COURSE STRUCTURE
AND
DETAILED SYLLABUS

M.TECH
POWER SYSTEMS CONTROL AND AUTOMATION

For
M.TECH TWO YEAR DEGREE PROGRAMME
(Applicable for the batches admitted from 2018-2019)

VAAGDEVI COLLEGE OF ENGINEERING
(Autonomous)
Bollikunta, Warangal-506 005
Telangana State, India.

VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE

M.TECH (POWER SYSTEM CONTROL AND AUTOMATION)

(Applicable for the batches admitted from A.Y. 2018-2019 onwards)

I-SEMESTER

S.No	Course Code	Title of the Course	L	T	P	Credits
1	M18PS01	Advanced Power System Analysis	3	0	0	3
2	M18PS02	Advanced Power System Protection	3	0	0	3
3	M18PS03 M18PS04 M18PE04 M18PE05	**Program Elective-I** Economic operation power systems Power System Reliability Renewable Energy Systems Modern Control Theory	3	0	0	3
4	M18PE01 M18PS05 M18EC02	**Program Elective-II** Analysis of Power Electronics Converters Distribution System Planning Micro Controller and Applications	3	0	0	3
5	M18MC01	Research Methodology	2	0	0	2
6	M18PS06	Power Systems Simulation Lab-I	0	0	4	2
7	M18PS07	Power Systems Lab-I	0	0	4	2
8	M18AC02	**Audit Course-I** Stress Management	2	0	0	0
		Total Credits	**16**	**0**	**8**	**18**

II-SEMESTER

S.No	Course Code	Title of the Course	L	T	P	Credits
1	M18PS08	Power System Dynamics	3	0	0	3
2	M18PS09	Power System Automation	3	0	0	3
3	M18PS10 M18PE14 M18PE15	**Program Elective-III** Restructured Power Systems Digital Control Systems Power Quality	3	0	0	3
4	M18PS11 M18PS12 M18PS13	**Program Elective-IV** AI Techniques in Electrical Engineering EHV AC Transmission Reactive Power Compensation and Voltage Stability	3	0	0	3
5	M18PS14	Power Systems Simulation Lab-II	0	0	4	2
6	M18PS15	Power Systems Lab-II	0	0	4	2
7	M18PS16	Mini Project	0	0	4	2
8	M18AC01	**Audit Course-II** English for Research Paper Writing	2	0	0	0
		Total Credits	**14**	**0**	**12**	**18**

III-SEMESTER

S.No	Course Code	Title of the Course	L	T	P	Credits
1	M18PE12 M18PS17 M18PS18 M18EC04	**Program Elective-V** HVDC & FACTS Smart Grid Technologies Distributed Generation Advanced Digital Signal Processing	3	0	0	3
2	M18EE01 M18ME01 M18EE02	**Open Elective** Energy Auditing, Conservation and Management Industrial Safety Optimization Techniques	3	0	0	3
3	M18PS19	Dissertation Phase-I	0	0	20	10
		Total Credits	**06**	**0**	**20**	**16**

IV-SEMESTER

S.No	Course Code	Title of the Course	L	T	P	Credits
1	M18PS20	Dissertation Phase-II	0	0	32	16
		Total Credits	**0**	**0**	**32**	**16**

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS01) ADVANCED POWER SYSTEM ANALYSIS

M. TECH:I-SEMESTER **L/T/P/C**
3/- /- /3

Prerequisite: Computer Methods in Power Systems

UNIT-I:

Admittance Model and Network Calculations, Branch and Node Admittances, Mutually Coupled Branches in Y_{BUS}, An Equivalent Admittance Network, Modification of Y_{BUS}, Network Incidence Matrix and Y_{BUS}, Method of Successive Elimination, Node Elimination, Triangular Factorization, Sparsity and Near Optimal Ordering.

UNIT-II:

Impedance Model and Network Calculations, the BUS Admittance and Impedance Matrices, Thevenins Theorem and Z_{BUS}, Algorithms for building Z_{BUS} Modification of existing Z_{BUS}, Calculation of Z_{BUS} elements from Y_{BUS}, Power Invariant Transformations, Mutually Coupled Branches in ZBUS.

UNIT-III:

Gauss Seidel method, N-R Method, Decoupled method, fast decoupled method, comparison between power flow solutions. DC load flow.

UNIT-IV:

Z_{BUS} Method in Contingency Analysis, Adding and Removing Multiple Lines, Piecewise Solution of Interconnected Systems, Analysis of Single Contingencies, Analysis of Multiple Contingencies, Contingency Analysis of DC Model, System Reduction for Contingency and Fault Studies.

UNIT-V:

Fault Analysis: Symmetrical faults-Fault calculations using Z_{BUS}- Fault calculations using ZBUS equivalent circuits –Selection of circuit breakers- Unsymmetrical faults-Problems on various types of faults.

TEXT BOOKS:

1. Power System Analysis, John J.Grainger and W.D. Stevenson, T.M.H.Edition.
2. Modern Power System Analysis, I.J.Nagrath & D.P.Kothari Tata Mc Graw–Hill Publishing Company Ltd, Second edition.

REFERENCES:

1. Power System Analysis and Design, J.Duncan Glover and M.S.Sarma, cengage Third edition.
2. Electrical Energy Systems Theory, Olle. L.Elgard, T.M.H.Edition.
3. Power System Operation and Control, Dr. K. Uma Rao, Wiley India Pvt. Ltd.
4. Power System Operation, Robert H. Miller, Jamesh H. Malinowski, McGraw-Hill companies.
5. Power Systems Analysis, operation and control, Abhijit Chakrabarti, Sunitha Halder, PHI, Third edition, 2010.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Perform power system network calculations using admittance model and explore various network reduction techniques.
2 Learn the algorithm for building Zbus of the network and modify the impedance matrix to perform network calculation.
3 Explore various load flow studies for the power system network
4 Explore various contingencies in the power system and reduce system for different contingency analysis
5 Gain knowledge on various types of fault on the system and select circuit breakers for different operating conditions

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS02) ADVANCED POWER SYSTEM PROTECTION

M. TECH:I-SEMESTER **L/T/P/C**
3/- /- /3

Prerequisite: Switch Gear and Protection

UNIT-I:

STATIC RELAYS: Advantages of static relays-Basic construction of static relays-Level detectors-Replica impedance –Mixing circuits-General equation for two input phase and amplitude comparators-Duality between amplitude and phase comparators.

AMPLITUDE COMPARATORS: Circulating current type and opposed voltage type- rectifier bridge comparators, Direct and Instantaneous comparators.

UNIT-II:

PHASE COMPARATORS: Coincidence circuit type- block spike phase comparator, techniques to measure the period of coincidence-Integrating type-Rectifier and Vector product type-Phase comparators.

STATIC OVER CURRENT RELAYS: Instantaneous over-current relay-Time over-current relays basic principles–definite time and Inverse definite time over-current relays.

UNIT-III:

STATIC DIFFERENTIAL RELAYS: Analysis of Static Differential Relays–Static Relay schemes–Duo bias transformer differential protection –Harmonic restraint relay.

STATIC DISTANCE RELAYS: Static impedance-reactance–MHO and angle impedance relay sampling comparator–realization of reactance and MHO relay using sampling comparator.

UNIT-IV:

MULTI-INPUT COMPARATORS: Conic section characteristics-Three input amplitude comparator–Hybrid comparator-switched distance schemes –Poly phase distance schemes phase fault scheme –three phase scheme – combined and ground fault scheme.

POWER SWINGS: Effect of power swings on the performance of distance relays–Power Swing analysis-Principle of out of step tripping and blocking relays-effect of line and length and source impedance on distance relays.

UNIT-V:

MICROPROCESSOR BASED PROTECTIVE RELAYS: (Block diagram and flowchart approach only)- Over current relays–impedance relays-directional relay-reactance relay. Generalized mathematical expressions for distance relays-measurement of resistance and reactance–MHO and offset MHO relays-Realization of MHO characteristics-Realization of offset MHO characteristics-Basic principle of Digital computer relaying.

TEXT BOOKS:

1. Power system protection and Switch gear, Badri Ram and D.N.Vishwakarma, TMH publication New Delhi 1995.
2. Power System Protection: Static Relays with Microprocessor Applications, T. S. Madhava Rao, Tata Mc Graw Hill Education.

