowledge on the purpose of distribution system protection and the principle of coordination between various protective devices
4. To illustrate compensation methods for voltage drops and pf improvements.
5. To learn different voltage control methods.

Course Outcomes:

At the end of this EDS course, students will be able to:

1. Explain the general concepts about distribution systems and feeders
2. Describe the layout of substations and perform system analysis of radial networks and 3-Φ balanced lines.
3. Demonstrate the necessity of protection of various distribution system devices and illustrate coordination of various protective devices.
4. Explain the importance of power factor improvement
5. Describe the principle of various voltage control methods.

Unit – I:

General Concepts

Introduction to distribution systems, Load modeling and characteristics. Coincidence factor, contribution factor, loss factor - Relationship between the load factor and loss factor. Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

Distribution Feeders: Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system.

Unit – II:

Substations

Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

System Analysis: Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

Unit – III:

Protection

Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses; Circuit Reclosures; Line Sectionalizers, and Circuit Breakers.

Coordination: Coordination of Protective Devices: General coordination procedure.

Unit – IV:

Compensation for Power Factor Improvement

Capacitive compensation for power-factor control. Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction, capacitor allocation - Economic justification - Procedure to Determine the best capacitor location.

Unit – V:

Voltage Control

Voltage Control: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop Compensation.

Text Books:

1. Electric Power Distribution system, Engineering – Turan Gonen, McGraw-Hill Book Company, 1986.
2. Electric Power Distribution – A. S. Pabla, Tata McGraw-Hill Publishing Company, 4th Edition, 1997.

Reference Books:

1. Electrical Power Distribution and Automation - S. Sivanagaraju, V. Sankar, Dhanpat Rai & Co., 2006.
2. Electrical Power Distribution Systems - V. Kamaraju, Tata McGraw-Hill Education, 2009.
3. Electrical Power Distribution and Automation by S. Ram Murthy, PHI Publications.

Flexible Alternating Current Transmission System

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A57017	PEC-III	L	T	P	C	CIE	SEE	Total
		2	0	0	2	40	60	100

Course Objectives:

Course Objectives of FACTS are:

1. To study the characteristics of AC transmission and the effect of Shunt and Series Compensation
2. To learn the working principle of shunt devices and their operating characteristics
3. To know the difference between shunt and series FACT devices
4. To acquire the knowledge of VSC based series FACTS controllers
5. To study the application of FACTS devices for Power System Control.

Course Outcomes:

At the end of this FACTS course, students will be able to:

1. Understand the characteristics of AC transmission and the effect of Shunt and Series Compensation
2. Understand the working principle of shunt devices and their operating characteristics
3. Compare the difference between shunt and series FACT devices
4. Explain the application of FACTS devices
5. Identify the application of FACTS devices for Power System Control

Unit –I:

Transmission Lines and Series/Shunt Reactive Power Compensation

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Unit –II:

Thyristor-based Flexible AC Transmission Controllers (FACTS)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and

Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

Unit –III:

Voltage Source Converter based shunt (FACTS) controllers

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM

Unit –IV:

Voltage Source Converter based series (FACTS) controllers:

Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

Unit –V:

Application of FACTS

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Text Books:

1. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
2. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.

References Books:

1. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.
2. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991
3. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.

Electromagnetic Waves

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	Category	Hours / Week			Credits	Marks		
A57018	PEC-III	L	T	P	C	CIE	SEE	Total
		2	0	0	2	40	60	100

Course Objectives:

Course Objectives of EMV are:

1. To learn the concepts of distributed elements in transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
2. To study the solution to real life plane wave problems for various boundary conditions.
3. To provide field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
4. To study the plane waves in different media interface to calculate phase and velocity in different media
5. To analyze TE and TM mode patterns of field distributions in a rectangular wave-guide. Understand and analyze radiation by antennas.

Course Outcomes:

At the end of this EMV course, students will be able to:

1. Analyze transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
2. Provide solution to real life plane wave problems for various boundary conditions.
3. Analyze the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
4. Analyze the plane waves in different media interface to calculate phase and velocity in different media
5. Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide. Understand and analyze radiation by antennas.

Unit-I:

Transmission Lines

Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a

transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Unit-II:

Maxwell's Equations

Basic quantities of Electro magnetics, Basic laws of Electro magnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

Unit-III:

Uniform Plane Wave

Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Unit-IV:

Plane Waves at Media Interface

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

Unit-V:

Waveguides

Parallel plane waveguide: Transverse Electric (TE) mode, Transverse Magnetic (TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

Text Books:

1. R. K. Shevgaonkar, **"**Electromagnetic Waves**"**, Tata McGraw Hill, 2005.
2. D. K. Cheng, "Field and Wave Electromagnetics**"**, Addison-Wesley, 1989.

Reference Books:

1. M. N. O. Sadiku, "Elements of Electromagnetics**"**, Oxford University Press, 2007.
2. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.
3. C. A. Balanis, "Antenna Theory: Analysis and Design**"**, John Wiley & Sons, 2005.

