K. S. R. M. College of Engineering - KADAPA

(AUTONOMOUS)

Detailed Syllabus for B. Tech. (Regular) (R18)

Department of Electrical & Electronics Engineering

B. Tech – VII Semester (Theory - 5, Lab - 3, Project - I Stage)

S. No.	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	1825701	Project Management	HSMC	3	0	0	30	70	3
2	1802702	Utilization of Electrical Power	PCC	3	0	0	30	70	3
3		**Professional Elective -III (PE - III)**							
	1802703	Flexible AC Transmission System	PEC	3	0	0	30	70	3
	1802704	Power Quality	PEC	3	0	0	30	70	3
	1802705	Digital Control Systems	PEC	3	0	0	30	70	3
	1802706	Digital Signal Processing	PEC	3	0	0	30	70	3
	1802707	Smart Grid	PEC	3	0	0	30	70	3
4	--	**Open Elective - II (OE-II)**	OEC	3	0	0	30	70	3
5	--	**Open Elective - III (OE-III)**	OEC	3	0	0	30	70	3
6	1802708	LabView Programming	ESC	0	0	3	50	50	1.5
7	1802709	Power Systems -II Lab	PCC	0	0	3	50	50	1.5
8	1824710	Effective Technical Communication Skills Lab	HSMC	0	0	2	50	50	1
8	1802711	Project Stage - I	PROJ	0	0	6	100	00	3
9	18997M3	Universal Human Values	MC	2	0	0	30	00	0
Total				19	00	10	380	450	22

Course Title	**Project Management**					**B. Tech. VII Semester**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
1825701	**Humanities & Social**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**

	Sciences (HSMC)	**3**	**0**	**0**	**3**	**70**	**30**	**100**
Mid Exam Duration : 2Hrs						**External Exam Duration: 3Hrs**		

Course Objectives: The main objective of the course is to learn

- To impart the basic concepts of Project selection.
- To develop an understanding of Project Planning and design, construction and execution, monitoring and control, completion.
- To achieve the Projects main goal within the constraints.
- To optimize the allocated necessary inputs.
- To shape and reform the clients vision or to negotiate with them as regards the project's objectives.

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

CO 1	**Remembering** and **recalling** the principles of project management and methods involved in the process of project management.

CO 2	**Understanding** of Project Planning, design, construction, execution, maintaining and controlling
CO 3	**Applying** techniques in Project Evaluation, Scheduling and controlling.
CO 4	**Classifying** and **analysis** risks in Project management and project scheduling

UNIT - I

Introduction to Project Management: Need for Project management, Taxonomy of project, Project life cycle, Project management Process, Principles of Project Management. Project Identification and Selection, Pre – feasibility study, Project Planning Process, Resources allocation, Project Break-even Point.

UNIT - II

Financial Evaluation of Projects: Cost of the Project, Means of finance, Financial Evaluation of projects – Payback period method, Accounting Rate of Return method, Net Present Value method, Internal Rate of Return method, Benefit Cost Ratio method (Profitability Index), (simple Problems).

UNIT - III

Project Risk & Quality Management: Introduction, Role of Risk management, Risk identification – Steps in risk management –, Risk analysis (Decision trees, Simulation and Break-even analysis), Techniques for managing risk. Project Quality Management and Value Engineering: Quality, Quality Concepts and Value Engineering.

UNIT - IV

Project Scheduling (Network Analysis): Development of Project network, Time estimation, Determination of the critical Path, PERT Model, Project Crashing. (Simple Problems)

UNIT - V

Project Execution & PMS: Process of Project Execution and Control, Project Management Information System (PMIS), Project Performance Measurement and Evaluation (PPME).
Project Management Software: Essential Requirement of Project Management Software, Common Features available in most of the project management software.

Text Books

1. Prasanna Chandra, Projects, Tata McGraw Hill.
2. Nagarajan K, Project Management 4th edition, New Age International (P) Ltd.
3. L S Srinath, PERT/CPM, Affiliated East-West Press 2005.

Reference Books

1. Nicholas J.M.& Steyn H., Project Management, Elsevier, Himalaya publications.
2. Narendra Singh, Project Management and Control, HPH, 2003.
3. Harvey Maylor, Project Management, Pearson Education.
4. Panneerselvam & Senthilkumar, Project Management, PHI.

