SRI VENKATESWARA UNIVERSITY: TIRUPATI

SRI VENKATESWARA UNIVERSITY COLLEGE OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEER

Course

M.Tech ELECTRICAL AND ELECTRONICS ENGINEERING

(Power Systems)

Choice Based Credit System (CBCS)

Academic Year 2017-2018

Vision

- The department aims at catering to the needs and aspirations of the people and their development, reach to the world through state of art technologies of Electrical and Electronics Engineering and to serve the society at large

Mission

- To provide the necessary domain expertise and infrastructure to the students.
- To make available the advanced laboratories, application oriented engineering principles for students and research scholars.
- To offer research and industry orientation to become successful service oriented technocrat.

Programme Outcomes

1. Graduates will have the ability to solve the problems related to their work by applying the knowledge of basic sciences, engineering mathematics, soft computing techniques, electrical and electronics engineering.
2. Graduated students will be in a position to demonstrate his ability to identify and formulate problems.
3. Graduates will be able to design electrical circuits, conduct experiments, analyze and interpret results.
4. Graduates will have a talent to design and develop digital systems.
5. Graduates can visualize and work in laboratories on multidisciplinary tasks.
6. Graduates will be ready to use modern engineering tools and software to analyze problems.
7. Graduates will have the knowledge of professional and ethical responsibilities.
8. Graduates will be able to communicate effectively in both verbal and written form.
9. Graduates will understand the impact of engineering solutions on the society being aware of contemporary issues as a member of a team.
10. Graduates will develop confidence for continued self-learning.

11. Graduates can participate and succeed in competitive examinations.

12. Graduates can do project management with economic viability

PSOs

- Graduates will, demonstrate professional behaviour to cater the global needs of the industry and society**.**
- Graduates will pursue higher education to upgrade their professional and research skills and inculcate the attitude of lifelong learning**.**
- Graduates will develop the qualities like creativity, leadership, team work and professional ethics contributing to the societal growth.

SYLLABUS

S V University College of Engineering: Tirupati – 517502

1st-year M.Tech Degree Programme

EEPSC 101A	**COMPUTER METHODS IN POWER SYSTEMS**		
	Instruction : 4 hr / week	***Credits : 4***	***Assessment : 20 + 20 + 60***
1	**Syllabus** **UNIT-I**		

	Incidence and network matrices : Graphs, Incidence matrices, Primitive network, formation of network matrices by singular transformation; Bus admittance and bus impedance matrices, Branch admittance and branch impedance matrices, loop impedance and loop admittance matrices, Formation of network matrices by non-singular transformation; Branch admittance and branch impedance matrices, loop impedance and loop admittance matrices. **UNIT-II** **Algorithm for the formation of network matrices:** Algorithm for formation of Bus impedance matrix, Addition of a branch and Addition of a link. Simple problems. **UNIT-III** **Three - phase Networks:** Representation of Three phase network elements, Symmetrical components and Clarke's components, Algorithm for formation of three-phase bus impedance matrix. **UNIT-IV** **Short – circuit studies:** Short circuit calculations using Bus impedance matrix, Fault currents and voltages, short circuit calculations for balanced 3-phase network using Bus impedance matrix. **UNIT-V** **Load flow studies**: Load flow problem, Classification of buses, Gauss-Seidal method, Newton Raphson method, Decoupled and fast decoupled load flow methods, comparison of load flow methods. **Text books :** 1. Computer methods in Power System Analysis by Stagg and Et. Abiad, Mc.Graw Hill Book Company. **2.** Advanced Power system analysis and dynamics by L.P.Singh, Wiley Eastern – 1981.	
2	**At the end of this course the Students are able to**	
	CO-1	Gain the knowledge on • formation of suitable mathematical model of a given power system network • Short circuit analysis and Load flow analysis.
	CO-2	Select suitable method and mathematical model for short circuit and load flow studies
	CO-3	Analyze the given power system network under normal and fault conditions
3	**MAPPING**	

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3			2						
2	3				2			1		
3	3	2	1	1	2			1		

EE PSC 102A	**DIGITAL CONTROL SYSTEMS** ***Instruction : 4 hr / week*** ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1.	**Syllabus** **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, discretozation 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)

1. 2.I H Nagrath, " State Space methods and digital control systems" , New Age International (2004).

2 **COURSE OUTCOMES: Students are able to**

CO-1	Acquire the knowledge of digital control system concepts.
CO-2	Design the digital control systems by applying Z-plane and state space analysis and conventional methods.
CO-3	Select and apply above techniques to realize the digital controllers

3

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3			1						
2	3	2	2					1		
3	3	2	1		1			1		

EEPSC 103	**ELECTRICAL POWER DISTRIBUTION SYSTEMS**
	Instruction : 4 hr / week ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1.	**UNIT-I**
	Load Modeling and characteristics: Introduction - distribution system planning – basic definitions – loss factor – Load characteristics - classification of loads and their characteristics – load modeling.