Electrical and Hybrid Vehicles

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	Category	Hours / Week			Credits	Marks		
A57019	PEC-IV	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of EHV are:

1. To learn about the comprehensive overview of hybrid Electrical Vehicles.
2. To present about the Hybrid Electrical Drive Trains.
3. To understand about the configuration and control of Trains.
4. To know about Energy Storage requirements in Hybrid & Electric Vehicles.
5. To illustrate about Energy Management Strategies.

Course Outcomes:

At the end of this EHV course, students will be able to:

1. Explain the importance of hybrid and electric vehicles.
2. Illustrate the drive-train topologies of electric vehicles & hybrid vehicles.
3. Demonstrate the configuration and control of various electrical machines used in electric drive-trains.
4. Choose proper Energy Storage systems for vehicles applications.
5. Identify various energy management strategies.

Unit- I:

Introduction:

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Unit- II:

Hybrid Electric Drive-Trains

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic

concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Unit- III:

Electric Trains

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit- IV:

Energy Storage

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Unit- V:

Energy Management Strategies

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles, Design fundamentals, CRC Press 2003.
2. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.

References Books:

1. James Lerminie, John Lowry, Electric Vehicle Technology, Explained Wiley, 2003.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.

Power System Dynamics and Control

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A57020	PEC-IV	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of PSDC are:

1. To understand the concept of Control and Operation of Power System, Power System Dynamic Model.
2. To impart knowledge on modeling of Synchronous Machine Models, controllers.
3. To have knowledge on modeling of power system components.
4. To know the stability analysis of Power System.
5. To understand the planning measures of stability.

Course Outcomes:

At the end of this PSDC course, students will be able to:

1. Understand concept of Control and Operation of Power System.
2. Understand the Power System Dynamic Model to find solution with different technique.
3. Analyze the analysis of Synchronous Machine Models, excitation System, Speed Governing Model.
4. Discuss the modeling of Transmission Lines and Loads stability.
5. Analyze the angle stability and voltage of Power System.

Unit-I:

Introduction to Power System Operations

Introduction to power system stability. Power System Operations and Analysis of linear Dynamical Systems & Numerical Methods Control. Stability problems in Power System. Impact on Power System Operations and control.

Analysis of Linear Dynamical System and Numerical Methods

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

Unit-II:

Modeling of Synchronous Machines and Associated Controllers

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

Unit-III:

Modeling of Power System Components

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads.

Unit-IV:

Stability Analysis

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

Unit-V:

Enhancing System Stability

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

Text Books:

1. K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.
2. P. Kundur, "Power System Stability and Control", McGraw Hill, 1995.

Reference Books:

1. P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997
2. P.M .Anderson & A.A. Fouad, "Power System Control & Stability", IEEE Press
3. R. Ramanujam," Power System Dynamics", PHI publications.

HVDC Transmission Systems

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	Category	Hours / Week			Credits	Marks		
A57021	PEC-IV	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of HVDC Transmission Systems are:

1. To understand the concepts of HVDC transmission, types of HVDC links, apparatus required for HVDC Transmission.
2. To get the Knowledge on analysis of various converters used in HVDC systems.
3. To study the concepts of Reactive power requirement and control in HVDC systems.
4. To introduce the concepts of Protection of various converters used in HVDC systems against over currents and voltages.
5. To gain the Knowledge on causes of harmonics and filter design concepts.

Course Outcomes:

At the end of this HVDC Transmission Systems course, students will be able to:

1. Classify different types of HVDC links, compare AC&DC Transmission systems.
2. Analyze various types of HVDC converters.
3. Identify the importance of reactive power control in HVDC systems and provide the solution for power flow problem in HVDC Network.
4. Categorize various types of converter faults and choose the type of protection scheme.
5. Investigate the causes of harmonics and design the suitable filter to mitigate concerned harmonics.

Unit – I:

Introduction to HVDC Transmission systems

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C Transmission.

Unit – II:

Analysis of HVDC Converters, Converter Control

Choice of Converter configuration – Analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters – Cases of two 3 phase converters in star –star mode – their performance.

Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control.

Unit-III:

Reactive Power Control in HVDC & Power Flow Analysis

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies-sources of reactive power-AC Filters – shunt capacitors-synchronous condensers. Modeling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow.

Unit-IV:

Converter Fault & Protection

Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference.

Unit –V:

Harmonics & Filters

Generation of Harmonics – Characteristics harmonics, calculation of AC Harmonics, Non-Characteristics harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics.

Types of AC filters, Design of Single tuned filters –Design of High pass filters.

Text Books:

1. HVDC Transmission – S. Kamakshaiah and V. Kamaraju – TMH – 2011.
2. EHVAC and HVDC Transmission Engineering and Practice – S. Rao, Khanna Publishers, 1990.