Course Title	**Utilization of Electric Power**				**B. Tech. VII Semester**		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
1802702	**Professional Core (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	End Exam	Total
		3	**0**	**0**	**3**	**30**	70	100
Mid Exam Duration: 2Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to learn the concepts of illumination, Electrical heating, Welding, Electrolytic Process and Electric Traction.								
On successful completion of this course, the students will be able to								
CO 1	Understand different types of electric drives, heating, welding and illumination.							

CO 2	Understand the basic principle of electric traction including speed– time curves of different traction services

CO 3	Understand the method of calculation of various traction systems for braking, acceleration and other related parameters
CO 4	Choose appropriate drive for the industrial purpose, proper illumination strategy for good lighting system, the traction system for better performance

UNIT - I

Illumination: Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light, discharge lamps, MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes- Basic principles of light control- Types of lighting schemes -factory lighting, street lighting and flood lighting.

UNIT - II

Electric Heating & Welding: Advantages and methods of electric heating - types and applications of electric heating equipment- Resistance ovens-induction heating –dielectric heating-Electric welding –resistance welding and arc welding techniques - arc furnaces.

UNIT –III

Electric Drives: Types of Electric drives, Choice of motor, starting and running characteristics, Speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

UNIT –IV

Systems of Electric Traction and Track Electrification: Review of existing electric traction systems in India. Special features of traction motors, methods of electric braking – plugging, rheostatic braking and regenerative braking.

UNIT –V

Mechanism of Train Movement: Speed-time curves for different services – Trapezoidal and quadrilateral speed time curves – Calculations of tractive effort, power, specific energy consumption for a given run, the effect of varying acceleration and braking retardation, adhesive weight and coefficient of adhesion.

Text Books:

1. Utilization of Electric energy by E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009.
2. Art & Science of Utilization of Electrical Energy by H. Partab, Dhanpat Rai & Co, 2004.

Reference Books:

1. Generation, Distribution and Utilization of Electrical energy by C. L. Wadhwa, New Age International (P) Limited, 1997.
2. Utilization of Electrical Power including Electric Drives and Electric Traction by N. V. Suryanarayana, New Age International (P) Limited, 1996.

Course Title	**Flexible AC Transmission Systems (PE – III)**				**B. Tech. VII Semester**		
Course Code	**Category**	**Hours / Week**		**Credits**	**Maximum Marks**		
1802703	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2Hrs					**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to learn the fundamentals of FACTS controllers, types of FACTS controllers, voltage source converters, shunt and series compensation, control of STATCOM and SVC.							
On successful completion of this course, the students will be able to							
CO 1	Understand the operating principles of various FACTS devices.						
CO 2	Choose proper controllers for specific application based on system requirement						

CO 3	Understand the importance of compensation methods in power system network
CO 4	Analyze the role of SVC & STATCOM in improving the power system dynamics.

CO 5	Analyze the use of control schemes of TCSC, TSSC, GSC in improving the power quality

UNIT - I

FACTS Concepts: Transmission interconnections, 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.

UNIT - II

Voltage Source Converters: Single & three phase full wave bridge Converters -transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT - III

Static Shunt Compensation: Objectives of shunt compensation, midpoint voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping. Methods of controllable VAR generation, variable impedance type static VAR generators, switching converter type VAR generators, hybrid VAR generators.

UNIT - IV

Static VAR Compensator(SVC) and Static Synchronous Compensation(STATCOM): The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT - V

Static Series Compensators: concept of series capacitive compensation, improvement of transient stability, power oscillation damping.

Functional requirements, GTO thyristor controlled Series Capacitors (GSC), Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC) control schemes for GSC, TSSC and TCSC.

Text Book

1. Concepts and Technology of Flexible AC Transmission Systems-Understanding FACTS by Narain G. Hingorani and Laszlo Gyuygyi, Standard Publishers Distributors, IEEE Press Publications, 1st Edition, 2001.
2. FACTS Controllers in Power Transmission & Distribution by K. R. Padiyaar, New Academic Science Publishers, 2020.

Reference Books

1. Thyristor based FACTS Controllers for Electrical Transmission Systems by R. Mohan Mathur, Rajiv K. Varma, IEEE Press Series on Power Engineering, 2002.
2. Flexible AC Transmission Systems by Yong Hua Song and Alln T Johns, The Institute of Electrical Engineers, London, UK, 1999.

Course Title	**POWER QUALITY (PE – III)**				**B. Tech. VII-Semester**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
1802704	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The student is able to learn the power quality issues, voltage disturbances, power transients, concept of harmonics and their effect in power system equipment, measuring and monitoring concepts of power quality.								
On successful completion of this course, the students will be able to								
CO 1	Understand the different power quality problems in the power system.							