	UNIT-II Distribution Feeders: Design considerations – LVDS – HVDS – Factors affecting feeder voltages - Application of ABCD parameters to feeder circuits – design practice of secondary distribution system – distribution transformers – secondary network types – secondary mains. **UNIT-III** Voltage drop, power loss calculation, voltage control – Derivation for voltage drop and power loss in for 3-phase and non 3 phase primary lines – importance of voltage control - definitions – methods of voltage control – capacitors – voltage regulators – distributed generation. **UNIT-IV** Distribution system protection : Objectives – protection schemes - Circuit breakers – sectionalizers – coordination of protective devices – objectives – types of coordination – classification of faults - fault calculations. **UNIT-V** Distribution Automation : Need for distribution automation (DA) – Description of distribution automation – DA functionalities – benefits – Distribution SCADA – distribution management systems (DMS) – functions of DMS – Functional requirements for distribution SCADA. **Text Books**: 1. Electrical power distribution and Automation by S.Sivanagaraju and V.Sankar, DhanpatRai and Co. 2. Electrical power distribution system Engineering by ToranGonen, Mc-Graw Hill book company. **3.** Electric power distribution by A.S.Pabla, Tata Mc-Graw Hill publication company, 4th edition.	
2.	**COURSE OUTCOMES: students are able to**	
	CO-1	Acquire In depth Knowledge on • Load modeling and their characteristics • Distribution feeders and transformers • Distribution Automation • Faults and protection schemes.
	CO-2	Design Distribution System with

		• Optimum voltage drop and power loss • Appropriate protection schemes
3	**MAPPING**	

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3									
2	3	2	2		2	1		3		

EE PSC 104	**REACTIVE POWER CONTROL IN POWER SYSTEMS**
	Instruction : 4 hr / week ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1.	**UNIT-I** THE STEADY STATE REACTIVE POWER CONTROL IN ELECTRICAL TRANSMISSION SYSTEMS: Basics of Reactive Power Control, uncompensated transmission lines, compensated transmission lines, passive shunt compensation, series compensation, line lodability. **UNIT-II** REACTIVE POWER COMPENSATION AND THE DYNAMIC PERFORMANCE OF TRANSMISSION SYSTEM: Introduction, study of passive shunt compensation, Static compensations, types, characteristics, comparison of compensations. **UNIT-III** PRINCIPLES OF STATIC COMPENSATORS: Introduction, Compensator applications, properties and types of static compensators, SVC Schemes/Configurations, Fixed Capacitance (FC), Thyristor Switches Capacitor (TSC), Mechanically Switched Capacitance (MSC), SVC Control Dynamics, Incorporation of SVC in SMIB System, SVC Applications. **UNIT-IV** HARMONICS : Basics, harmonic sources, effect of harmonics on electrical equipment, resonance, shunt capacitors, filters, filter systems, telephone interference. **UNIT-V** OVERVIEW OF POWER QUALITY AND POWER QUALITY STANDARDS : Basics of power quality

and voltage quality, overview of power quality phenomena, power quality and EMC standards.

Text Books:

1. Reactive Power Control in Electrical Power Systems by T.J.E.Miller

2. Understanding Power Quality Problems by Math.H.J.Bollen, Standard Publishers and Distributors, Delhi.

2. **Course Outcomes*:* Students are able to**

CO-1	Understand the significance of reactive power control in power systems to maintain quality of power
CO-2	Design appropriate control scheme to compensate reactive power and to filter harmonics.

3 **MAPPING**

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3			3						
2	3	2	3	2	2	1		3		

EEPSE 101 **RELIABILITY AND PLANNING OF POWER SYSTEMS**

Instruction :4 hr / week ***Credits : 4*** ***Assessment : 20 + 20 + 60***

1.

UNIT-I

LOAD FORECASTING : Short time and Long time considerations, statistical and probabilistic approach to load forecasting – Basic Reliability concepts.

UNIT-II

Generating capacity, Transmission stability and assessment of system resource.

UNIT-III

Generation planning, various aspects of system planning and extension.

UNIT-IV

Voltage and load stability, Short circuit level and reactive power considerations.

UNIT-V

Mathematical modeling of interconnected systems for planning studios

Overall assessment of power systems planning and operation.

Text Books:

1. "Power system reliability evaluation" by Roy Billinton.
2. "Power system reliability calculations" by Roy Billiton
3. "Power system Engg., and Mathematics" by U.G.Knight

2. Course Outcomes: Students are able to

CO-1	Acquire the knowledge of basic reliability concepts and planning aspects.
CO-2	Assess the generation capacity and stability of the system under various load conditions.
CO-3	Derive the mathematical model for the power systems and assess the reliability of the modeled power system.
CO-4	Apply the knowledge of reliability and planning concepts to the practical and real time systems.

3. MAPPING

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3									
2	3									
3	3			1						
4	3	2	2	1		1		1		

EEPSE 102 **ENERGY AUDITING, CONSERVATION & MANAGEMENT**

Instruction : 3hr / week ***Credits : 2*** ***Assessment : 20 + 20 + 60***

1. Syllabus:

UNIT-I

Principles of energy management – organizing an energy management program – initiating and managing an energy management program – planning – leading – controlling and promoting – monitoring and reporting.