REFERENCES:

1. Protection and Switchgear, Bhavesh Bhalja, R. P. Maheshwari, Nilesh G. Chothani, Oxford University Press.
2. Electrical Power System Protection, C. Christopoulos and A. Wright, Springer International.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Learn constructional details of static relays and importance of duality of comparators in them.

2 Explore various techniques to measure the period of coincidence in phase comparators and learn the operation of static over current relays

3 Apply static relay for transformer and transmission line protection

4 Study the characteristics of multi-input hybrid comparators and analyse the power swing on the performance of distance relays.

5 Learn basic principle of operation and application of microprocessor based relaying.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS03) ECONOMIC OPERATION OF POWER SYESTEMS
(Program Elective – I)

M. TECH:I-SEMESTER **L/T/P/C**
3/- /- /3

Prerequisite: Power System Operation and Control

UNIT-I:

ECONOMIC LOAD DISPATCH AND UNIT COMMITMENT: Economic dispatch problem – Economic importance – Economic dispatch of Thermal Units and methods of solutions – Iterative and non–iterative – problem considering and neglecting transmission losses – economic dispatch using dynamic programming.

Unit Commitment – Definition – Constraints in Unit Commitment–Unit Commitment solution methods – Priority – Dynamic Programming methods. Economic dispatch versus Unit Commitment.

UNIT-II:

HYDRO THERMAL CO-ORDINATION: Introduction to long range and short range hydro scheduling, Types of short range scheduling problem, Scheduling energy. Constraints in hydro–units – hydro thermal coordination - short term hydro-thermal scheduling problems and its solution by dynamic programming.

UNIT-III:

OPTIMAL POWER FLOW: Need of Optimal Power Flow – OPF Problem with and without Inequality Constraints – OPF solution methods – gradient, Newton method, linear programming and interior point methods.

UNIT-IV:

AUTOMATIC GENERATION CONTROL AND VOLTAGE CONTROL: Control of generation – models of power system elements – development of state variable model of single and two area system – generation control with PID controllers – implementation of Automatic Generation Control (AGC) – Automatic load frequency control loop to multi area systems, tie line power flow model. Static and dynamic performance of AVR loop, automatic load frequency control, primary and secondary loop.

Production and absorption of reactive power - Methods of Voltage Control – Shunt reactors –Shunt Capacitors – Series Capacitors – Synchronous condensers – Static Var systems – tap changing transformers – Distribution system voltage regulation.

UNIT-V:

MARKET OPERATIONS: load forecasting, components in market operation of power system – Interchange, Pooling, Brokers and Auctioning, Interchange contracts, Energy Interchange between utilities, power wheeling, power pools, Energy broker system, Auction markets for power system. Definitions of spot markets and Day-a-ahead markets, ATC definitions.

TEXT BOOKS:

1. Power Generation Operation and control, Allen J.Wood and Wollenberg B.F, John Wiley & Sons, Third edition, 2013.
2. Power System Analysis, Operation and Control, Abhijit Chakrabarti and Sunita Halder, PHI, Third edition, 2010
3. Power System Operation and Control, Dr. K. Uma Rao, Wiley India Pvt. Ltd.

REFERENCES:

1. Power System Operation, Robert H. Miller, Jamesh H. Malinowski, The Mc Graw – Hill companies.
2. Economic Operation of Power Systems, G L.K. Kirchmayer, John Wiley & Sons.
3. Optimization of Power system operation, Jizhong Zhu, IEEE Press series on Power Engineering, John Wiley and sons Inc.

COURSE OUTCOMES:

After the completion of this course students should be able to

1	Gain knowledge on economic operation of power system and its solution techniques.
2	Understand hydrothermal scheduling techniques and maintenance scheduling
3	Study the need of optimal power flow in power systems and various solution techniques
4	Get the insight of Automatic generation control and voltage control using compensation devices
5	Explore various forecasting techniques and power markets in deregulated power system operation.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS04) POWER SYSTEM RELIABILITY
(Program Elective – I)

M.TECH:I-SEMESTER **L/T/P/C**
3/- /- /3

Prerequisite: Reliability Engineering

UNIT-I:

GENERATING SYSTEM RELIABILITY ANALYSIS – I: Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal - Evaluation of loss of load and energy indices – Examples.

UNIT-II:

GENERATING SYSTEM RELIABILITY ANALYSIS – II: Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units – 2- level daily load representation - merging generation and load models – Examples.

UNIT-III:

OPERATING RESERVE EVALUATION: Basic concepts - risk indices – PJM methods – security function approach – rapid start and hot reserve units – Modelling using STPM approach.

BULK POWER SYSTEM RELIABILITY EVALUATION: Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

UNIT-IV:

INTER CONNECTED SYSTEM RELIABILITY ANALYSIS: Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity - imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency.

DISTRIBUTION SYSTEM RELIABILITY ANALYSIS – I (RADIAL CONFIGURATION): Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices – load point and system reliability indices – customer oriented, loss and energy oriented indices – Examples.

UNIT-V:

DISTRIBUTION SYSTEM RELIABILITY ANALYSIS - II (PARALLEL CONFIGURATION): Basic techniques – inclusion of bus bar failures, scheduled maintenance – temporary and transient failures – weather effects – common mode failures –Evaluation of various indices – Examples

SUBSTATIONS AND SWITCHING STATIONS: Effects of short-circuits - breaker operation – Open and Short circuit failures – Active and Passive failures – switching after faults – circuit breaker model – preventive maintenance – exponential maintenance times.

TEXT BOOKS:

1. Reliability Evaluation of Power systems, R. Billinton, R.N.Allan, BS Publications, 2007.
2. Reliability Modeling in Electric Power Systems, J. Endrenyi, John Wiley and Sons, 1978.

REFERENCES:

1. Reliability Engineering: Theory and Practice, Alessandro Birolini, Springer Publications.
2. An Introduction to Reliability and Maintainability Engineering, Charles Ebeling, TMH Publications.
3. Reliability Engineering, E. Balaguruswamy, TMH Publications.
4. Reliability Engineering, A. Elsayed, Prentice Hall Publications.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Assess the generation system reliability under outage and evaluate the loss of load – energy indices.

2 Evaluate the cumulative probability and cumulative frequency of non-identical generating units and merge generation load models

3 Distinguish various methods and approaches to evaluate operating reserves and bulk power system reliability indices

4 Analyse the reliability indices of interconnected system and radial distribution system with independent loads

5 Evaluate the reliability of the parallel distribution systems and study the effect of short circuits in substation and switching stations.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PE04) RENEWABLE ENERGY SYSTEMS
(Program Elective – I)

M.TECH:I-SEMESTER **L/T/P/C**
3/- /- /3

Prerequisite: None

UNIT- I:

SOLAR ENERGY SYSTEMS: Introduction – solar radiation - solar thermal energy conversion - Flat plate collector - concentric collectors- solar pond - central receiver system- solar pumping - Solar photovoltaic systems - characteristics of PV cell- Photo voltaic modules - Types of Photo voltaic systems.

UNIT-II:

WIND ENERGY AND BIO GAS: Basics of wind energy - classification of turbines - wind characteristics - energy extraction - Betz limit - Modes of wind power generation- Bio Mass energy conversion - Anaerobic Digestion - Aerobic Digestion - Gasification-Bio Gas Plants.

UNIT-III:

OCEAN ENERGY CONVERSION: Tidal Energy generation - characteristics of Tides - Power generation schemes - Components in Tidal power plant- Wave Energy - Principle of wave energy plant - Wave energy conversion machines - Ocean Thermal Energy conversion - Principle - cycles of operation - Types of OTEC plants - Applications

UNIT-IV:

GEO-THERMAL ENERGY AND FUEL CELLS : HYBRID ENERGY SYSTEMS: Geothermal Energy - Structure of Earth's interior - Geothermal fields, gradient, resources - Geothermal power generation - Fuel cells – Introduction - Principle of operation - Types of Fuel cells - State of art fuel cells-energy output of a fuel cell - operating characteristics of fuel cells - thermal efficiency - Need for Hybrid systems - Types of Hybrid systems.