CO 2	Understand the effect of harmonics in the system and the equipment

CO 3	Examine the voltage variations and over voltage transients and conventional devices for voltage regulations in the system
CO 4	Analyze the concepts on measuring and monitoring issues of quality

UNIT-I

Introduction: Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues-Magnitude Versus Duration Plot - Power Quality Standards (IEEE & IEC) - Responsibilities of The Suppliersand Users of Electric Power-CBEMA and ITIC Curves.

UNIT-II

Transients, Short Duration and Long Duration Variations: Categories and Characteristics of Electromagnetic Phenomena in Power Systems-Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption - Under Voltage – Over Voltage–Outage. Sources of Different Power Quality Disturbances- Principles of Regulating the Voltage- Conventional Devices for Voltage Regulation.

UNIT-III

Fundamentals of Harmonics & Applied Harmonics: Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quality Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources From Commercial Loads, Harmonic Sources From Industrial Loads. Applied Harmonics**:** Effects Of Harmonics, Harmonic Distortion Evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion.

UNIT-IV

Power Quality Monitoring: Power Quality Benchmarking-Monitoring Considerations- Choosing Monitoring Locations- Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments- Power Quality Measurement Equipment-Types of Instruments- Assessment of Power Quality Measurement Data- Power Quality Monitoring Standards.

UNIT-V

Power Quality Enhancement Using Custom Power Devices: Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL)-Solid State Breaker (SSB) -Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner (UPQC)-Principle of Operation Only.

Text Books

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd., 2008.
2. Power quality, C. Sankaran, CRC Press, 2002.

Reference Books

1. Understanding Power quality problems, Math H. J. Bollen IEEE Press, 2007.
2. Power quality enhancement using custom power devices, Arindam Ghosh, Gerard Ledwich, Kluwer academic publishers, 2002.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2010.

Course Title	**Digital Control Systems (PE – III)**				**B. Tech. VII-Semester**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
1802705	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The student is able to learn basics of digital control systems, Z-plane analysis of discrete time control systems, Design of systems by conventional methods, state space analysis and design of pole placement and state observer.								

On successful completion of this course, the students will be able to	
CO 1	Understand the basic concepts of digital control systems, Z-transforms & inverse Z-transforms

CO 2	Analyze z-plane for various discrete time control systems, liapunov stability
CO 3	Design control systems by using conventional methods, pole placement and state observer
CO 4	Apply state space for solving discrete and continuous state space equations

UNIT- I

Introduction: Digital Control Systems, quantization and quantization error, Z-transform, Z-transforms of elementary functions, properties of Z-transform, Inverse Z-transform, Z-transform method for solving difference equations.

UNIT-II

Z-plane Analysis of Discrete time Control Systems: Introduction, Impulse sampling and data hold, pulse transfer function, realization of digital controllers and digital filters.

UNIT-III

Design of Digital control systems by Conventional methods: Introduction, Mapping between s-plane and z-plane, transient and steady-state response analysis, Design based on frequency response methods, Analytical Design method.

UNIT IV

State Space Analysis: State space representation of digital systems, solving discrete state space equations, pulse transfer function matrix, discretization of continuous time state space equations, Liapunov stability analysis.

UNIT V

Pole placement and State Observers design: Controllability, Observability, useful transformations of state space analysis and design, Design through pole placement, state observer.

Text Books

1. Katsuhiko Ogatta, "Discrete time Control Systems" Second Edition, Prentice Hall of India (2005)
2. I. J. Nagrath, "State Space methods and digital control systems", New Age International (2004).

Course Title	**Digital Signal Processing (PE – III)**					**B. Tech. VII-Semester**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
1802706	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to learn about Discrete Fourier Transform and its efficient computation, various IIR and FIR realization techniques, design of IIR and FIR filters.								
On successful completion of this course, the students will be able to								
CO 1	Interpret, represent and process discrete/digital signals and systems							
CO 2	Understand discrete and fast Fourier transforms							
CO 3	Apply Z-transforms in digital system design							
CO 4	Design FIR and IIR Digital Filter for the desired characteristics							

UNIT-I

Introduction: Definition and Classification of Signals, Elementary signals, Basic operations on signals.
Discrete-time signals: Sequences, Discrete-time systems, Linear-time invariant systems and its properties**,** linear constant coefficient difference equations, Frequency-domain representation of discrete-time signals and

systems

UNIT-II

Discrete Fourier Transform: The Fourier Transform of periodic signals, sampling the Fourier transform, the discrete Fourier transform, properties of DFT, linear convolution of sequences using DFT.