UNIT-II

Electrical energy management – energy efficient motors – Power factor improvement – lighting and lighting system control energy saving opportunities – sources of losses – demand control.

UNIT-III

Energy Auditing – Definitions and concepts – Types of plant energy studies - energy index – cost index – piecharts – Sankei diagrams – load problems – energy conservation schemes – energy Audit of industries – energy saving potential.

UNIT-IV

Qualities and functions of energy managers – language of energy manages – questionnaire – checklist for top management.

UNIT-V

Economic analysis – Depreciation method – Time value of money – evaluation methods of projects – Replacement analysis – special problems – inflation – Roscoe analysis.

Text Books:

1. Carig, B.Smith, Energy management Principles, Applications, Benefit and Savings, Pergamon press, New york
2. Energy management – W.R.Murphy & G.Mekey BV Herworth
3. Energy conservation – pau 1 0 callagan pagamon press
4. Energy management Handbook – W.C Turner, John wiley & sons
5. Energy management and conservation – Prentice Hall inc engle wood cliffs(uj) 7632
6. Energy, planning & Policy – B.Bukhootseo eval.

Course Outcomes(COs): students will be able to

CO-1	Gain the knowledge on energy management, electrical and lighting energy management, role of energy manager, energy auditing, economical and conservation schemes.
CO-2	Analyze energy saving opportunities, auditing and apply suitable methods to estimate the economic benefits of conservation, management and auditing of energy.

3

MAPPING

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3									
2	3	2	2	2		1	1			

EE PSE 103	**EE PSE 103 EHV AC TRANSMISSION** ***Instruction : 4 hr / week*** ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1.	Syllabus: **UNIT-I** **Introduction** to EHV AC Transmission – Role of EHV AC Transmission, Brief description of Energy Sources and their development. **Transmission line trends and preliminaries** : Standard transmission voltages, Average values of line parameters, Power-Handling capacity and Line Loss, Examples of Giant Power pools and Number of Lines, Costs of Transmission Lines and equipment, Mechanical considerations in line performance. **UNIT-II** **Calculation of line and ground parameters** : Resistance of conductors, Temperature rise of conductors and current carrying capacity, Properties of Bundled Conductors, Inductance of e.h.v. line configurations, Line capacitance calculation, Sequence Inductances and Capacitances, Line parameters for Modes of Propagation, Resistance and Inductance of Ground Return. **UNIT-III** **Corona Effects – I** : Power loss and Audible Noise : I^2R Loss and Corona loss, Corona-Loss formulas, Attenuation of Travelling Waves due to corona loss, Audible Noise : Generation and characteristics, Limits for Audible Noise, AN Measurement and Meters, **UNIT-IV** **Corona Effects –II** : Radio Interference : Properties of pulse Trains and Filter Response, Limits for Radio Interference Fields, Lateral profile of RI and Modes of Propagation. **UNIT-V** **Power – Frequency voltage control and over voltages** : Problems at power frequency, Generalized constants, No-Load voltage conditions and charging current, The power circle Diagram and its use, Voltage control using synchronous condensers, Cascade connection of components – shunt and series compensation, Sub-synchronous resonance in series-capacitor compensated lines, Static reactive compensating systems (static VAR). **Text Books**: 1. "Extra High Voltage A.C.Transmission Engineering by Rakosh Das Begamudre.

2.	**Course outcomes: Students will be able to**

CO-1	Understand the factors that decide rating of EHVAC Transmission.
CO-2	Calculate the Line & Zone parameters.
CO-3	Analyze the Effect of corona on various parameters such as power loss and Travelling waves.
CO-4	Analyze and design the compensating equipment's for different power frequency voltage control problems.

3. **MAPPING**

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3		2	2		1				
2	2	2	2							
3	2			2		2	2			
4	2	1	1	2						

EEPSE 106 **INTELLIGENT SENSORS AND TRANSDUCERS**

Instruction : 4 hr / week ***Credits : 4*** ***Assessment : 20 + 20 + 60***

1. Syllabus:

UNIT – I

Smart Sensor Basics: Introduction, Mechanical-Electronic Transitions in Sensing, Nature of Sensors, Integration of Micromachining and, Microelectronics (Micromachining-Introduction).

UNIT – II

Semiconductor Sensor ::Introduction, Sensor Output Characteristics, Wheatstone Bridge, Piezo-resistivity in Silicon, Semiconductor Sensor Definitions ,Static Versus Dynamic Operation ,Other Sensing Technologies, Capacitive Sensing, Piezoelectric Sensing ,Hall Effect, Chemical Sensors, Improving Sensor Characteristics.