Reference Books:

1. HVDC Transmission – J. Arrillaga, IEE, 2nd Edition, 1998.
2. Direct Current Transmission – E. W. Kimbark, Volume I, John Wiley & Sons, 1971.
3. Power Transmission by Direct Current – E. Uhlmann, B. S. Publications.
4. HVDC Power Transmission Systems: Technology and system Interactions – K. R. Padiyar, New Age International (P) Limited, 1990.

High Voltage Engineering

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A57022	PEC-V	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of HVE are:

1. To know High Voltage Engineering & its applications.
2. To get the knowledge of dielectric materials.
3. To study the generation and measurement of high voltages and currents.
4. To understand the over voltage phenomena and insulation co-ordination.
5. To understand the need for testing high voltage equipment's for their withstanding capability.

Course Outcomes:

At the end of this HVE course, students will be able to:

1. Explain the concepts of high voltage technology and its applications.
2. Describe the properties and applications of gaseous, liquid and solid dielectrics.
3. Explain the concepts of generation and measurement of high voltages and currents.
4. Analyze the over voltage phenomena and insulation coordination.
5. Describe the methods of high voltage testing of materials and electrical apparatus.

Unit I:

Introduction to High Voltage Technology and Applications

Electric Field Stresses, Gas / Vaccum as Insulator, Liquid Dielectrics, Solids and Composites, Estimation and Control of Electric Stress, Numerical methods for electric field computation, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.

Unit II:

Break Down in Gaseous, Solid and Liquid Dielectrics

Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids. Intrinsic breakdown, electromechanical breakdown, thermal breakdown,

breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.

Unit III:

Generation and Measurements of High Voltages and Currents

Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators. Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.

Unit IV:

Over Voltage Phenomenon and Insulation Co-ordination

Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.

Unit V:

Non-Destructive and High Voltage Testing of Material and Electrical Apparatus

Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements. Testing of Insulators and bushings, Testing of Isolators and circuit breakers, Testing of cables, Testing of Transformers, Testing of Surge Arresters, Radio Interference measurements.

Text Books:

1. High Voltage Engineering - M. S. Naidu and V. Kamaraju – TMH Publications, 3rd Edition, 2009.
2. High Voltage Engineering: Fundamentals - E. Kuffel, W. S. Zaengl, J. Kuffel, Elsevier publications, 2nd Edition, 2000.

Reference Books:

1. High Voltage Engineering - C. L. Wadhwa, New Age Internationals (P) Limited, 1997.
2. High Voltage Insulation Engineering - Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.
3. High Voltage Engineering, theory and Practice, Mazen Abdel Salan, Hussian Anis, Andan Ei Morshedy, Roshdy Radwan, Marcel Dekker, Taylor and Francis.

Smart Grid Technologies

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A57023	PEC-V	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of SGT are:

1. To study the difference between conventional grids and smart grids and its self-healing capacity.
2. To know the importance of smart grid components in deployment of smart grids.
3. To know the importance of intelligent electronic devices and their applications for monitoring and protection.
4. To acquire knowledge on role of communication technologies in the deployment of sustainable smart grids.
5. To acquire knowledge on power quality issues of integrated smart grids for control and monitoring.

Course Outcomes:

At the end of this SGT course, students will be able to:

1. Explain the difference between conventional grids and smart grids and its self-healing capacity.
2. Demonstrate the importance of smart grid components in deployment of smart grids.
3. Illustrates the importance of intelligent electronic devices and their applications for monitoring and protection.
4. Understand the importance of communication infrastructure in deployment of smart grids.
5. Analyze power quality issues of integrated smart grids for control and monitoring.

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 in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.

Unit II:

Smart Grid Technologies

Part 1: Introduction to Smart Meters, Real Time Prizing, 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.

Unit III:

Smart Grid Technologies

Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Phase Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS).

Unit IV:

Communication Technologies in Smart Grid

Classification of power system communication according to their functional requirements, Existing electric power system communication infrastructure and its limitation, Smart Grid communication system infrastructure, Standards for information exchange, Fiber Optical Networks, WAN based on Fiber optical networks, IP based Real Time data Transmission, Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Broadband over Power Line (BPL), IP based protocols.

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.

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley.

Reference Books:

1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011.
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press.
3. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication.

AI Techniques in Electrical Engineering

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A57024	PEC-V	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of AI Techniques in Electrical Engineering are:

1. To locate soft commanding methodologies, such as artificial neural networks, Fuzzy Logic and Genetic Algorithms.
2. To observe the concepts of feed forward neural networks and about feedback neural networks.
3. To practice the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control
4. To analyze genetic algorithm, genetic operations and genetic mutations
5. To acquire knowledge on Applications of AI Techniques

Course Outcomes:

At the end of this AI Techniques in Electrical Engineering course, students will be able to:

1. Understand feed forward neural networks, feedback neural networks and learning techniques.
2. Analyze fuzziness involved in various systems and fuzzy set theory
3. Develop fuzzy logic control for applications in electrical engineering
4. Develop genetic algorithm for applications in electrical engineering.
5. Understand the Applications of AI Techniques

UNIT – I:

Artificial Neural Networks: Introduction-Models of Neural Network - Architectures – Knowledge representation – Artificial Intelligence and Neural networks – Learning process – Error correction learning – Hebbian learning – Competitive learning — Supervised learning – Unsupervised learning – Reinforcement learning - learning tasks.