Fast Fourier Transforms: Efficient computation of the DFT, Decimation in time and decimation in frequency FFT algorithms, Implementation of FFT algorithms and FFT algorithms for composite N.

UNIT-III

Z–Transforms: Introduction, The z-transform, properties of the Region of Convergence for the z-transform, The Inverse z-transform, z-transform properties, the inverse z-transform using contour integration.
Realization of Digital Filters: Block diagram representation of linear constant-coefficient difference equations, basic structures of IIR filters- direct form I, direct form II, transposed form, cascade form, parallel forms, basic structures of FIR filters-Direct form, Cascade form, Linear phase structure, Lattice structures.

UNIT-IV

IIR Digital Filters: General considerations-Causality and its implications, Characteristics of Practical Frequency-selective filters, IIR filter design by Impulse Invariance, Bilinear transformation, Design of IIR filters from analog filters-Butterworth and chebyshev approximations, design examples: frequency transformations, Illustrative Problems.

UNIT-V

FIR Digital Filters: Symmetric and Antisymmetric FIR filters, Design of Linear Phase FIR digital filters using windows, Frequency sampling technique, comparison of IIR and FIR filters, Illustrative Problems,
Applications of DSP (Dual Tone Multi frequency signal detection, Spectral analysis of sinusoidal and non stationary signals).

Text Books

1. A.V.Oppenheim and R.W. Schaffer, & J R Buck, "Discrete Time Signal Processing," 2nd ed., Pearson Education, 2012.
2. John G. Proakis, Dimitris G. Manolakis, "Digital signal processing, principles, Algorithms and Applications", Pearson Education/PHI, 4th Edition, 2007.
3. Sanjit K Mitra, "Digital signal processing", A computer base approach- Tata McGraw-Hill, 3rd Edition, 2009.

Reference Books

1. Andreas Antoniou, Digital signal processing: Tata McGraw-Hill, 2006.
2. Digital signal processing: M H Hayes, Schaum's Outlines, Tata McGraw-Hill, 2007.
3. A. Anand Kumar, "Digital Signal Processing," PHI Learning, 2011.

Course Title	**Smart Grid (PE – III)**				**B. Tech. VII-Semester**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
1802707	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The student is able to learn fundamentals, Architecture and analysis of smart grid with communication, networking and measuring technologies involved in it.								
On successful completion of this course, the students will be able to								
CO 1	Understand the features, fundamental components and architecture of smart grid							
CO 2	Explain information, communication and networking technologies involved with the smart grid							
CO 3	Explain operation and importance of PMU, WAMPS and smart storage systems in smart grid							
CO 4	Analyze Microgrid with various concepts and challenges in future							

UNIT-1

Introduction to Smart Grid: Working definitions of Smart Grid and Associated Concepts – Need of Smart Grid –

Smart Grid Functions – Opportunities & Barriers of Smart Grid - Conventional Power Grid and Smart Grid -Concept of Resilient & Self-Healing Grid.

UNIT-II

Smart Grid Architecture: Components and Architecture of Smart Grid – Review of Proposed Architectures for Smart Grid – The Fundamental Component of Smart Grid Designs – Transmission Automation – Distribution Automation –Renewable Integration.

UNIT-III

Information and Communication Technology: Smart sensors, Wired and wireless communication Technology, Network Structures (**HAN, LAN, NAN, WAN**), Introduction to Smart Meters – Advanced Metering Infrastructure (AMI).

UNIT-IV

Smart Grid Technologies: Geographic Information System (GIS) - Intelligent Electronic Devices (IED) - Smart storage like Battery- SMES - Pumped Hydro - Compressed Air Energy Storage - Wide Area Measurement System (WAMS) – SCADA - Phase Measurement Unit (PMU).

UINT – V

Micro grids and Distributed Energy Resources: Concept of micro grid, need & application of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid, Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, and fuel cells.

Text Books

1. Janaka Ekanayake, Kithsir iLiyanage, Jian zhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
2. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 1e,2013.
3. James Momoh, "Smart Grid: Fundamentals of Design and Analysis"- Wiley, IEEE Press, 2012.

Reference Books

1. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press.
2. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability", Artech House Publishers July 2011.
3. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.