UNIT - III

Digital Sensors: Digital Output Sensors, Incremental Optical Encoders, Digital Techniques, Noise/Interference Aspects, Low-Power, Low-Voltage Sensors, Impedance Analysis of Sensitivity Improvement, Thin Diaphragm, Increased Diaphragm Area Combined Solution: Micromachining and Microelectronics, Getting Sensor Information into the MCU :Introduction, Amplification and Signal Conditioning

UNIT - IV

Instrumentation Amplifiers: SLEEPMODE. Operational Amplifier, Rail-to-Rail Operational Simplifiers, Switched-Capacitor Amplifier, Barometer Application Circuit, 4- to 20-mA Signal Transmitter, Separate versus Integrated Signal Conditioning, Integrated Passive Elements, Integrated Active Elements, Digital Conversion, A/D Converters, Performance of A/D Converters, Implications of A/D Accuracy and Errors.

UNIT - V

Using MCUs/DSPs to Increase Sensor IQ: Introduction, Other IC Technologies, Logic Requirements, MCU Control, MCUs for Sensor Interface, Peripherals Memory, Input/Output, Onboard A/D Conversion, Power-Saving Capability, Local Voltage or Current Regulation, Modular MCU Design, DSP Control, Algorithms versus Lookup Tables, Techniques and Systems Considerations, Linearization, PWM Control, Auto zero and Auto-range .

TEXT BOOKS:

1. Randy Frank , " Understanding Smart Sensors" Artech House, London (2000)
2. Creed Huddleston, "Intelligent Sensor Design"Elsevier(2007).

Course Outcomes(COs): students will be able to

CO-1	Exhibit the knowledge in • Smart Sensors(analog & Digital) • Instrumentation amplifiers • Interfacing of sensors with MCUs
CO-2	Apply to solve interfacing of sensors with amplifiers and MCU

	CO-3	Understand Principles of interfacing D/A and A/D converters and apply to simple applications

3

MAPPING

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	1					1		1		
2	1	1	1			1				
3	1					1				

EE PSE 107

PROCESS INSTRUMENTATION AND CONTROL

Instruction : 4 hr / week ***Credits : 4*** ***Assessment : 20 + 20 + 60***

1.

UNIT-I

Introduction to process control, Elements of process control loop, Control system Evaluation, Analog and Digital Processing.

Principles of Analog signal conditioning, OPAMP circuits in instrumentation, Design guidelines, Principles of Digital signal conditioning, comparators, Digital-to-Analog converters (DACS), Analog-to-Digital converters (ADCS), Frequency-Based converters, Data-Acquisition systems (DAS).

UNIT-II

Review of transducers related to pressure, temperature, flow, level measurements. Final control operation, Electrical actuators, fluid Valves.

UNIT-III

Process characteristics, control system parameters, Discontinuous controller modes, continuous Controller modes, composite control modes, cascade control, feed forward control, Ration control, Process loop tuning.

UNIT-IV

Discrete-State process Control, Characteristics of the systems, Relay Controllers and Ladder diagrams,

Programmable Logic Controllers : Relay Sequences, Programmable Logic Controller design,

PLC Operation, Programming, PLC Software functions.

UNIT-V

Computers in process control : Data logging, supervisory control, computer-based controller.

Process – control Networks : Functions of the network, General characteristics, foundation field bus and profibus.

Text Books:

1. Process control instrumentation technology by CourterD.Johnson, PHI, Edition (2006)
2. Principles of process control by D.Patranabis, TMH Edition (2001).
3. Process Control Principles and applications by SurekhaBhanot, Oxford University press, 2008.

Course outcomes:Students will be able to

CO-1	Learn about • analog and digital conditioning • Sensors and process control techniques • Computer application in process control
CO-2	Analyze different methods of interfacing sensors with amplifiers and digital circuits
CO-3	Design signal conditioning and analog controllers for process control

3 **MAPPING**

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3			1		1				
2	3	1	1	1	1	1		1		
3	2	1	1	1		1		1		

2nd Semester M.Tech Degree Programme

EE PSC 201A	**ADVANCED POWER SYSTEM PROTECTION** ***Instruction : 4 hr / week*** ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1	**Syllabus:** **UNIT-I** **Introduction-**Need for Protective Systems, Nature and Causes of Faults, Types of Faults Effects of Faults, Essential Qualities of Protection, Classification of Protective Schemes Zones of protection, primary and Back-up Protection, Automatic Re-closing, Curren Transformers &Potential Transformer for protection. **UNIT-II** **Operating Principles and Relay Construction-**Evolution of Protective Relays, Basic Relay Terminology, classification of Protective Relays, Electromagnetic Relays, Introductory aspects of static relaying. **UNIT-III** **Over-current Protection-** Over-current Protective Schemes, Directional Relay, Protection Parallel Feeders, Protection of Ring Mains, Earth Fault Protection, Directional Earth Fa Relay, Static Over-current Relays, applications of Over-current Relay.

UNIT-IV

Distance Protection-Characteristics ofImpedance Relay, Reactance Relay, Mho Relay, Zones Protection, Applications of distance protection.

UNIT-V

Pilot Relaying Schemes-Pilot types, construction and operating principles, Bus-zone Protection-Protection of Generators, Transformer Protection, Auto re-closing mechanisms - Co-ordination of relaying schemes in power system. Testing and maintenance of protective relays.