UNIT- II:

ANN Paradigms : Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network.

UNIT – III:

Fuzzy Logic: Introduction – Fuzzy versus crisp – Fuzzy sets - Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy Cartesian Product – Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers - Fuzzy Inference - Fuzzy Rule based system - Defuzzification methods.

UNIT – IV:

Genetic Algorithms: Introduction-Encoding – Fitness Function-Reproduction operators - Genetic Modeling – Genetic operators - Crossover - Single–site crossover – Two-point crossover – Multi point crossover-Uniform crossover – Matrix crossover - Crossover Rate - Inversion & Deletion – Mutation operator –Mutation – Mutation Rate-Bit-wise operators - Generational cycle-convergence of Genetic Algorithm.

UNIT–V:

Applications of AI Techniques: Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control – speed control of DC and AC Motors.

TEXT BOOK:

1. S. Rajasekaran and G. A. V. Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms"- PHI, New Delhi, 2003.

REFERENCE BOOKS:

1. P. D. Wasserman, Van Nostrand Reinhold, "Neural Computing Theory & Practice" - New York, 1989.
2. Bart Kosko, "Neural Network & Fuzzy System" Prentice Hall, 1992.
3. G. J. Klir and T. A. Folger,"Fuzzy sets, Uncertainty and Information" - PHI, Pvt. Ltd, 1994.
4. D. E. Goldberg, "Genetic Algorithms" - Addison Wesley 1999.

Utilization of Electrical Energy

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A57025	PEC-VI	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of UEE are:

1. To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading conditions.
2. To acquaint with the different types of heating and welding techniques.
3. To study the basic principles of illumination and its measurement and to understand different types of lightning system including design.
4. To understand the basic principle of electric traction including speed–time curves of different traction services.
5. To acquaint with the different types of Tractive efforts & estimate specific energy consumption level at various modes of operation.

Course Outcomes:

At the end of this UEE course, students will be able to:

1. Analyze right drive for a particular application and able to design suitable schemes for Electrical welding, heating, drives, illumination and traction
2. Describe various methods of heating & welding of electrical equipment's.
3. Design Illumination systems for various applications.
4. Discuss about various Methods of braking system of electric traction and understand the speed-time characteristics of different services in traction systems.
5. Solve the mathematical aspects involved in tractive effort and specific energy consumption.

Unit – I:

Electric Drives

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, types of industrial loads, continuous, intermittent and variable loads, load equalization, applications of electric drives.

Unit – II:

Electric Heating & Welding

Advantages and methods of electric heating, Resistance heating, Induction heating and Dielectric heating. Electric welding, Resistance and Arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

Unit – III:

Illumination Fundamentals & Methods

Introduction, terms used in illumination, laws of illumination, polar curves, Discharge lamps, MV, SV and LED lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of interior lighting and flood lighting.

Unit – IV:

Electric Traction – I

System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking, plugging, rheostatic braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves.

Unit – V:

Electric Traction-II

Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and coefficient of adhesive.

Text Books:

1. Utilization of Electric Energy – E. Openshaw Taylor, Orient Longman Private Limited, 1971.
2. Art & Science of Utilization of electrical Energy – Partab, Dhanpat Rai & Sons, 2nd edition, 1986.

Reference Books:

1. Generation, Distribution and Utilization of electrical Energy – C. L. Wadhwa, New Age International (P) Limited, Publishers, 1997.
2. Utilization of Electrical Power including Electric drives and Electric traction – by N. V. Suryanarayana, New Age International (P) Limited, Publishers, 1996.
3. Utilization of Electrical Power & Electrical traction – JB Gupta, SK Kataria & sons- eight edition

Electrical Energy Conservation and Auditing

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A57026	PEC-VI	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of EEC & A are:

1. To gain knowledge to the students about current energy scenario, energy conservation audit and management.
2. To gain knowledge and skills support assessing the energy efficiency, energy auditing and energy management.
3. To study different techniques for maximizing the efficiency in electrical systems.
4. To obtain basic knowledge of various energy efficient technologies in electrical systems.
5. To learn different industrial applications for estimating the energy.

Course Outcomes:

At the end of this EEC & A course, students will be able to:

1. Explain present energy scenario.
2. Explain the concepts of Energy Management.
3. Apply the methods for improving energy efficiency in different Electrical Systems.
4. Differentiate the methods of improving energy efficiency in different Industrial Systems.
5. Use different energy efficient devices for various applications.