UNIT-V:

ENVIRONMENTAL ASPECTS OF ELECTRIC ENERGY GENERATION: Introduction - Thermal pollution - Hydel power projects - Impact on environment - Nuclear power generation – Impact on environment - Impact of renewable energy generation on environment - Global environmental awareness.

TEXT BOOKS:

1. Renewable Energy Resources and emerging technologies, D.P.Kothari, K.C.Singal, R.Ranjan, PHI, Second edition, 2011.
2. Renewable Energy Resources, John Twidell and Tony Weir, second edition, CRC Press
3. Energy conversion systems, Rakosh Das Begamudre, New Age International Publishers, New Delhi - 2000.
4. Energy conversion systems, Rakosh das Begamudre, New age International publishers, New Delhi - 2000.
5. Renewable Energy Resources, John Twidell and Tony Weir, Second edition, Routledge.

REFERENCES:

1. Understanding Renewable Energy Systems, Volker Quaschning, 2005, UK.
2. Renewable Energy Systems-Advanced Conversion, Technologies & Applications, Faner Lin Luo Honer Ye, CRC press, Taylor & Francis group.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Understand the characteristics of PV cell- Photo voltaic modules and its applications.
2 Understand the basics of wind energy conversion systems and bio-gas energy generation.
3 Analyze various Wave energy conversion machines - Ocean Thermal Energy conversion schemes.
4 Gain Knowledge on the need of hybrid energy systems such as geothermal and fuel cells.
5 Assess the impact of various renewable energy sources on environment.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PE05) MODERN CONTROL THEORY
(Program Elective – I)

M. TECH:I-SEMESTER **L/T/P/C**
3/- /- /3

Prerequisites: Control Systems

UNIT-I:

MATHEMATICAL PRELIMINARIES AND STATE VARIABLE ANALYSIS: Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous Time State models - Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties. Complete solution of state space model due to zero input and due to zero state.

UNIT II:

CONTROLLABILITY AND OBSERVABILITY: General concept of controllability – Controllability tests, different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms.

UNIT III:

STATE FEEDBACK CONTROLLERS AND OBSERVERS: State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers.

UNIT IV:

NON-LINEAR SYSTEMS: Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

UNIT V:

STABILITY ANALYSIS: Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

TEXT BOOKS:

1. Modern Control System Theory, M.Gopal, New Age International, 1984.
2. Modern Control Engineering, Ogata. K, Prentice Hall, 1997.
3. Control Systems, N K Sinha, New Age International Third edition.

REFERENCES:

1. Optimal Control Theory an Introduction, Donald E.Kirk, Prentice - Hall Network series, First edition.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Gain knowledge on basic concepts and various terms related to modern control system concepts.
2 Understand the concepts of controllability and observability.
3 Analyze the state feedback controller design and gain knowledge on full order and reduced order observers.
4 Understand the concepts of linearization of nonlinear systems.
5 Assess the stability of the system by using Lyapunov stability analysis.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PE01) ANALYSIS OF POWER ELECTRONIC CONVERTERS
(Program Elective – II)

M.TECH: I-SEMESTER **L/T/P/C**
3/- /- /3

Prerequisite: Power Electronics

UNIT I:
SINGLE PHASE & THREE PHASE CONVERTERS: Single phase converters – Half controlled and Fully controlled converters – Evaluation of input power factor and harmonic factor – continuous and Discontinuous load current – single phase dual converters – power factor Improvements Techniques– Extinction angle control – symmetrical angle control, PWM – single phase sinusoidal PWM – single phase series converters – overlap analysis – Applications & Problems.
Three phase converters – Half controlled and fully controlled converters – Evaluation of input power factor and harmonic factor – continuous and Discontinuous load current – three phase dual converters – power factor Improvements Techniques– three phase PWM - twelve pulse converters – Applications – Problems – Design of converters.

UNIT II:
AC VOLTAGE CONTROLLERS: Single phase AC voltage controllers with Resistive, Resistive-inductive and Resistive inductive-induced e.m.f. loads – ac voltage controllers with PWM Control – Effects of source and load inductances - Synchronous tap changers.
Three phase AC voltage controllers – Analysis of controllers with star and delta Connected Resistive, Resistive-inductive loads – Effects of source and load Inductances – Applications & Problems.

UNIT III:
CYCLO-CONVERTERS: Single phase to single phase cyclo-converters – analysis of midpoint and bridge Configurations – Three phase to three phase cyclo-converters –analysis of Midpoint and bridge configurations – Limitations – Advantages – Applications & Problems - Matrix Converter.

UNIT IV:
D.C. TO D.C. CONVERTERS: Analysis of step-down and step-up dc to dc converters with Resistive and Resistive-inductive loads – Switched mode regulators – Analysis of Buck Regulators - Boost regulators – buck and boost regulators – Cuk regulators – Condition for continuous inductor current and capacitor voltage – comparison of regulators –Multi output boost converters – advantages – Applications – Problems.

UNIT V:
PULSE WIDTH MODULATED INVERTERS: Principle of operation – performance parameters – single phase bridge inverter- evaluation of output voltage and current with resistive, inductive and Capacitive loads– Voltage control of single phase inverters – single PWM – Multiple PWM – sinusoidal PWM – modified PWM – phase displacement Control – Advanced modulation techniques for improved performance – Trapezoidal, staircase, stepped, harmonic injection and delta modulation – Advantages – Applications & Problems.

Three phase inverters – analysis of 180 degree conduction for output voltage And current with resistive, inductive loads – analysis of 120 degree Conduction – voltage control of three phase inverters – sinusoidal PWM – Third Harmonic PWM – 60 degree PWM – space vector modulation – Comparison of PWM techniques – harmonic reductions – Problems.

TEXT BOOKS:

1. Power Electronics, Mohammed H. Rashid, Pearson Education Third Edition – First Indian reprint 2004.
2. Power Electronics, Ned Mohan, Tore M. Undeland and William P. Robbins, John Wiley & Sons, Third Edition.

REFERENCE BOOKS:

1. Power converters circuits, Milliman Shepherd and Lizang, Chapter 14 (Matrix converter), PP- 415-444.
2. Power Electronics Hand Book, Academic Press, 2006.
3. Control in power electronics, Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg, Academic Press, 2002.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Analyze the principle of operation of single phase and three phase converters.
2 Analyze the single phase and three phase AC voltage controller for various loads.
3 Understand the various configurations of cyclo converters and their limitations.
4 Gain knowledge on various DC to DC converter topologies.
5 Understand the various control techniques for DC to AC converters including pulse width modulation techniques.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS05) DISTRIBUTION SYSTEM PLANNING
(Program Elective – II)

M.TECH:I-SEMESTER **L/T/P/C**
3/- /- /3

Prerequisite: EDS

UNIT-I:
Distribution System Planning:
Planning and forecasting techniques – Present and future – Role of computers.
Load Characteristics:
Definitions – Load forecasting – methods of forecast – regression analysis – correlation analysis and time series analysis – Load management – tariffs and metering of energy..

UNIT-II:
Distribution Transformers:
Types – Three phase and single phase transformers – connections – Dry type and self protected type transformers – regulation and efficiency.
Sub Transmission Lines and Distribution Sub–Stations:
Distribution substations –Bus schemes –description and comparison of switching schemes Substation location and rating.

UNIT-III:
Primary Systems:
Types of feeders – voltage levels – radial type feeders.
Voltage Drop And Power Loss Calculations:
Three phase primary lines – Copper loss – Distribution feeder costs – Loss reduction and Voltage improvement in rural networks.

UNIT-IV:
Capacitors in Distribution Systems:
Effects of series and shunt capacitors – justification for capacitors – Procedure to determine optimum capacitor size and location.
Distribution System Protection:
Basic definitions – types of over current protection devices. Objective of distribution system protection.

UNIT-V:
Grounding:
Grounding system – earth and safety – nature and sizes of earth electrodes – design – earthing schemes.
Metering and Tariff:
Integrated sub– station metering system – Revenue improvement – issues in multi–year tariff and availability based tariff.

TEXT BOOKS:

1. Electric Power Distribution Engg., Turan Gonen, Mc-Graw Hill, 3rd Edition.
2. Electric Power Distribution, A. S. Pabla, TMH,2000.