Text Books:

1. B.Ravindranath and M.Chander, Power System Protection and Switchgear, Wiley Eastern, New Delhi, 1977.

2. Badrinath and D.N.Viswakarma, Power System Protection and Switchgear, Tata McGraw-Hill, 1995.

3. C.R.Mason, The Art and Science of Protecting relaying, John wiley& Sons, 195
4. A.R.VanC.Warrington, Protective Relays-Their Theory and Practice, Vol.I and II, 3rd ed. Chapman & hall, London and John Wiley & Sons, New York, 1977.

5. S.S.Rao, Switchgear and Protection, Khanna publishers, delhi,1986.

6. T.S.M.Rao, Power System Protection: Static relays w microprocessor applications,2nded, Tata McGrah-Hill, New delhi,1989.

2 **Course Outcomes: Students will be able to**

CO-1	Understand • various types of faults • Protective schemes • Power system protective equipment • significance of relay testing and co-ordination
CO-2	Design and develop different protection schemes
CO-3	Select and apply different relays in real time power system protection

3	**MAPPING**

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3									
2	3	3			2			1		
3	3	2	2		1	1		2		

EE PSC 202A	**OPTIMAL CONTROL THEORY** ***Instruction : 4 hr / week*** ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1	**Syllabus:**

UNIT-I

Introduction : The mathematical model of a process, Physical constraints. The performance measure, The optimal control problem,Forms of the optimal control, state variable representation of system –system classification and output equations,Solution of state equation-Linear Systems, typical control problems, selection of performance measure, Controllability and observability.

UNIT-II

The calculus of variations : Fundamental concepts , maxima and minima of functions, fundamental theorem of calculus of variations , functionals of single function, The simplest variational problem – Euler's equation , fixed end point problem- free end point problem functionals involving several independent functions- problem with fixed end points- problem with free end points, Constrained extrema-costrained minimization of function and functional.

UNIT-III

Variational approach to optimal : control problems: Necessary conditions for optimal control Hamaltonian function – Boundary conditions in optimal control problems – Linear regulator problems – Matrix ricalti equation – linear Tracking problem.

Numerical determination of optimal trajectories: Two – point boundary – value

problem – method of steepest descent – steepest Descent algorithm.

UNIT-IV

Pontryagin's minimum principle : State un equality constraints – minimum time problem – minimum control effort problem – minimum fuel problem – minimum energy problem

UNIT-V

Dynamic programing : The optimal control law, The principle of optimality, Dynamic programming applied to routing problem, An optimal control systems- A recurrence relation of dynamic programming – Computational procedure for solving optimal control problems- Analytical results , Discrete linear regulator problems, Hamilton-Jacobian-Bellman equation- Continuous linear regulator problems.

Text Books:

1. Optimal Control Theory – Donald E.Kirk
2. Optimal System Control – A.P.Sage.
3. Modern Control Systems Theory – M.GOPAL.

2 **Course Outcomes: Students will be able to**

CO-1	Demonstrate knowledge in • Variational approaches to control systems • Min/max principle • dynamic programming application in control
CO-2	Analyze different solutions for minimizing performance measure
CO-3	Apply above principles for solving numerical problems in optimal control.

3 **MAPPING**

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3		3	2						
2	3	2	3	3	3	3				
3	3	1	3	3	3			1		

EE PSC 203	**OPERATION & CONTROL OF INTERCONNECTED POWER SYSTEMS** ***Instruction : 4 hr / week*** ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1	**Syllabus:** **UNIT-I** **Economic operation of power systems** : Introduction – operating cost of a thermal plant – Economic dispatch neglecting losses and no generation limits – economic dispatch neglecting losses and including generation limits, Economic dispatch including losses – derivation of loss formula **UNIT-II** **Hydrothermal scheduling** – Hydroelectric power plants – Scheduling of hydro power plant – hydro thermal scheduling- problems. **UNIT-III** **Unit commitment and optimal power flow; constraints of unit commitment problem** – Solution methods of unit commitment priority list methods – Dynamic programming approach to solve the unit commitment problem – optimal power flow solution – Elementary treatment of optimal power flow with and without constraints. **UNIT-IV** **Load frequency control** : The load frequency control problem – Basic p-f and Q-V control loops of a synchronous generator – Governor model – prime mover model – Generator model – Load model – Block diagrams representation of an isolated single area power system – steady state and dynamic responses of uncontrolled and proportional plus integral control of single area power system – load frequency control of two-area power system. **UNIT-V** **Automatic voltage regulator** – modeling of amplifier, exciter, Generator and sensor – A simplified automatic voltage regulator block diagram – Excitation system stabilizer – Rate feedback and PID controller – automatic excitation generation control - optimal feed back design.. **Text Books**: 1. "Power System Analysis" by HadiSaadat, Tata Mc.Graw Hill International.