Unit-I:

Energy Scenario

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Unit-II:

Energy Management & Audit

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system

efficiencies, optimizing the input energy requirements, fuel energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Unit-III:

Energy Efficiency in Electrical Systems

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Unit-IV:

Energy Efficiency in Industrial Systems

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Unit-V:

Energy Efficient Technologies in Electrical Systems

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Text Books:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)

Reference Books:

1. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org.

Digital Control Systems

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	Category	Hours / Week			Credits	Marks		
		L	T	P	C	CIE	SEE	Total
A57027	PEC-VI	3	0	0	3	40	60	100

Course Objectives:

Course Objectives of DCS are:

1. To gain knowledge about Discrete representation of continuous system
2. To know about Discrete System analysis
3. To gain knowledge about stability of Discrete time system.
4. To acquire knowledge about state space approach for discrete time systems
5. To know about design of digital control system.

Course Outcomes:

At the end of this DCS course, students will be able to:

1. Demonstrate discrete representation of continuous system.
2. Apply the knowledge of Discrete System analysis.
3. Determine stability of discrete systems.
4. Apply state space approach for discrete systems.
5. Design a control system.

Unit I:

Discrete Representation of Continuous Systems

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modeling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency, ZOH equivalent.

Unit II:

Discrete System Analysis

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Unit III:

Stability of Discrete Time System

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

Unit IV:

State Space Approach for discrete time systems

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Unit V:

Design of Digital Control System

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

Text Books:

1. K. Ogata, "Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.
2. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.

Reference Books:

1. G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley, 1998.
2. B.C. Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.
3. Discrete Time Control Systems by K. Ogata, Dorling Kindersley Pvt. Ltd.

Power Systems and Simulation Lab

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A57203	PCC	L	T	P	C	CIE	SEE	Total
		0	0	3	1.5	40	60	100

Course Objectives:

Course Objectives of PS & Simulation Lab are:

1. To understand generator and transformer protection system.
2. To understand the performance characteristics of various types of relays.
3. To use software packages to find solutions to Power System problems.
4. To perform load flow studies and short circuit analysis using appropriate software.
5. To study the design and modeling of transmission line parameters.

Course Outcomes:

At the end of this PS & Simulation Lab course, students will be able to:

1. Understand power industry practices for design, operation and planning.
2. Analyze the performance characteristics of various types of relays.
3. Use software packages to find solutions to Power System problems.
4. Apply knowledge of load flows for planning and future expansion of Power Systems.
5. Design and modeling of transmission line parameters

.List of Experiments

1. Performance and Testing of Transmission Line Model.
2. Determination of Transmission Line Parameters.
3. Characteristics of Over Current Relay.
4. Performance and Testing of Generator Protection System.
5. Develop MATLAB program for Y BUS formation and G-S Load Flow Analysis.
6. Develop MATLAB program for N-R and FDLF Load Flow Analysis.
7. Develop MATLAB program for Short Circuit Analysis.
8. Transient Stability Analysis for Single Machine connected to Infinite Bus by Point by Point Method.
9. Load Frequency Control of Multi Area Systems in MATLAB/SIMULINK.
10. Load Flow Analysis Using ETAP.
11. Short Circuit Analysis Using ETAP.
12. Transient Stability Analysis Using ETAP.

NOTE: - From the above any 10 Experiments have to be conducted

Microprocessor & Microcontroller Lab

B. Tech IV Year I Semester					Dept. of Electrical & Electronics Engineering			
Code	Category	Hours / Week			Credits	Marks		
A57204	PCC	L	T	P	C	CIE	SEE	Total
		0	0	3	1.5	40	60	100

Course objectives:

1. To understand the fundamentals of assembly level programming of microprocessor.
2. To understand the concepts of Assembly language programming and its applications.
3. To learn to develop the assembly level programming using 8086 instruction set.
4. To learn to develop the assembly level programming using 8051 instruction set.
5. To learn to interface peripherals with 8086 and 8051.

Course outcomes:

At the end of this PS-II course, students will be able to:

1. Build a program on a microprocessor using instruction set of 8086.
2. Analyze the problems and apply a combination of hardware and software to address the problem.
3. Contrast how different I/O devices can be interfaced to processor and will explore several techniques of interfacing.
4. Experiment with standard microprocessor interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters.
5. Design 8051 microcontroller interface with I/O peripherals.

List of Experiments:

The Following programs/experiments are to be written for assembler and execute the same with 8086 Microprocessor and 8051 microcontroller.

1. Programs for 16 bits arithmetic operations for 8086 (using Various Addressing Modes).

2. Program for sorting an array and to generate Fibonacci series for 8086.

3. Programs for string manipulations for 8086.

4. Program for digital clock design using 8086.

5. Interfacing ADC and DAC to 8086.

6. Parallel communication between two microprocessors using 8255.

7. Interfacing to 8086 and programming to control stepper motor using.

8. To interface Seven Segment Display using 8086

9. Programming using arithmetic, logic and bit manipulation instructions of 8051.

10. Program and verify Timer / Counter in 8051.

11. Program and verify Interrupt handling in 8051.

12. UART Operation in 8051.

13. LCD interface with 8051.

14. Keypad Interface with 8051.

LAB Note: Minimum of 12 experiments to be conducted.