REFERENCES:

1. Transmission and Distribution Electrical Engineering, Colin Bayliss, Butterworth Heinemann, 1996
2. Electrical Distribution Engineering, Pansini
3. Electricity distribution network design, E. Lakervi & E J Holmes, 2nd edition, Peter Peregrimus Ltd.
4. Power System Reliability, Safety and Management, Dhillan, B.S., An Arbor Sam, 1981.

COURSE OUTCOMES:

After the completion of this course students should be able to

1	Explore various distribution system planning and forecasting techniques and understand the tariffs and metering of energy transactions.
2	Understand and distinguish characteristics of different transformers employed in distribution system and identify and select appropriate sub–station location and rating
3	Explore various types of feeders of primary distribution and calculate the voltage and loss in them. Explore various voltage improvement and loss reduction techniques.
4	Analyse the need of capacitor in distribution system and optimally locate capacitor banks for compensation of voltage drop in the system. Explore the protection schemes adopted in distribution system.
5	Design the appropriate grounding system with proper size of earthing electrodes and explore the integrated substation metering and available power tariffs.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18EC02) MICROCONTROLLERS AND APPLICATIONS
(Program Elective – II)

M.TECH: I-SEMESTER **L/T/P/C**
3/- /- /3

Prerequisite: Microprocessors and Interfacing Devices

UNIT-I:

OVERVIEW OF ARCHITECTURE & MICROCONTROLLER RESOURCES: Architecture of a microcontroller – Microcontroller resources – Resources in advanced and next generation microcontrollers – 8051 microcontroller – Internal and External memories – Counters and Timers – Synchronous serial-cum asynchronous serial communication - Interrupts.

UNIT-II:

8051- MICROCONTROLLERS INSTRUCTION SET: Basic assembly language programming – Data transfer instructions – Data and Bit manipulation instructions – Arithmetic instructions – Instructions for Logical operations on the test among the Registers, Internal RAM, and SFRs – Program flow control instructions – Interrupt control flow.

UNIT-III:

REAL TIME CONTROL INTERRUPTS: Interrupt handling structure of an MCU – Interrupt Latency and Interrupt deadline – Multiple sources of the interrupts – Non-maskable interrupt sources – Enabling or disabling of the sources – Polling to determine the interrupt source and assignment of the priorities among them – Interrupt structure in Intel 8051. TIMERS: Programmable Timers in the MCU's – Free running counter and real time control – Interrupt interval and density constraints.

UNIT-IV:

SYSTEMS DESIGN DIGITAL AND ANALOG INTERFACING METHODS: Switch, Keypad and Keyboard interfacings – LED and Array of LEDs – Keyboard-cum-Display controller (8279) – Alphanumeric Devices – Display Systems and its interfaces – Printer interfaces – Programmable instruments interface using IEEE 488 Bus – Interfacing with the Flash Memory – Interfaces – Interfacing to High Power Devices – Analog input interfacing – Analog output interfacing – Optical motor shaft encoders – Industrial control – Industrial process control system – Prototype MCU based Measuring instruments – Robotics and Embedded control – Digital Signal Processing and digital filters.

UNIT-V:

REAL TIME OPERATING SYSTEM FOR MICROCONTROLLERS: Real Time operating system – RTOS of Keil (RTX51) – Use of RTOS in Design – Software development tools for Microcontrollers. 16-BIT MICROCONTROLLERS: Hardware – Memory map in Intel 80196 family MCU system – IO ports – Programmable Timers and High-speed outputs and input captures – Interrupts – instructions. ARM 32 Bit MCUs: Introduction to 16/32 Bit processors – ARM architecture and organization – ARM / Thumb programming model – ARM / Thumb instruction set – Development tools.

TEXT BOOKS:

1. Microcontrollers Architecture, Programming, Interfacing and System Design, Raj Kamal, Pearson Education, 2005.
2. The 8051 Microcontroller and Embedded Systems, Mazidi and Mazidi, PHI, 2000.

REFERENCES:

1. Microcontrollers (Theory & Applications), A.V. Deshmuk, WTMH, 2005.
2. Design with PIC Microcontrollers, John B. Peatman, Pearson Education, 2005.
3. Microcontroller Programming, Julio Sanchez, Maria P. Canton, CRC Press.
4. The 8051 Microcontroller, Ayala, Cengage Learning.
5. Microprocessors and Microcontrollers, Architecture, Programming and System Design, Krishna Kant, PHI Learning PVT. Ltd.
6. Microprocessors, Nilesh B. Bahadure, PHI Learning PVT. Ltd.

COURSE OUTCOMES:

After the completion of this course students should be able to

1	Relate the basic architecture and addressing modes of a microcontroller.
2	Gain knowledge on various instruction sets for 8051 microcontrollers.
3	Analyze a typical I/O interface and understand interrupts and timer circuits.
4	Demonstrate assembly language programs for 16-bit Microcontroller, assembly language code for high-level language structures such as IF-THENELSE and DO-WHILE.
5	Translate Hardware applications using Microcontrollers

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18MC01) RESEARCH METHODOLOGY

M.TECH: I-SEMESTER **L/T/P/C**
2/- /- /2

Prerequisites: English

UNIT I:
RESEARCH METHODOLOGY: Objectives and Motivation of Research, Significance of Literature review, Types of Research, Research Approaches, and Research Methods verses Methodology, Research and Scientific Method, Importance of Research Methodology, Research Process, Criteria of Good Research.

UNIT II:
RESEARCH DESIGN: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, ,Data collection methods, Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data.

UNIT III:
RESEARCH REPORT WRITING: Format of the Research report, Synopsis, Dissertation, References/Bibliography/ Webliography, Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

UNIT IV:
NATURE OF INTELLECTUAL PROPERTY: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

UNIT V:
PATENT RIGHTS: Scope of Patent Rights. Licensing and transfer of technology. Patentinformation and databases. New Developments in IPR: Administration of Patent System.

TEXT BOOKS:

1. Research Methodology, Methods & Technique, C.R Kothari, New Age. International Publishers, 2004.
2. Research Methodology for Engineers, R. Ganesan, MJP Publishers, 2011.
3. Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell, Mark A. Lemley, 2016.
4. Intellectual Property Rights Under WTO, T. Ramappa, S. Chand, 2008.
5. Intellectual property rights and copy right, Satarkar, S.V, ESS Publications,2000.

REFERENCE:

1. Research Methodology: A Step by Step Guide for beginners, Ranjit Kumar, 2nd Edition.
2. Resisting Intellectual Property, Halbert, Taylor & Francis Ltd ,2007.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Gain the knowledge on literature review collection.
2 Analyze research related information.
3 Understand research problem formulation.
4 Emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5 Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS06) POWER SYSTEMS SIMULATION LAB – I

M.TECH: I-SEMESTER **L/T/P/C**
-/- / 4/2

LIST OF EXPERIMENTS

1. Develop Program for YBUS formation.
2. Develop Program for G-S Load Flow Analysis.
3. Develop Program for N-R Load Flow Analysis.
4. Simulation of Ferranti Effect in transmission line.
5. Develop Program for Short Circuit Analysis.
6. Develop Program for Transient Stability Analysis for Single Machine connected to Infinite Bus by Point by Point Method.
7. Write a program and simulate dynamical system of following models.
   i. I/O Model
   ii. State variable model also identify time domain specifications of each
8. Obtain frequency response of a given system by using various models
   i. General method of finding the frequency domain specifications
   ii. Polar plot
   iii. Bode plot
   iv. Also obtain the gain margin and phase margin.
9. Transform a given dynamical system from I/O model to state variable model and vice versa.
10. Design a PID controller based Bode plot

COURSE OUTCOMES:

After the completion of this course students should be able to

1. Acquire the skill of converting the system in equivalent admittance and impedance model
2. Demonstrate the load flows with programming
3. Develop program to illustrate the fault and transient stability analysis in the system
4. Simulate dynamic power system to show the frequency response of the system.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS07) POWER SYSTEMS LAB - I

M.TECH: I-SEMESTER **L/T/P/C**
-/- / 4/2

LIST OF EXPERIMENTS

1. Determination of Equivalent circuit of a 3-Winding Transformer.
2. Determination of Sequence Impedances of a Cylindrical Rotor Synchronous Machine
3. Single Line to Ground fault (L-G) Analysis of an Alternator
4. Line to Line fault (L-L) Analysis of an Alternator
5. Determination of Sub-transient reactance's of a Salient Pole Synchronous Machine.
6. Determination of Sequence Impedances of Three Phase Transformer
7. Determination of regulation & efficiency of Transmission lines.
8. Determination of A, B, C, D constants of Transmission Line.
9. Study of Ferranti effect and Surge Impedance loading in transmission line.
10. Analysis of Double line to Ground (L-L-G) fault on Alternator.