Course Title	**Labview Programming**				**B. Tech. VII Semester**		
Course Code	**Category**	**Hours / Week**		**Credits**	**Maximum Marks**		
1802708	**Engineering Science Course (ESC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**3**	**1.5**	**50**	**50**	**100**
						End Exam Duration : 3Hrs		
Course Objectives: The objective of the course is to learn, write, test and debug simple Labview Programs.								
On successful completion of this course, the students will be able to								
CO 1	Understand, test and debug simple Labview Programs							
CO 2	Demonstrate operations on arrays and strings							
CO 3	Apply conditional statements with Labview							
CO 4	Make use of SubVI's for structuring Labview Programs							
CO 5	Make use of Read and write data from/to files in Labview							

LIST OF PROGRAMS

1. Basic arithmetic operations (Add, mul, div, compound arithmetic, expression node, express formula and formula node)

2. Boolean operations (truth table verification of logic gates, Half Adder and Full Adder, convert binary to decimal value, convert BCD to Gray and Vice-Versa)

3. String operations (Length, concatenation, insert string, substring, replace string, reverse string, rotate string, etc)
4. Sum of 'N' numbers using feedback loop (use 'for ' loop and 'while' loop)
5. Factorial of a given number using shift register (use 'for' loop and 'while' loop)
6. Generate Fibonacci series for N iteration (use 'for' loop)
7. Create a VI to increase the tank level from 0 to 100 & decrease the value from 100 to 0 using a while loop in a single process.
8. Create a VI to implement and, or & not gates(or arithmetic operations) using case structure
9. Build a VI that generates a 1D array of random numbers and sort the array in descending and ascending order and find the following:
    a) Maximum and min value of array elements
    b) Size of the array
    c) Sum and product of array elements
    d) Rotate array by 1 position
    e) Split the array after 2 elements
10. Build an array of cluster controls in which each cluster consists of a numeric control and 1D numeric array. This forms the database of students. The numeric control indicates the roll no and array indicates the test marks of 4 subjects. Build the logic to modify the mark in a particular subject of a particular student. Input the roll number, subject in which mark is to be changed and new mark. Display the database on a separate array indicator.
11. Create a VI to implement Full Adder circuit using SubVI.
12. Any application using Flat and stacked sequence

Software Used: LABVIEW Software for Windows/Linux

Course Title	**Power Systems – II Lab**					**B. Tech. VII Semester**		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
1802709	**Professional Core (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**3**	**1.5**	**50**	**50**	**100**
						End Exam Duration : 3Hrs		

Course Objectives: The objective of the course is to learn,

- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system networks using software tools.
- To identify & formulate solutions to problems relevant to power systems using software tools.

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

CO 1	Understand the concept of MATLAB programming and ETAP in solving power systems problems.
CO 2	Acquire knowledge on formation of Bus Admittance matrix.
CO 3	Analyze the power flow using GS, NR method and DC load flow method.
CO 4	Analyze various fault studies on the power system.
CO 5	Understand power system planning and operational studies.

List of Experiments (Any Eight)

1. Modelling of a Transmission Line with Lumped parameters.
2. Formation of Y-bus for a given power system network.
3. AC Load flow analysis of a simple 3-bus system using Gauss Seidel method.

4. AC Load flow analysis of a simple 3-bus system using Newton Raphson method.
5. Study on D C Load Flow
6. Study on Economic Load Dispatch.
7. Short circuit analysis.
8. Simulation of single area load frequency control system.
9. Simulation of Automatic Voltage Regulator.
10. Tripping characteristics of Fuse & MCB.
11. Tripping sequence of protective devices.
12. Characteristics of over current relay.

Note: All the above experiments are simulated using MATLAB/ETAP Software/Power World Simulator

Course Title	**Project Stage - I**					**B. Tech. VII Semester**		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
1802711	**PROJ**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		--	--	6	3	**100**	**--**	**100**

Course Objectives: The objective of the course is to

- develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- Acquire and apply new knowledge as needed, using appropriate learning strategies.
- Apply knowledge of probability and statistics to applications in electrical engineering.