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<tr><td></td><td colspan="2">2. “Modern Power system analysis” by J.Nagrath& DP Kothari, Tata Mc.Graw Hill second edition.
3. “Power System Analysis and design” by B.R.Gupta wheeler publishing
4. “Electrical energy system theory” by O.I.Elgerd Tata Mc Grawhill Ltd second edition.
5. Power system control and stability : by Anderson Foud</td></tr>
<tr><td rowspan="4">2</td><td colspan="2">Course Outcomes (COs): students are able to</td></tr>
<tr><td>CO-1</td><td>Acquire knowledge on optimum operation and scheduling of thermal and hydel plants, unit commitment, load frequency control and automatic voltage generation.</td></tr>
<tr><td>CO-2</td><td>Solve economic dispatch, unit commitment, load frequency control and automatic voltage generation using conventional method</td></tr>
<tr><td>CO-3</td><td>Select and apply appropriate methods to operate inter connected power systems most economically and at constant frequency by optimum utilization of fuels at different loads.</td></tr>
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EE PSC 204	**POWER SYSTEM STABILITY** ***Instruction : 4 hr / week*** ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1	**Syllabus:** **<u>UNIT-I</u>** **Steady State Stability:** Stability, Steady state stability, Power limit of a short transmission line, Power angle characteristic and steady state stability limit of cylindrical rotor synchronous machines, Power angle characteristic and steady state stability limit of salient pole synchronous machines, steady state stability limit of a two machine system with and

	without losses, incremental analysis and synchronizing coefficient. **UNIT-II** **Clarke's Diagrams:** Clarke diagram for single machine connected to infinite bus bar, Clarke diagram for two machine system with negligible losses, Clarke diagram for reactance network including shunt admittance, Clarke diagram for two machine system with losses, Effect of inertia and governor operation on stability. **UNIT - III** **Transient Stability:** Swing equation, Equal area criterion; sudden change in mechanical input, effect of clearing time on stability, sudden loss of one of parallel lines, short circuit at one end of the line, short circuit away from the line ends, reclosure, determination of critical clearing angle. Simulation of equal area criterion using MATLAB. **UNIT-IV** **Numerical solution of swing equation:** Numerical solution of swing equation by point by point method, Swing curve, determination of critical clearing time, SIMULINK block diagram model for the swing equation, determination of critical clearing time using MATLAB. **UNIT-V** **Voltage Stability:** Introduction, Reactive power transmission, voltage stability limit, Graphical methods: P-V curve and V-Q curve, shunt compensation and series compensation, comparison of series and shunt compensation. **Text Books :** 1. Power System Analysis by HadiSaadat, Tata Mc.Graw Hill edition. 2. Analysis and stability of Electric power systems by K.A. Gangadhar.3. Modern power system analysis by Nagrath and Kothari,TataMc.Graw Hill edition.4. Power system analysis and design by B.R. Gupta.	
2	**Course Outcomes(COs):**	
	CO-1	Gain the knowledge on Steady State, Transient and Voltage Stability aspects
	CO-2	Select suitable method, mathematical model and tool for stability studies

	CO-3	Analyze the given power system network with respect to stability point of view
3	**MAPPING**	

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3									
2	3				2					
3	3	2	1		2			2		

EE PSE 203	**FACTS AND CUSTOM DEVICES**
	Instruction : 4 hr / week ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1	**Syllabus:**

UNIT-I

FLEXIBLE AC TRANSMISSION SYSTEM: Transmission inter connections, flow of power in ac systems, loading capability, dynamic stability considerations, basic types of FACTS controllers.

UNIT-II

STATIC SHUNT COMPENSATORS: Objectives of shunt compensation, static var compensators, STATCOM configuration, characteristics and control, comparison between STATCOM and SVC.

UNIT-III

STATIC SERIES COMPENSATION: Objectives of series compensation, Variable Impedance type series compensators, switching converter type series compensators, external control for series reactive compensators.

UNIT-IV

UPFC: Principle of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the series compensators and phase angle regulators.

IPFC: Principle of operation and characteristics and control aspects.

UNIT-V

CUSTOM POWER DEVICES: Introduction to custom power devices, DSTATCOM and DVR operating principles, their applications In Distribution Systems

Text Books:

1. Hingorani ,L.Gyugyi, ' Concepts and Technology of flexible ac transmission system', IEEE Press New York, 2000.

2. K.R.Padiyar, "FACTS controllers in power transmission and distribution", New age International Publishers, Delhi, 2007.

2 **Course Outcomes(COs):Students will be able to**

CO-1	Acquire knowledge on: • Transmission line performance without FACTS. • Transmission line performance with FACTS. • Construction & operation characteristics of different FACTS.
CO-2	Acquire knowledge on: • Distribution line performance without Custom power. • Distribution line performance with Custom power. • Construction & operation characteristics of different Custom power devices.