Entrepreneurship Development

B. Tech IV Year II Semester					Dept. of Electrical & Electronics Engineering			
Code	Category	Hours / Week			Credits	Marks		
A58007	OE-II	L	T	P	C	CIE	SEE	Total
		2	1	0	3	40	60	100

Course Objectives:

Course Objectives of ED are:

1. To provide insights into basic characteristics and process of entrepreneurship.
2. To develop a business idea and prepare a bankable project report.
3. To identify the methods to initiate ventures and the sources of finance.
4. To create awareness about the legal challenges of entrepreneurship and IPR.
5. To know and apply the various strategic and managerial concerns in the growth stage of the firms.

Course Outcomes:

At the end of this ED course, students will be able to:

1. Interpret concepts and process of entrepreneurship.
2. Apply idea development strategies and prepare a bankable project report.
3. Analyse various opportunities towards initiating ventures.
4. Recognize legal challenges of entrepreneurship.
5. Assess the strategic perspectives of entrepreneurship.

Unit- I:

Introduction

Introduction to Entrepreneurship – Characteristics, Qualities, Key Elements and Skills of an Entrepreneur, entrepreneurial stress, Corporate entrepreneurship, Entrepreneurial process.

Unit –II:

Business Plan Preparation

Search for business idea, project identification, project formulation and development, contents of business plan and Preparation of a Bankable Project Report.

Unit-III:

Launching Entrepreneurial Venture

Opportunities identification, Methods to initiate Ventures, Creating new ventures, Acquiring existing ventures, Franchising. Sources of finance, Forms of capital requirements, funding agencies and supporting institutions.

Unit IV:

Legal challenges of Entrepreneurship

Intellectual Property Protection – Patents, Copyrights, Trademarks and Trade Secrets. The challenges of new Venture Startups- Poor financial understanding, critical factors for new venture development, Evaluation process, Feasibility criteria approach.

Unit V:

Strategic perspectives in Entrepreneurship

Strategic planning- Strategic Action, Strategic Positioning, Business Stabilization, Building the adaptive firms, understanding the growth stage, unique managerial concern of growing ventures.

Text Books:

1. D F Kuratko and T V Rao "Entrepreneurship- A South-Asian Perspective "Cengage Learning, 2012
2. Vasant Desai, Small Scale Industries and Entrepreneurship, HPH, 2012.

References Books:

1. Rajeev Roy, Entrepreneurship, 2e, Oxford, 2012.
2. B.Janakiram and M.Rizwana, Entrepreneurship Development: Text& Cases, Excel Books, 2011.
3. Stuart Read, Effectual Entrepreneurship, Routledge, 2013.
4. Robert Hisrich et al, Entrepreneurship, 6e, TMH, 2012.
5. Nandan H, Fundamentals of Entrepreneurship, PHI, 2013
6. Shejwalkar, Entrepreneurship Development, Everest, 2011
7. Khanka, Entrepreneurship Development, S. Chand, 2012

Project Management

B. Tech IV Year II Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A58008	OE-II	L	T	P	C	CIE	SEE	Total
		2	1	0	3	40	60	100

Course Objectives:

Course Objectives of PM are:

1. To understand the concept of Project Management.
2. To know about the different approaches to project screening and planning.
3. To explain about the factors of risk involved in project execution.
4. To understand about team leading and functional cooperation.
5. To know about the project performance and future trends in the project management.

Course Outcomes:

At the end of this PM course, students will be able to:

1. Explain about the life cycle and other concepts of Project Management.
2. Apply different approaches to project screening and planning
3. Analyze different risk factors in project execution
4. Estimate how to lead a team, to get functional cooperation
5. Build performance evaluation reports and future trends in project management.

Unit-I:

Introduction

Meaning, Need, Principles Project Lifecycle and its Phases, Project Management Research in brief, Project Management today, Organization strategy and structure and culture, Format of organization structure, Stake holder Management, Organization Culture, creating a culture for Project Management.

Unit-II:

Project Identification and Planning

Defining the project, Project Identification Process, Approaches to Project Screening and Selection, Project Planning, Work Breakdown Structure, Financial Module, Getting Approval and Compiling a Project Charter, setting up a Monitoring and Controlling Process.

Unit-III:

Project Execution

Initiating the Project, Controlling and Reporting Project Objectives, Conducting project evaluation, Risk, Risk Management Factors, Project Management, Four Stage Process, Risk Management an Integrated Approach, Cost Management, Creating a Project Budget.

Unit-IV:

Leading Project Teams

Building a Project Team, Characteristics of an effective Project Team, achieving Cross- Functional Co-operation, Virtual Project Teams, Conflicts Management, Negotiations.