COURSE OUTCOMES:

After the completion of this course students should be able to

1. Demonstrate the symmetrical and unsymmetrical fault in the generator
2. Realize the Ferranti effect in the transmission line and extract generalized constants of a transmission network
3. Perform fault analysis on synchronous machine, 3 winding transformer and 3 Phase Transformer
4. Determine efficiency of transmission line

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18AC02) STRESS MANAGEMENT
(Audit Course)

M.TECH: I-SEMESTER **L/T/P/C**
2/- / -/0

Prerequisites: None

Unit-I
Understanding Stress: Meaning – Symptoms – Work Related Stress – Individual Stress – Reducing Stress -sources of stress –consequence of stress-burnout-symptoms of Burnout- stress verses Burnout-model of stress-strategies for coping stress (individual and organizational strategies) –case study

Unit-II
Time Management: Techniques – Importance of Planning the day –developing concentration – Prioritizing Beginning at the start – Techniques for conquering procrastination – Sensible delegation – Taking the right breaks – Learning to say "No"

Unit-III
Career Plateau: Career plateau – Identifying Career plateaus – Structural and Content - Plateauing – Making a fresh start – Importance of Sabbaticals – Counseling out – Executive leasing – Sustaining a marketable Career.

Unit-IV
Crisis Management: Implications – People issues – Structure issues – Environmental issues – Learning to keep calm - Preventing interruptions – Controlling crisis – Pushing new ideas – Empowerment – Work place Humor, developing a sense of Humor – Learning to laugh – role of group cohesion and team spirit.

Unit-V
Self-Development: Improving personality – Leading with Integrity – Enhancing Creativity – Effective decision making – Sensible Communication – The Listening Game – Managing Self – Mediation for peace – Yoga for Life

TEXT BOOKS
1. The Executive Track: An Action Plan for Self-Development, R.L Bhatia, Wheeler Publishing, New Delhi.
2. Human Values for Manager, Charavathy.S.K, McGraw Hill/Henely Management Series.

REFERENCES
1. Managing Stress, Jeffr Davison, Prentice Hall of India, New Delhi.
2. Comprehensive Stress Management, Jerrold S Greenberg, Jain Books, 2009.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Enhance of Physical strength and flexibility.
2 Learn to relax and focus.
3 Relieve physical and mental tension
4 Improve work performance/ efficiency.
5 Gain knowledge about yoga and meditation

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS08) POWER SYSTEM DYNAMICS

M.TECH: II-SEMESTER **L/T/P/C**
3/- / -/3

UNIT-I:

BASIC CONCEPTS: Power system stability states of operation and system security – system dynamics – problems system model analysis of steady State stability and transient stability – simplified representation of Excitation control.

UNIT-II:

MODELING OF SYNCHRONOUS MACHINE: Synchronous machine - park's Transformation-analysis of steady state performance per – unit quantities-Equivalent circuits of synchronous machine-determination of parameters of equivalent circuits.

UNIT-III:

EXCITATION SYSTEM: Excitation system modelling-excitation systems block Diagram - system representation by state equations- Dynamics of a synchronous generator connected to infinite bus – system model Synchronous machine model-stator equations rotor equations - Synchronous machine model with field circuit - one equivalent damper winding on q axis (model 1.1) – calculation of Initial conditions.

UNIT-IV:

ANALYSIS OF SINGLE MACHINE SYSTEM: Small signal analysis with block diagram - Representation Characteristic equation and application of Routh Hurwitz criterion- synchronizing and damping torque analysis-small signal model - State equations.

UNIT-V:

APPLICATION OF POWER SYSTEM STABILIZERS: Basic concepts in applying PSS - Control signals - Structure and tuning of PSS – Washout circuit - Dynamic compensator analysis of single machine infinite bus system with and without PSS.

TEXT BOOK:

1. Power system dynamics, K.R. Padiyar, B.S. Publications.

REFERENCE:

1. Power system control and stability, P.M. Anderson and A.A. Fouad, IEEE Press.
2. Power Systems Dynamics, R. Ramanujam, PHI Publications.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Learn the basics of system dynamics and able to analyse steady state stability and transient stability
2 Model synchronous machine to analyse steady state operation analyse its dynamics of operation.
3 Model the excitation system and analyse the dynamics of the synchronous machine connected to infinite bus.
4 Analyse the small signal stability of the system using Routh's Hurwitz criterion
5 Dynamic compensator analysis of single machine infinite bus system with and without PSS.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS09) POWER SYSTEM AUTOMATION

M.TECH: II-SEMESTER **L/T/P/C**
3/- / -/3

UNIT I:

POWER SYSTEM AUTOMATION: Introduction –Evolution of automation system – Benefits of power system automation, Structure of power system automation, Electrical Protection, Control, Measurement, Monitoring- Architecture for power system automation – Classification of power system automation – Substation automation and Distribution automation – Problems with Data acquisition - implementation of power system automation and protection using SCADA.

UNIT II:

ENERGY MANAGEMENT SYSTEMS (EMS): Introduction, EMS in Power Systems, Objectives of EMS, Evolution of EMS, Functions and Benefits of EMS, EMS Architecture, Working of EMS, Evolution of EMS.

PROGRAMMABLE LOGIC CONTROLLERS: Introduction – Basic Operation – PLC architecture and components – Programming Languages – PLC's Applications to Power System Automation.

UNIT III:

SCADA FUNDAMENTALS: Introduction – Building Blocks of SCADA - SCADA in power systems – Its application functions in Generation, Transmission and Distribution – Advantages of SCADA - SCADA Communication systems - RTUs – Components of RTUs –Communication Protocols – Advanced RTU functionalities, IEDs, Data concentrators and merging units, Human Machine Interface, Classification of SCADA systems Single master–single remote, Single master–multiple RTU, Multiple master–multiple RTUs, Single master, multiple submaster, multiple remote.

UNIT IV:

SUBSTATION AUTOMATION: Why Substation automation (SA)? Why now?, Role of IEDs in SA, Conventional substations: Islands of automation, Substation automation issues, SA architectures, application functions, Enterprise- level application functions, Benefits of data analysis to utilities

UNIT V:

DISTRIBUTION AUTOMATION: Introduction to Distribution Automation (DA), control system interfaces, control and data requirements, centralized (Vs) decentralized control, DA System (DAS), DA Hardware, DAS software, Distribution Automation Functions-Information management, system reliability management, system efficiency management, voltage management, Load management, Communication systems used in DA - DA communication requirements, Communication reliability, Cost effectiveness, Data rate Requirements, Two way capability, Technical Benefits of DA.

TEXT BOOKS

1. Power system SCADA and smart grids, Mini S Thomas, John D Mcdonald, CRC Press, 2015.
2. Control and Automation of Electrical Distribution Systems, James. Northcote, Green Robert Wilson, CRC Press.
3. Electric Power Distribution Automation, Dr. M. K. Khedkar, Dr. G.M.Dhole, University Science press.
4. PLCs and SCADA- Theory and Practice, Rajesh Mehra, Vikrant Vij, Laxmi Publications, First edition, 2016.

REFERENCES

1. NPTEL course on Energy Management Systems and SCADA

COURSE OUTCOMES:

After the completion of this course students should be able to

1	Learn the need of structure and operation of power system automation and its evolution with SCADA.
2	Understand the Energy Management System and the role of program logic controller in EMS.
3	Learn the fundamentals of SCADA and its various classification to various applications
4	Understand the substation automation structure and its applications functions.
5	Explore various control schemes of distribution automation and know its technical benefits.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS10) RESTRUCTURED POWER SYSTEMS
(Program Elective – III)

M.TECH: II-SEMESTER **L/T/P/C**
3/- / -/3

Prerequisite: PSOC and EOPS

UNIT I:

INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY: Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behaviour, Supplier behaviour, Market equilibrium, Short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models, Electricity vis – a – vis other commodities, Market architecture, Case study.