3 **MAPPING**

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3	3	3		3					
2	3	3	3		3					

EE PSE 205	**NEURAL AND FUZZY CONTROL SYSTEMS**
	Instruction : 4 hr / week ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1	**Syllabus:** **UNIT-I** Biological Neurons and their artificial models, Models of artificial neural networks, Neural Processing, Learning and adaptation, Neural networks learning rules. Single-layer Perception networks, Multi layer feed forward networks, Single layer feedback networks: Back propagation, Learning and training, Hopfield network. **UNIT-II** Neural networks for non-linear systems, Schemes of neuro control, system identification, Forward model and inverse model, Indirect learning neural network control applications, Case studies. **UNIT-III** Fuzzy sets, Fuzzy operation, Fuzzy relations, Fuzzy relational equations, Fuzzy measure, Fuzzy functions, Approximate reasoning, Fuzzy propositions, Fuzzy quantifiers, If-then rules. **UNIT-IV** Structure of Fuzzy Logic Controller, Fuzzification models, Database, Rulebase, Inference Engine, Defuzzication modules, Fuzzy Control Applications, Case studies. **UNIT-V** Adaptive Fuzzy Controllers: Design and Performance Evolution, Membership function tuning, Self organizing Controllers, Modelbased Controller, Stability of Fuzzy Control systems. **Text Books:** 1. Jacker.M.Zurada, "Introduction to Artificial Neural Systems". Jaico Publishing House,1999. 2. Kosko.B, "Neural Networks and Fuzzy Systems", PHI,1994. 3. Drainkov,Hellendroon,Reinfran, "Introduction to Fuzzy Control", Narosa Publishers. 4. John Yen and RejaLangari, "Fuzzy Logic Intelligence, Control and Information", Pearson Education,2003.

2	**Course Outcomes(COs):Students will be able to**	
	CO-1	Demonstrate knowledge in: • Neural networks and fuzzy logic • Design of fuzzy controllers • Adaptive fuzzy controllers.
	CO-2	Apply fuzzy logic for designing of Fuzzy and adaptive fuzzy controllers for different real time systems
3	**MAPPING**	

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3			3		3				
2	2	2	2	2		3		3		

EE PSE 209	**RENEWABLE ENERGY SOURCES** ***Instruction : 4 hr / week*** ***Credits : 4*** ***Assessment : 20 + 20 + 60***
1	**Syllabus:** **UNIT-I** **Introduction to Energy Sources :**Energy sources and their availability, Non-renewable reserves and resources; renewable resources, Transformation of Energy, Energy scenario in India. **UNIT-II** **Solar Energy**- Basic characteristics of sunlight – solar energy resource – Solar processes and spectral composition of solar radiation; Radiation flux at the Earth's surface. Solar collectors. Types and performance characteristics. **UNIT-III** **Applications photovoltaic cell** - Characteristics – equivalent circuit –photo voltaic effect – photo voltaic for battery charging – applications. **UNIT-IV**

Biomass Energy Systems- Biomass sources – production processes – Gasification, Anaerobic Digestion, Pyrolysis, Biogas – performance analysis and testing.

UNIT-V

Wind energy- Wind distribution – principles of wind energy conversion – basic components of wind energy conversion – advantages and disadvantages – principles of operation of wind turbines, types of wind turbines and characteristics, Generators for wind Turbines, Control strategies..

Text Books :

1. G.D.Rai "Non Conventional Energy sources", Khanna publishers, New Delhi, 1999.
2. G.N.Tiwari and M.K.Ghosal, "Renewable energy resources, Basic principles and applications", Narosa Publishing house, New Delhi.
3. S.N.Badra, D.Kastha and S.Banerjee "Wind electrical Sustems", Oxford University press, New Delhi.
4. M.V.R.Koteswara Rao "Energy resources Conventional & Non conventional" BS publications – Hyderabad, 2004.
5. Gilbert M.Masters "Renewable and Efficient electric power systems" Wiley interscience Publications, 2004.

2 **Course Outcomes (COs): students are able to**

CO-1	Gain knowledge on non-renewable sources like solar, biomass, wind energies
CO-2	Realize solar energy applications using photo voltaic cells
CO-3	Analyses biogas performance and testing

3 **MAPPING**

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3			2		2				
2	3		2	1	2	2		2		
3	3	1	1			2		1		

EEPSC 101B	**COMPUTER METHODS IN POWER SYSTEMS Lab**		
	Instruction : 2hr / week	***Credits : 2***	***Assessment : 40 + 60***

1	**Syllabus:** Based on the **CMPS theory** syllabus (**EEPSC 101A**) the experiments are to be conducted practically with MATLAB/ETAP/MATPOWER environment. Aminimum numberof 8 experiments out of maximum 10 experiments are to be conducted. .	
2	**Course Outcomes (COs): students are able to**	
	CO-1	Select and apply modern Engineering tools like MATLAB for solving Power System problems
	CO-2	Analyze the power system network for different conditions
3	**MAPPING**	

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3			3	3			2		
2	3	2	1	2	3			3		

EEPSC 102B	**DIGITAL CONTROL SYSTEMS Lab** ***Instruction : 2hr / week*** ***Credits : 2*** ***Assessment : 40 + 60***	
1	**Syllabus:** Based on the **DCS** syllabus (**EEPSC 102A**) the experiments has conducted practically with MATLAB/ETAP/MATPOWER environment minimum of 8 and maximum of 10 during their course period. .	
2	**Course Outcomes (COs): students are able to**	
	CO-1	Interpret and recall the basic mathematical operations
	CO-2	Assess the different state space techniques
	CO-3	Select and apply stability methods for digital control system