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

CO 1	Demonstrate a sound technical knowledge of their selected project topic.
CO 2	Understand problem identification, formulation and solution
CO 3	Design engineering solutions to complex problems utilising a systems approach.
CO 4	Communicate with engineers and the community at large in written an oral form
CO 5	Demonstrate the knowledge, skills and attitudes of a professional engineer

B. Tech – VIII Semester (Theory - 2, Project - II Stage)

S. No.	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1		**Professional Elective - IV (PE-IV)**							
	1802801	Electrical Distribution Systems	PEC	3	0	0	30	70	3
	1802802	Power System Reliability	PEC	3	0	0	30	70	3
	1802803	Industrial Automation & Control	PEC	3	0	0	30	70	3
	1802804	SCADA & its Application	PEC	3	0	0	30	70	3
	1802805	Distributed Generation & Micro Grid	PEC	3	0	0	30	70	3
2	--	**Open Elective -IV (OE-IV)**	OEC	3	0	0	30	70	3
3	1802806	Technical Seminar	PROJ	2	0	0	100	00	1
4	1802807	Project Stage - II	PROJ	0	0	10	50	50	5
Total				08	0	10	210	190	12

Course Title	Electrical Distribution Systems (PE – IV)					B. Tech. VIII Semester		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
1802801	Professional Elective (PEC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	30	70	100
Mid Exam Duration: 2 Hrs						End Exam Duration : 3Hrs		
Course Objectives: The student is able to learn load modelling characteristics, classification of distribution systems and various substations, improvement of power factor in substations and distribution automation								
On successful completion of this course, the students will be able to								
CO 1	Understand The Concept of Load Characteristics, SCADA, Distribution Automation Systems							
CO 2	Classify Various Loads In Distribution Systems And Substations							
CO 3	Estimate Voltage and Current In Feeders							
CO 4	Analyze Distribution Feeder Configurations, Bus bar Arrangements In Substations							
CO 5	Analyze Voltage Drop and Power Loss Calculations for Radial Networks and Power Factor Improvement							

UNIT- I

Load Modeling and Characteristics: 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.

UNIT-II

Classification of Distribution Systems: Classification of Distribution Systems - Comparison of DC Vs AC– comparison of Under-Ground Vs Over - Head Distribution Systems- Requirements and Design Features of Distribution Systems-

Design Considerations of Distribution Feeders: Radial and Loop Types of Primary Feeders,-Voltage Levels, Feeder Loading, Basic Design Practice of the Secondary Distribution System.

Voltage Drop & Current Calculations (Numerical Problems) In D.C. Distributors.

UNIT-III

Substations: Location of Substations, Rating of Distribution Substation, Service Area within Primary Feeders. Benefits Derived Through Optimal Location of Substations.

Classification of Substations: Air Insulated & Gas insulated Substations, Substation Layouts and functioning of different components of the substations, Merits & Demerits of GIS over AIS, Busbar arrangements in the Sub-Stations with Relevant Diagrams.

UNIT-IV

Power Factor Improvement: 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.

Causes of Low P. F -Methods of Improving P. F-Phase Advancing and Generation of Reactive KVAR Using Static Capacitors-Most Economical P.F. for Constant KW Load and Constant KVA Type Loads, Numerical Problems.

UNIT-V

Distribution Automation: Distribution Automation (DA) – Project Planning – Definitions – Communication – Sensors – Supervisory Control and Data Acquisition (SCADA) – Consumer Information Service (CIS) – Geographical Information System (GIS) – Automatic Meter Reading (AMR) – Automation Systems.

Text Books

1. Electric Power Distribution System, Engineering by Turan Gonen, Mc Graw-hill Book Company, 1986.
2. Electric Power Distribution by A. S. Pabla, Tata Mc Graw-hill Publishing Company, 4th edition, 1997.

Reference Books

1. Electrical Power Distribution Systems by V. Kamaraju, Jain Book Depot. 2012.
2. HandBook of Electric Power Distribution by G. Ramamurthy, 2nd Edition, Universities Press, 2009.

Course Title	Power System Reliability (PE – IV)				B. Tech. VIII Semester		
Course Code	Category	Hours/Week		Credits	Maximum Marks		
1802802	Professional Elective (PEC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	30	70	100
Mid Exam Duration: 2 Hrs					End Exam Duration : 3Hrs			

Course Objectives: The objective of the course is to learn the basic reliability concepts, density and distribution functions, random variables and networks, reliability functions and time dependent reliability evaluation of different networks, markov modelling and component repairable models for frequency and duration and reliability applications to generation, transmission and distribution systems.

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

CO 1	Understand the basic reliability concepts, density and distribution functions and network modeling.
CO 2	Apply different reliability functions and time dependent reliability evaluation for different networks.
CO 3	Understand the concepts of markov modeling and component repairable models for frequency and duration techniques
CO 4	Apply various reliability fundamental techniques to power systems.