UNIT II:

TRANSMISSION CONGESTION MANAGEMENT: Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

UNIT III:

LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS: Mathematical preliminaries: - Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality -Simultaneous feasibility test and revenue adequacy – FTR issuance process: FTR auction, FTR allocation – Treatment of revenue shortfall – Secondary trading of FTRs – Flow gate rights – FTR and market power - FTR and merchant transmission investment.

UNIT IV:

ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK: Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service - How to obtain ancillary service –Co-optimization of energy and reserve services - International comparison 16 Transmission pricing – Principles – Classification – Rolled in transmission pricing methods – Marginal transmission pricing paradigm – Composite pricing paradigm – Merits and demerits of different paradigm.

UNIT IV:

REFORMS IN INDIAN POWER SECTOR: Introduction – Framework of Indian power sector – Reform initiatives - Availability based tariff – Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future.

TEXT BOOKS

1. Competition and Choice in Electricity, S. Hunt and G. Shuttleworth, John Wiley.
2. Power System Economics: Designing Markets for Electricity, S. Stoft, John Wiley.
3. Power System Restructuring and Deregulation, L. L. Lai, John Wiley.
4. Operation of Restructured Power Systems, K. Bhattacharya, M. H. J. Bollen and J. E. Daalder, Springer.
5. Optimization Principles: Practical Applications to the Operation and Markets of the Electric Power Industry, N. S. Rau, John Wiley

REFERENCES

1. M. llic and F. Galiana, "Power System Restructuring Engineering & Economics", Academic.
2. L. Philipson and H L. Willis, "Understanding Electric Utilities and Deregulation", CRC Press.
3. M. Shahidehpour, H. Yamin and Z. Li, "Market Operations in Electric Power Systems", John Wiley.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Acquire basic knowledge on restructuring of power industry and market models.
2 Impart knowledge on fundamental concepts of congestion management and its classifications
3 Understand locational marginal pricing and its various methods of evaluation.
4 Explore various ancillary services and international Transmission pricing paradigms
5 Review of framework of Indian power sector and its initiatives and its various reforms

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PE14) DIGITAL CONTROL SYSTEMS
(Program Elective – III)

M.TECH: II-SEMESTER **L/T/P/C**
3/- / -/3

Prerequisite: None

UNIT – I:

Introduction: Block Diagram of typical control system- advantages of sampling in control systems – examples of discrete data and digital systems – data conversion and quantization – sample and hold devices – D/A and A/D conversion – sampling theorem – reconstruction of sampled signals – ZOH. Z-transform: Definition and evaluation of Z-transforms – mapping between s-plane and z-plane – inverse z-plane transform – theorems of the Z-transforms –limitations of z-transforms – pulse transfer function –pulse transfer function of ZOH –relation between G(s) and G(z) – signal flow graph method applied to digital systems.

UNIT- II:

State Space Analysis: State space modeling of digital systems with sample and hold – state transition equation of digital time in variant systems – solution of time in variant discrete state equations by the Z-Transformation – transfer function from the state model – Eigen values – Eigen vector and diagonalisation of the A-matrix – Jordan canonical form. Computation of state transition matrix-Transformation to phase to variable canonical form-The state diagram – decomposition of digital system – Response of sample data system between sampling instants using state approach. Stability: Definition of stability – stability tests – The second method of Liapunov.

UNIT- III:

Time Domain Analysis: Comparison of time response of continuous data and digital control systems-correlation between time response and root locus j the s-plane and z-plane – effect of polezero configuration in the z-plane upon the maximum overshoot and peak time of transient response – Root loci for digital control systems – steady state error analysis of digital control systems – Nyquits plot – Bode plot-G.M and P.M.

UNIT- IV:

Design: The digital control design with digital controller with bilinear transformation – Digital PID controller-Design with deadbeat response-Pole placement through state feedback-Design of full order state observer-Discrete Euler Lagrance Equation – Discrete maximum principle.

UNIT-V:

Digital State Observer: Design of - Full order and reduced order observers. Design by max. Principle: Discrete Euler language equation-discrete maximum principle.

TEXT BOOKS:

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition.
2. Digital Control and State Variable Methods by M. Gopal, TMH.

REFERENCE:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control Engineering, M. Gopal

COURSE OUTCOMES:

After the completion of this course students should be able to

1	Acquire a strong foundation in sampling and reconstruction Z-transforms.
2	Apply knowledge of Mathematics, Z-plane analysis to discrete time control systems.
3	Replace the conventional control system with Digital control system.
4	Evaluate and apply Z-plane analysis of discrete time control systems
5	Apply state feedback controllers and observers

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PE15) POWER QUALITY
(Program Elective – III)

M.TECH: II-SEMESTER **L/T/P/C**
3/- / -/3

Prerequisite:
Power Systems
Power Electronics

Course Objectives:

1. To study, understand and analyze various power quality issues.
2. To be able to address power quality problems with various mitigation techniques.

UNIT-I: Power quality problems and definitions

Voltage sag, Voltage swells, Voltage spikes, Voltage notches, Voltage fluctuations, Over/Under voltages, Interruptions, transients, unbalance and Harmonics. Causes and effects of power quality disturbances on various power system equipments. Overview of power quality phenomenon and compensation techniques. Power outages: System average interruption frequency index (SAIFI), Customer average interruption frequency index (CAIFI), System average Interruption duration index (SAIFI), Customer average interruption duration index (CAIDI), Momentary average interruption frequency index (MAIFI)
Unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers.
voltage sag: Voltage sag energy, Voltage sag lost energy index (VSLEI), and Distortions,

UNIT-II: Single phase circuits: power definitions and its components

Power terms in a single-phase systems- Active power, Reactive power, Apparent power, Non active power, Distortion power and power factor- for sinusoidal voltage source supplying non-linear load current, Non-sinusoidal voltage supplying non-linear loads.

UNIT III: Three phase balanced/unbalanced sinusoidal/non-sinusoidal circuits: power definitions and its components

Three-phase sinusoidal system: Three-phase instantaneous active and reactive power, power invariance in *abc* and $\alpha\beta 0$ coordinates.
Three-phase non-sinusoidal balanced system: Three-phase instantaneous active, reactive powers and oscillatory powers, Symmetrical components, Effective apparent power, positive sequence powers and unbalance power. Neutral current, Line to Line voltage, apparent power with budeanu resolution for balanced distortion case. Effective apparent power for balanced non-sinusoidal systems
Three phase unbalanced non-sinusoidal system: Three-phase instantaneous powers, Arithmetic and Vector Apparent Power with Budeanu's Resolution, Effective apparent power.

UNIT-IV: Passive and active shunt compensator/power filters:

Passive compensators: Classification, Principle of operation, Analysis and design for single-phase/three-phase power factor correction and zero voltage regulation.

Passive power filters: Introduction, classification, Principle of operation, Analysis and design, parallel resonance and its mitigation.
Active compensation: Load compensation using symmetrical component theory
Active power filter: Synchronous reference frame theory based control

UNIT-V: Passive and Active series compensator:
Introduction, Classification of series compensators, Design and principle of operation, Series active compensator: Control or series compensator based on synchronous reference frame theory.

Text Books:

1. Ghosh, Arindam, and Gerard Ledwich. *Power quality enhancement using custom power devices*. Springer Science & Business Media, 2012.
2. Singh, Bhim, Ambrish Chandra, and Kamal Al-Haddad. *Power quality: problems and mitigation techniques*. John Wiley & Sons, 2014.

Reference book:

1. Bollen, Math HJ. "Understanding power quality problems." *Voltage sags and Interruptions*. IEEE press, 2000.
2. Chattopadhyay, Surajit, Madhuchhanda Mitra, and Samarjit Sengupta. "Electric power quality." *Electric Power Quality*. Springer, Dordrecht, 2011. 5-12.