Unit-V:

Performance Measurement and Evaluation

Monitoring Project Performances, Project Control Cycles, and Earned Value Management, Human factors in Project Evaluation and Control, Project Termination, Types of Project Terminations, Project Follow-up. Current and Future Trends in Project Management.

Text Books:

1. Gray, Larson, Project Management, Tata McGraw Hill, 2015
2. Jeffery K. Pinto, Project Management, Pearson Education,2015

References Books:

1. Enzo Frigenti, Project Management, Kogan, 2015
2. R. Panneerselvam & P. Senthil Kumar, Project Management, PHI, 2015
3. Thomas M. Cappels, Financially Focused Project Management, SPD, 2008.

Technical and Business Communication Skills

B. Tech IV Year II Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A58001	OE-II	L	T	P	C	CIE	SEE	Total
		2	1	0	3	40	60	100

Introduction

The course is intended to expose the students to learn and practice the five communication skills thinking, listening, speaking reading, and writing in English, the global language of communication. It reflects some of the approaches in English language teaching and learning currently in practice around the world.

Objective:

Course Objectives of T & BCS are:

To help the students to develop effective communication skills in all communicative contexts for professional advancement.

Course Outcomes:

At the end of this T & BCS course, students will be able to:

1. communicate technical and business correspondence
2. reflect on the themes discussed
3. recognize ethical implications of technical communication in professional contexts
4. identify the contemporary issues in engineering from environmental, societal, economic, and global perspectives
5. demonstrate ethical decisions in complex situations

UNIT-I:

E-World & E-Communication

E-language - E-governance - E-commerce/E-business - E-banking - E-waste

UNIT-II:

Business Establishment & Infrastructure Development

Power Supply - Industrial Park - Business Correspondence: Follow-up letters - Acceptance & Rejections - Persuasive letters - Resignation letters

UNIT-III:

Technology and Society

Robot Soldiers - For a Snapshot of a Web - Placing an order - Proposal Writing - Patents & Rights (National & International) - Intellectual Property - Nanotechnology

UNIT-IV:

Ethics in Business Communication

Ethical issues involved in Business Communication - Ethical dilemmas facing managers - Ethical Code & Communication - Standards in Daily Life - Total Quality Management - World University Ranking

UNIT-V:

Management Information System

Corporate Governance - Business Process Outsourcing - Project Management Communication - Marketing Communication

Textbooks:

1. English and Communication Skills for Students of Science and Engineering by S P Dhanavel. Orient Black Swan. 2009.

Reference Books:

1. Business Communication (Second Edition) by Meenakshi Raman & Prakash Singh by Oxford University Press. 2012.
2. Language and Communication skills for Engineers by Sanjay Kumar & Pushp Lata by Oxford University Press. 2018.
3. Business Communication by Anjali Kalkar, et.al. Orient BlackSwan. 2010.
4. Technical Communication by Paul V. Anderson. Cengage. 2014.
5. Engineering Communication by Charles W. Knisely & Karin I. Knisely. Cengage. 2015.

Intellectual Property Rights

B. Tech IV Year II Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A58002	OE-III	L	T	P	C	CIE	SEE	Total
		2	1	0	3	40	60	100

Course Objectives:

Course Objectives of IPR are:

1. To understand the concepts of Intellectual Property Rights and related agencies.
2. To know about the purpose and functions of Trademarks in competitive environment
3. To explain the process of Patent and Copyrights and related procedures
4. To know the Trade Secret Law and its protection from Unfair practices.
5. To get knowledge on the overview of International Intellectual Property Scenario.

Course Outcomes:

At the end of this IPR course, students will be able to:

1. Explain the concepts of Intellectual Property Rights and related agencies.
2. Describe the purpose and functions of Trademarks in Competitive Environment
3. Analyze the process of Patent and Copyrights and related procedures
4. Explore the Trade secret law and its protection from Unfair practices
5. Explain the overview of International Intellectual Property Scenario

Unit -I:

Introduction to Intellectual Property

Introduction, Types of Intellectual Property, International Organization, Agencies and Treaties, Importance of Intellectual Property Rights.

Unit -II:

Trademarks

Purpose and Function of Trademarks, Acquisition of Trademarks Rights, Protectable Matter, Selecting and Evaluating Trade Mark, Trade Mark Registration Processes.

Unit-III:

Law of Copy Rights & Patents

Fundamental of Copy Rights Law, Originality of Material, Rights of Reproduction, Rights to Perform the Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice of Copy Right, International Copy Right law. Foundation of Patent Law, Patent Searching Process, Ownership Rights & Transfer.

Unit- IV:

Trade Secrets & Unfair Competition

Trade Secret Law, Determination of Trade Secret Status, Liability for Misappropriation Right of Trade Secrets, Protection for Submission, Trade Secret Litigation. Misappropriation Right of Publicity, False Advertising.