UNIT I

Basic probability theory: Introduction-rules for combining probabilities of events, Bernoulli's trials, Probability Density and Distribution Functions, Binomial Distribution- Expected Value and Standard Deviation, Problems.
Network Reliability: Analysis of Series, Parallel, Series – Parallel Networks, Complex Networks – Decomposition Method, Problems

UNIT II

Reliability Functions: Functions – f(t), R(t), F(t), h(t) and their relationships – Exponential Distribution – Expected Value and Standard Deviation – Reliability Analysis of Series – parallel Networks using Exponential Distribution, Problems, Bath – tub Curve – Reliability Measures. MTTF, MTTR, MTBF.

UNIT III

Markov Modeling
Discrete Markov Chains – Concept of STPM, Evaluations of Limiting State Probabilities, Problems.
Continuous Markov Process: Single component repairable model – Time Dependent Probabilities - Evaluation by using Laplace Transform and STPM Approach – Two Component Reliability Models - evaluation of LSP's using STPM Approach.
Frequency and Duration Concept: Evaluation of Frequency of Encountering State, Mean Cycle Time for One and Two Component Repairable Models.
Evaluation of Cumulative Probability and Cumulative Frequency of Encountering of Merged States, Problems

UNIT IV

Generation System Reliability Analysis: Reliability Model of a Generation System, Recursive Relation for Unit Addition and Removal, Load Modeling, Problems.
Two-level representation of daily load, Merging of Generation with Load Model – Evaluation of Transition Rates for Merged State Model - LOLP, LOLE, Problems.

UNIT V

Composite System Reliability Analysis: System and Load Point Reliability Indices, Weather Effects on Transmission Lines - Weighted Average Rate and Markov Model.

Distribution System Reliability Analysis: Basic Reliability Indices for Radial Networks, Performance Indices - Customer Oriented, Load and Energy Oriented Indices, problems

Text Books:

1. Reliability Evaluation of Engg. System – R. Billinton, R. N. Allan, Plenum Press, New York, Reprinted in India by B. S. Publications, 2006.
2. Reliability Evaluation of Power Systems – R. Billinton, R. N. Allan, Plenum Press, New York, Reprinted in India by B. S. Publications, 2006.

Reference Books

1. System Reliability Concepts by V. Sankar, Himalaya Publishing House, 2015.
2. Reliability Engineering by E. Balagurusamy, Tata McGraw Hill, 2003.

Course Title	**Industrial Automation & Control (PE – IV)**					**B. Tech. VIII Semester**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
1802803	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The student is able to learn Automation is playing a key role in Industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn the basics of automation, how systems work and the importance of PLC, SCADA and robots in automation. This course will provide an opportunity to learn industrial automation techniques.								
On successful completion of this course, the students will be able to								
CO 1	Understand various automation components and systems							
CO 2	Draw block diagram of industrial automation and control system							
CO 3	Explain architecture of industrial automation system							
CO 4	Measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity and pH.							

UNIT – I

Introduction: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & profibus

UNIT - II

Automation components: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT – III

Computer aided measurement and control systems: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation

UNIT –IV

Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT – V

Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Text Books

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI
3. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A.K. Deb, Jaico Publishing House, 2013
4. Programmable logic controller, Dunning, Delmar

Reference Books

1. Groover, Mikell. P: Automation, Production systems and Computer integrated Manufacturing –Prentice hall India-2004.
2. Mark W Spong& M Vidyasagar: Robot Dynamics and Control, John Wiley & Sons, 1989
3. Robert J Schilling: Fundamentals of Robotics, Analysis and Control. Printice Hall of India 1996
4. R.K.Mittal and I.J. Nagarath: Robotics and Control, TMH-2003

Course Title	**SCADA & Its Applications (PE – IV)**					**B. Tech. VIII Semester**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
1802804	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The student is able to understand SCADA and its applications.								
On successful completion of this course, the students will be able to								
CO 1	Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications.							
CO 2	Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system							
CO 3	Acquire knowledge about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server							
CO 4	Acquire knowledge about SCADA communication, various industrial communication technologies, open standard communication protocols							
CO5	Learn and understand about SCADA applications in transmission and distribution sector, industries etc							
CO6	Gain knowledge and understanding for the design and implementation of a SCADA system							

UNIT - I

Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries

UNIT - II

SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems

UNIT - III

SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850

UNIT - IV

SCADA Communication: various industrial communication technologies -wired and wireless methods and fiber optics. Open standard communication protocols

UNIT - V

SCADA Applications: Utility applications- Transmission and Distribution sector -operations, monitoring, analysis and improvement. Industries - oil, gas and water.

Text Books

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications, USA,2004.
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004.

Reference Books

1. William T. Shaw, Cyber security for SCADA systems, PennWell Books, 2006.
2. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003.
3. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric power, PennWell 1999.