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

1. Know the terminology, and definitions of various power quality problems and their analysis.
2. Define and understand the components of current/power in sinusoidal/non-sinusoidal single-phase supply/load systems.
3. Define and understand the components of current/power in sinusoidal/non-sinusoidal three-phase supply/load systems.
4. Design of passive/active shunt compensators and power filters.
5. Design of passive/active series compensators.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS11) AI TECHNIQUES IN ELECTRICAL ENGINEERING
(Program Elective – IV)

M.TECH: II-SEMESTER **L/T/P/C**
3/- / -/3

Prerequisite: None

UNIT-I:

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

UNIT-II:

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

UNIT-III:

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

UNIT-IV:

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

UNIT-V:

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

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

After the completion of this course students should be able to

1	Gain knowledge on models and architecture of artificial neural networks and various learning process involved in neural networks.
2	Explore various paradigms of artificial neural network such as BPA, RBF and SO Mapping etc
3	Get the concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy rules
4	Acquire complete knowledge on genetic algorithm including three genetic operators.
5	Apply AI techniques to various power system problems

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS12) EHV AC TRANSMISSION
(Program Elective – IV)

M.TECH: II-SEMESTER **L/T/P/C**
3/- / -/3

Prerequisite: Power System - II

UNIT-I:
E.H.V.A.C. Transmission line trends and preliminary aspect standard transmission voltages – Estimation at line and ground parameters-Bundle conductor systems-Inductance and Capacitance of E.H.V. lines - positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

UNIT-II:
Electrostatic field and voltage gradients – calculations of electrostatic field of AC lines–Effect of high electrostatic field on biological organisms and human beings - surface voltage gradients and maximum gradients of actual transmission lines – voltage gradients on sub conductor.

UNIT-III:
Electrostatic induction in unenergized lines – measurement of field and voltage gradients for three phase single and double circuit lines – un energized lines. Power Frequency Voltage control and over-voltages in EHV lines: No load voltage – charging currents at power frequency-voltage control – shunt and series compensation – static VAR compensation.

UNIT-IV:
Corona in E.H.V. lines – Corona loss formulae- attention of traveling waves due to Corona –Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – frequency spectrum of RI fields – Measurements of RI and RIV.

UNIT-V:
Design of EHV lines based on steady state and transient limits - EHV cables and their Characteristics.

TEXT BOOKS:
1. EHVAC Transmission Engineering, R. D. Begamudre, New Age International (p) Ltd. Third edition.
2. HVDC Power Transmission Systems, K.R. Padiyar, New Age International (p) Ltd. Second revised Edition, 2012.

REFERENCES:

1. EHVAC and HVDC Transmission Engg. Practice,S. Rao, Khanna publishers.
2. High Voltage Direct Current Transmission, Arrillaga.J, Second Edition (London) peter Peregrines, IEE, 1998.
3. FACTS Controllers in Power Transmission and Distribution,Padiyar.K.R, New Age Int. Publishers, 2007.
4. Understanding FACTS-Concepts and Technology ofFlexible AC Transmission Systems, Hingorani H G and Gyugyi. L, New York, IEEE Press, 2000.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Explore various trends and preliminary aspects of EHVAC transmission line voltage and line parameters
2 Evaluate the electrostatic field of EHAC lines and voltage gradients on the line and also study its effect on bio organism and human being.
3 Study the field and voltage gradient on an un-energized lines and explore VAR compensating devices.
4 Study the concept of Corona in E.H.V. lines and impact of radio interference on EHV lines
5 Design the EHV cables and lines and study their characteristics for transient and steady state limits

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS13) REACTIVE POWER COMPENSATION AND VOLTAGE STABILITY
(Program Elective – IV)

M.TECH: II-SEMESTER **L/T/P/C**
3/- / -/3

Prerequisite: Power Systems – II, **Computers Methods in Power Systems**

UNIT-I:

LOAD COMPENSATION: Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

UNIT-II:

STEADY–STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM: Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation –examples

TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation – compensation using synchronous condensers – examples.

UNIT III:

REACTIVE POWER COORDINATION: Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences.

UNIT-IV:

INTRODUCTION TO VOLTAGE STABILITY: Definitions - Voltage Stability, Voltage Collapse, Voltage Security; Physical relation indicating dependency of voltage on reactive power flow; Factors affecting Voltage collapse and instability; Previous cases of voltage collapse incidences. Comparison of Voltage and angular stability of the system, P-V and Q-V curves, Voltage Stability Indices.

LOADS THAT INFLUENCES VOLTAGE STABILITY: Discharge lights, Induction Motor, Air-conditioning, heat pumps, electronic power supplies, OH lines and cables.

UNIT-V:

REACTIVE POWER COMPENSATION: Generation and Absorption of reactive power, Series and Shunt compensation, Synchronous condensers, SVCs, Booster Transformers.

VOLTAGE STABILITY MARGIN: Stability Margin - Compensated and un-compensated systems.

VOLTAGE SECURITY: Definition - Methods to improve voltage stability and its practical aspects.

TEXT BOOKS:

1. Reactive power control in Electric power systems, T.J.E.Miller, John Wiley and sons, 1982.
2. Reactive power Management by D.M.Tagare, Tata McGraw Hill,2004.
3. Performance, operation and control of EHV power transmission system, A.Chakrabarthy, D.P.Kotari and A.K.Mukopadyay, A.H.Wheeler Publishing, First edition, 1995.

REFERENCES:

1. Reactive Power Compensation: A Practical Guide,Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just, April, 2012, Wiely publication.
2. Power System Voltage Stability, C.W.Taylor, Mc Graw Hill, 1994.
3. Power System Dynamics: Stability and Control, K.R.Padiyar, Second edition, B.S.Publications.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Understand the need of load compensation in voltage regulation and power factor correction

2 Explore various reactive power compensation in transmission systems for steady state and transient state operation

3 Coordinate the reactive power compensation to balance quality power supply, effect of under voltages, harmonics and electromagnetic interference.

4 Study the effect of compensation on the voltage and angle stability and analyze the effect of different loads on the voltage stability

5 Explore various series and shunt compensating devices and their effect on voltage stability margin and voltage security.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS14) POWER SYSTEMS SIMULATION LAB - II

M.TECH: II-SEMESTER **L/T/P/C**
-/- /4 /2

LIST OF EXPERIMENTS

1. Simulation of Load flows using Back Propagation Algorithm.
2. NN Toolbox verification of Load flows.
3. Determination optimal value of Sin(x) using Genetic Algorithm
4. Economic Load Dispatch with Genetic Algorithm.
5. Economic Load Dispatch using PSO.
6. Toolbox verification of ELD problem.
7. Unit Commitment using Fuzzy logic method
8. Single Area Load frequency control with Fuzzy Logic control
9. Two Area Load frequency control with Fuzzy Logic control
10. Load forecasting using ANFIS.

COURSE OUTCOMES:

After the completion of this course students should be able to

1. Apply neural network tool box to simulate ED, load flows etc
2. Simulate load frequency control using fuzzy controllers
3. Gain working knowledge on ANFIS and apply it to load forecasting
4. Simulate unit commitment using Fuzzy Logic

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS15) POWER SYSTEMS LAB - II

M. TECH: II-SEMESTER **L/T/P/C**
-/- /4 /2

LIST OF EXPERIMENTS

1. Characteristics of Microprocessor based Over Current Relay
2. Characteristics of Over Voltage Relay.
3. Characteristics of Under Voltage Relay.
4. Unbalanced current and voltage protection with Static Negative sequence Relay
5. Performance and Testing of Generator Protection System.
6. Performance and Testing of Transformer Protection System.
7. Over current protection of Feeder lines.
8. Differential protection on Single Phase Transformer.
9. Characteristics of IDMT Electromagnetic Over Current Relay
10. Study of earth fault protection of feeder lines

COURSE OUTCOMES:

After the completion of this course students should be able to

1. Study the characteristics of mechanical and microprocessor based relays
2. Protect the feeder from faulty conditions
3. Study the Characteristics of IDMT Electromagnetic Over Current Relay
4. Study the characteristics of Over and Under voltage relay.

VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18AC01) ENGLISH FOR RESEARCH PAPER WRITING
(Audit Course)

M.TECH: II-SEMESTER **L/T/P/C**
2/- / - /0

Prerequisites: None

UNIT I:
ACADEMIC WRITING: What is Research? - Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT II:
RESEARCH FORMAT: Title – Abstract – Introduction – Discussion - Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT III:
RESEARCH METHODOLOGY: Methods (Qualitative – Quantitative) – Literature Review – Who did what – Criticizing, Paraphrasing & Plagiarism.