Unit- V:

New Development & International Overview on Intellectual Property

New Developments in Trade Mark Law, Copy Right Law, Patent Law, and Intellectual Property Audits. International Trade Mark Law, Copy Right Law, International Patent Law, International Development in Trade Secrets Law.

Text Books:

1. Deborah. E. Bouchoux, Intellectual Property Rights, Cengage learning
2. Prabuddha Gangulli, Intellectual Property Rights Unleashing the knowledge economy, Tata McGraw Hill Publishing Company Ltd.

References Books:

1. Khushdeep Dharni and Neeraj Pandey, Intellectual Property Rights, PHI Learning Pvt. Ltd.
2. Vivien Irish, Intellectual Property Rights for Engineers, 2nd edn, IET, 2005
3. Carlos Alberto Primo Braga, Carsten Fink, Claudia Paz Sepulveda, Intellectual Property Rights and Economic Development, World Bank Publications, 2000

Internet of Things

B. Tech IV Year II Semester					Dept. of Electrical & Electronics Engineering			
Code	Category	Hours / Week			Credits	Marks		
A58009	OE-III	L	T	P	C	CIE	SEE	Total
		2	1	0	3	40	60	100

Course Objectives:

Course Objectives of IOT are:

1. To understand the basics of Internet of Things.
2. To get an idea of some of the application areas where Internet of Things can be applied.
3. To understand the middleware for Internet of Things.
4. To understand the concepts of Web of Things.
5. To understand the concepts of Cloud of Things with emphasis on Mobile cloud computing.

Course Outcomes:

At the end of this IOT course, students will be able to:

1. Identify and design the new models for market strategic interaction.
2. Design business intelligence and information security for WoB.
3. Analyze various protocols for IoT.
4. Design a middleware for IoT.
5. Analyze and design different models for network dynamics.

Unit I:

Introduction to Internet of Things (IoT)

Definition and characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels and Deployment Templates.

Unit II :

Domain Specific IoTs

Introduction, Home Automation, cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle.

IoT and M2M

Introduction to M2M, Difference between IoT and M2M, SDN and NFV to IoT. Basics of IoT System Management with NETCOZF

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Unit III:

Developing Internet of Things:

IoT Platform Design Methodology, Introduction, IoT Design Methodology, Case Study on the IoT System for Whether Monitoring, Motivation for using Python.

Unit IV:

IoT Systems

Logical Design using Python, Introduction, Installing Python, Python Data Types and Data Structures, Control Flow and Functions, Modules , Packages, File Handling, Date/Time Operations, Classes, Python packages of Internet of Things, JSON, XML, HTTP, Lib and URL lib, SMTP lib.

Unit V:

IoT Physical Device and Endpoints

What is an IoT Device, Exemplary Device: Raspberry P_i about Raspberry Board, Linux on Raspberry P_i, Raspberry P_i Interfaces, Serial, SPI, I2C. Programming Raspberry P_i with Python, Other IoT Devices.

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hands –on approach, Universities Press, 2015.

Reference Books:

1. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Springer – 2011
3. David Easley and Jon Kleinberg, Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press, 2010
4. Olivier Hersent, Omar Elloumi and David Boswarthick, The Internet of Things: Applications to the Smart Grid and Building Automation, Wiley, 2012

Nano Science and Nano Technology

B. Tech IV Year II Semester					Dept. of Electrical & Electronics Engineering			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A58040	OE-III	L	T	P	C	CIE	SEE	Total
		2	1	0	3	40	60	100

Course Objectives:

Course Objectives of NSNT are:

1. To provide the most exciting and novel properties at nanoscale regime.
2. To explain the interdisciplinary issues in Nano scale science and technology.
3. To discuss about the basics of nanotechnology.
4. To classify and explain the various properties of nanomaterials.
5. To describe the various methods for synthesis of nanomaterials and their applications.

Course Outcomes:

At the end of this NSNT course, students will be able to:

1. Explain the concepts and applications of nanotechnology and the growth techniques of nano materials.
2. Apply the materials in the nano scale.
3. Discuss about Synthesis Techniques of nano materials.
4. Classify the different characterization techniques of nano materials.
5. Explain the applications in the fields of automobiles, textiles and energy.

Unit I:

Introduction:

History and Scope, Can Small Things Make a Big Difference?

Quantum confinement, Surface area to Volume ratio, Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges and Future Prospects.

Unit II:

Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials:

Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations.

Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility.

Magnetic Properties: Soft magnetic nano crystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

Unit III:

Synthesis Routes: Bottom up approaches:

Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly,

Top down approaches: Mechanical alloying, Nano-lithography.

Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

Unit IV:

Tools to Characterize nanomaterials:

X-Ray Diffraction (XRD), Small Angle X-ray Scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nano indentation.

Unit V:

Applications of Nanomaterials:

Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water-Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

Text Books:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

References Books:

1. Nano: The Essentials by T. Pradeep, McGraw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact– Ed. Challa S.,S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.