Course Title	**Distributed Generation & Micro Grid (PE – IV)**				**B. Tech. VIII Semester**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
1802805	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The student is able to learn about different distributed generations, energy storage devices and Micro grid systems and Understanding the concepts of system development and relevant issues.								
On successful completion of this course, the students will be able to								
CO 1	Understand the synchronization and other distributing resources such as energy storage and fuel cell							
CO 2	Understanding of the microgrid types and configurations							
CO 3	Applications of power electronics in Micro grid and acquire the knowledge of multifunction grid connected converters							
CO 4	Analyze the various types of control in micro grid in islanded and grid connected operation							

UNIT - I

Introduction to Distributed Generation: DG Units - Micro turbines, reciprocating engines, wind generators, photovoltaic generators, fuel cells, biomass, and tidal sources - Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Sitting and sizing of DGs – optimal placement of DG sources in distribution systems.

UNIT - II

Grid integration of DGs: Synchronization - Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units - Distributed resources to electric power systems: IEEE 1547. Energy storage elements: Batteries, ultra-capacitors, flywheels.

UNIT - III

Economics and Regulatory Aspects of DGs: Selection of sources, regulatory standards/ framework, Standards for interconnecting DG installation classes, security issues in DG implementations. Economic and control aspects of DGs –Market facts, issues and challenges - Limitations of DGs.

UNIT - IV

Introduction to Micro grid: Micro grid Configurations – CERTS Microgrid Test Bed – DC Micro grid- HFAC Micro grid –LFAC – Micro grid – Hybrid DC- and AC- Coupled Micro grid.

Power Electronics in Micro grid: Power Electronics based Microgrid - Grid Connected Mode – Islanded mode – Battery Charging mode – design of parallel inverters – Microgrid application - Brick Busses Software Framework.

UNIT - V

Control in Micro grid: Impact of load characteristics – Local control – Centralized Control- Decentralized Control Microgrid control for island operation – PQ Control - Droop control methods – Frequency/Voltage Control – Control of Inverter Output Impedance.

Text Books

1. N. Jenkins, J.B. Ekanayake and G. Strbac, 'Distributed Generation', IET Press, 2010.
2. Nikos Hatziargyiou, "Micro grids: Architectures and Control", Wiley-IEEE Press, December 2013.

Reference Books

1. Suleiman M. Sharkh, Mohammad A. Abu-Sara, Georgios I. Orfanoudakis, Babar Hussai, "Power Electronic Converters for Microgrid" , Wiley-IEEE Press, 2014.
2. S. Chowdhury, S. P. Chowdury and Peter Crossley," Microgrids and Active Distribution Networks" ISBN978-1-84919-014-5, IET renewable Energy series, 2009.

Course Title	**Technical Seminar**				**B. Tech. VIII Semester**		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
1802806	PROJ	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		2	-	-	1	**100**	**--**	**100**
Course Objectives: The main objective of the seminar helps to develop in an emerging field at the intersection of multidisciplinary understandings of culture and education. The students also explore and develop new perspectives.								
On successful completion of this course, the students will be able to								
CO 1	Understand the theme of the seminar.							
CO 2	Identify and discuss current real-world issues.							
CO 3	Distinguish and integrate differing forms of knowledge and academic disciplinary approaches with that of the student's own academic discipline and apply a multidisciplinary strategy to address current, real-world issues.							
CO 4	Improve oral and written communication skills							
CO 5	Explore an appreciation of the self in relation to its larger diverse social and academic contexts.							
CO 6	Apply principles of ethics and respect in interaction with others.							

<table>
<tr><td>Course Title</td><td colspan="5">Project Stage - II</td><td colspan="3">B. Tech. VIII Semester</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">1802807</td><td rowspan="2">PROJ</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>--</td><td>--</td><td>10</td><td>5</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to
1. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
2. Acquire and apply new knowledge as needed, using appropriate learning strategies.
3. Apply knowledge of probability and statistics to applications in electrical engineering.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Demonstrate a sound technical knowledge of their selected project topic.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand problem identification, formulation and solution</td></tr>
<tr><td>CO 3</td><td colspan="8">Design engineering solutions to complex problems utilising a systems approach.</td></tr>
<tr><td>CO 4</td><td colspan="8">Communicate with engineers and the community at large in written an oral form</td></tr>
<tr><td>CO 5</td><td colspan="8">Demonstrate the knowledge, skills and attitudes of a professional engineer</td></tr>
</table>