3	**MAPPING**

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3				3					
2	3				3			2		
3	3	2		2	3			2		

EE PSE 201A	**ADVANCED POWER SYSTEM PROTECTION Lab**
	Instruction : 2hr / week ***Credits : 2*** ***Assessment : 40 + 60***
1	**Syllabus:**
	Based on the **APSP** syllabus (**EEPSC 201A**) the experiments has conducted practically with MATLAB/ETAP/MATPOWER environment minimum of 8 and maximum of 10 during their course period.
2	**Course Outcomes (COs): students are able to**

CO-1	Conduct test on different types of electromechanical relays
CO-2	Conduct test on different types of micro-controller relays
CO-3	Find solutions for the numerical problems related to synchronous machine dynamics

3 **MAPPING**

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3	1						1		
2	3	1						3		
3	3	1		1	3			1		

<table>
<tr><td>EEPSC 202B</td><td colspan="2">OPTIMAL CONTROL THEORY Lab
Instruction : 2hr / week Credits : 2 Assessment : 40 + 60</td></tr>
<tr><td>1</td><td colspan="2">Syllabus:
Based on the OCT syllabus (EEPSC 202A) the experiments has conducted practically with MATLAB/ETAP/MATPOWER environment minimum of 8 and maximum of 10 during their course period.</td></tr>
<tr><td rowspan="3">2</td><td colspan="2">Course Outcomes (COs): students are able to</td></tr>
<tr><td>CO-1</td><td>Convert state space representation of the system into Jordan canonical form and test controllability and observability.</td></tr>
<tr><td>CO-2</td><td>Investigate the stability of a system by time domain and frequency domain methods</td></tr>
<tr><td>3</td><td colspan="2">MAPPING
<table>
<tr><td rowspan="2">Course Outcomes</td><td colspan="10">Program Outcomes</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>1</td><td>3</td><td></td><td></td><td></td><td>3</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>2</td><td>3</td><td>1</td><td></td><td></td><td>3</td><td></td><td></td><td>1</td><td></td><td></td></tr>
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<table>
<tr><td>EE PSE 209</td><td>SEMINAR
Instruction : 3hr / week Credits : 2 Assessment : 100</td></tr>
<tr><td>1</td><td>Syllabus:
The seminar topics are should be relevant to the current trends in field of power systems or the topics from different subjects in the semester.
For each seminar course, the sessional marks for a maximum of 100 shall be awarded based on the quality, depth and organization of contents, documentation, presentation</td></tr>
</table>

	and answering capability of questions from the participants of the seminar.	
2	**Course Outcomes (COs): students are able to**	
	CO-1	prepare comprehensive report based on literature survey/Topics related to different subjects in the semester
	CO-2	Identify the applicability of modern software tools and technology.
	CO-3	Deliver presentation based on the preparation
	CO-4	Answer queries posed by the listeners.
	CO-5	Correct himself to improve presentation skills.
3	**MAPPING**	

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3	1			3		3			1
2	1				3					
3	3						3			
4							3			1
5							3			3

EE PSE 209	**COMPREHENSIVE VIVA**		
	Instruction : -----	***Credits : 2***	***Assessment : 100***
1	The comprehensive viva shall be conducted by a committee consisting of one external examiner and two internal examiners. The external examiner shall be appointed by the principal from among panel of examiners recommended by the chairman, BOS (PG) concerned whereas, the internal examiners shall be nominated by the HOD concerned.		

2	**Course Outcomes (COs): students are able to**	
	CO-1	Prepare comprehensively to answer questions from all the courses of two semesters.
	CO-2	Attain Oral Presentation skills by answering questions in precise and concise manner.
	CO-3	Gain confidence and inter-personal skills.
3	**MAPPING**	

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3									
2							3			
3								3		

EE PSE 209	**PROJECT WORK**		
	Instruction : 3hr / week	***Credits : 4***	***Assessment : 20 + 20 + 60***
1	The Evaluation of the project work are to be carried out in the following way: 1. Continuous Evaluation through guide. 2. An open pre-submission seminar by the student. 3. End-semester University Examination (An open seminar followed by a Viva-voce)		
	Course Outcomes (COs): students are able to		
	CO-1	Prepare comprehensive report based on literature survey.	
	CO-2	Select a suitable problem relevant to power systems with an attention to real life problems faced by the society	

	CO-3	Find solution either through simulation or through practical work.
	CO-4	Present the results from the work comprehensively through presentation.
	CO-5	Present his/her work in a conference or publish the work in a peer reviewed journal
3	**MAPPING**	

Course Outcomes	Program Outcomes									
	1	2	3	4	5	6	7	8	9	10
1	3		3				3	3	3	1
2	3	3	3	3	3	3		2	3	1
3	3	3	3	3	3	2			3	2
4	1						3		2	
5	3			3			3		3	3