UNIT IV:
PROCESS OF WRITING A RESEARCH PAPER: Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - Typing the final draft

UNIT V:
HOW TO & WHERE TO GET PUBLISHED: Reputed Journals – National/International – ISSN No, No. of volumes, Scopes Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

TEXT BOOKS:

1. MLA Hand book for writers of Research Papers, East West Press Pvt. Ltd, New Delhi, Seventh edition.
2. Research Methodology Methods and Techniques, C. R Kothari, Gaurav, Garg, New Age International Publishers. Fourth edition.
3. Schaum's Quick Guide to Writing Great Research Papers, Lauri Rozakis, Tata McGraw Hills Pvt. Ltd, New Delhi.
4. Scientific Thesis Writing and Paper Presentation, N. Gurumani, MJP Publishers

REFERENCES:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Write a research paper with required writing skills and be confident to share their writing with others
2 Publish a paper using the requisite standard in a journal and Review the research papers and articles in a scientific manner.
3 Work on citations and ably place them in her research paper.
4 Check plagiarism and be able to develop their own writing skills in presenting the research work.
5 Gain knowledge on publishing papers with peer reviewed journals.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PE12) HVDC & FACTS
(Program Elective – V)

M.TECH: III-SEMESTER **L/T/P/C**
3/- / - /3

Prerequisite: Power Electronics and Power Systems

UNIT-I:
Need for power system interconnections – Evolution of AC and DC transmission systems – Comparison of HVDC and HVAC Transmission systems – Types of DC links – relative merits – Components of a HVDC system – Modern trends in DC Transmission systems – Pulse number – choice of converter configurations – Analysis of Graetz circuit with and without overlap – voltage waveforms – Analysis of two and three valve conduction mode.

UNIT-II:
Converter Bridge characteristics –Inverter mode of operation – voltage waveforms – Principles of DC link control – Converter Control characteristics – system control – Constant current Control – CEA Control – firing angle control of valves – Starting and stopping of a dc link – Power control.

UNIT-III:
Harmonics & Filters – effects of Harmonics – sources of harmonic generation – Types of filters – Design examples – Power flow Analysis in AC/DC systems – Modelling of DC links – solutions of AC-DC Power flow.

UNIT-IV:
Power flow in AC systems – Relative importance of controllable parameters – Basic types of FACTS controllers – shunt and series controllers – Current source and Voltage source converters – Objectives of shunt compensation – Methods of controllable VAR generation – Static Var Compensator – its characteristics – TCR – TSC – FC –TCR configurations – STATCOM – basic operating principle – control approaches and characteristics.

UNIT-V:
Objectives of series compensator – variable impedance type of series compensators – TCSC – TSSC – operating principles and control schemes – SSSC – Power Angle characteristics – Control range and VAR rating – Capability to provide reactive power compensation – external control – Introduction to Unified Power Flow Controller – Basic operating principles – Conventional control capabilities – Independent control of real and reactive power.

TEXT BOOKS:

1. Direct current Transmission, E.W. Kimbark, Wiely Inter Science – New York.
2. HVDC Transmission, S. Kamakshaiah, V. Kamaraju, Tata McGraw Hill Education Private Limited.
3. HVDC Transmission, J. Arillaga, Peter Peregrinus ltd. London UK 1983.
4. Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems, Hingorani H G and Gyugyi. L, New York, IEEE Press, 2000.
5. FACTS Controllers in Power Transmission and Distribution, Padiyar.K.R, New Age Int. Publishers, 2007.

REFERENCE BOOKS:

1. High Voltage Direct current Transmission, K. R. Padiyar, Wiely Eastern Ltd New Delhi, 1992.
2. Power Transmission by Direct Current, E. Uhlman, Springer Verlag, Berlin Helberg. 1985.
3. Flexible AC Transmission Systems: Modeling and Control, Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash, Springer, 2012
4. Flexible AC Transmission Systems, Yong-Hua Song, Allan Johns, IET, 1999.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Gain knowledge on DC transmission system and its advantages over AC transmission.
2 Understand the reactive power control in HVDC transmission.
3 Study the impact of FACTS devices in the power flow in the AC system.
4 Analyze various shunt compensation techniques using SVC and STATCOM.
5 Explore various series compensators such as TCSC, TSSC.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS17) SMART GRID TECHNOLOGIES
(Program Elective – V)

M.TECH: III-SEMESTER **L/T/P/C**
3/- / - /3

Prerequisite: None

UNIT-I:

INTRODUCTION: Introduction to smart grid- Electricity network-Local energy networks-Electric transportation- Low carbon central generation-Attributes of the smart grid- Alternate views of a smart grid.

SMART GRID TO EVOLVE A PERFECT POWER SYSTEM: Introduction- Overview of the perfect power system configurations- Device level power system- Building integrated power systems- Distributed power systems- Fully integrated power system-Nodes of innovation.

UNIT-II:

DC DISTRIBUTION AND SMART GRID: AC vs DC sources-Benefits of and drives of DC power delivery systems-Powering equipment and appliances with DC-Data centers and information technology loads-Future neighborhood-Potential future work and research.

INTELLIGRID ARCHITECTURE FOR THE SMARTGRID: Introduction- Launching intelligrid Intelligrid today- Smart grid vision based on the intelligrid architecture-Barriers and enabling technologies.

UNIT-III:

DYNAMIC ENERGY SYSTEMS CONCEPT: Smart energy efficient end use devices-Smart distributed energy resources-Advanced whole building control systems- Integrated communications architecture Energy management-Role of technology in demand response- Current limitations to dynamic energy management-Distributed energy resources-Overview of a dynamic energy management-Key characteristics of smart devices- Key characteristics of advanced whole building control systems-Key characteristics of dynamic energy management system.

UNIT-IV:

ENERGY PORT AS PART OF THE SMART GRID: Concept of energy -Port, generic features of the energy port. Policies and Programs to Encourage End – Use Energy Efficiency: Policies and programs in action -multinational - national-state-city and corporate levels.

MARKET IMPLEMENTATION: Framework-factors influencing customer acceptance and response - program planning-monitoring and evaluation.

UNIT-V:

EFFICIENT ELECTRIC END – USE TECHNOLOGY ALTERNATIVES: Existing technologies – lighting – Space conditioning - Indoor air quality - Domestic water heating - hyper efficient appliances – Ductless residential heat pumps and air conditioners - Variable refrigerant flow air conditioning-Heat pump water heating - Hyper efficient residential appliances - Data center energy efficiency- LED street and area lighting - Industrial motors and drives - Equipment

retrofit and replacement - Process heating - Cogeneration, Thermal energy storage - Industrial energy management programs – Manufacturing process-Electro-technologies,
Residential, Commercial and industrial sectors.

TEXT BOOKS:

1. The Smart Grid, Enabling Energy Efficiency and Demand Side Response, Clark W Gellings, CRC Press, 2009.
2. Smart Grids, Jean Claude Sabonnadière, Nouredine Hadjsaïd, IEEE Press, May 2012

REFERENCES:

1. Smart Grid: Technology and Applications, Janaka Ekanayake, Kithsiri Liyanage, Jianzhong.Wu, Akihiko Yokoyama, Nick Jenkins, Wiley, 2012.
2. Smart Grid :Fundamentals of Design and Analysis, James Momoh, Wiley, IEEE Press, 2012

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Learn the attributes of smart grid and explore the structure of an electricity market in regulated and deregulated market conditions.
2 Understand the advantages of DC distribution in power delivery systems and developing AI technologies in future grids.
3 Apply various distributed energy resources and build a dynamic energy management system.
4 Understand the policies and programs enacted for energy ports and market implementation
5 Analyze the development of smart and intelligent domestic, commercial and industrial systems.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18PS18) DISTRIBUTED GENERATION
(Program Elective – V)

M.TECH: III-SEMESTER **L/T/P/C**
3/- / - /3

Prerequisite: RPS, RES

UNIT-I:

INTRODUCTION: The electric conventional grid vs. Future microgrids: Advantages and limitations in technical and historic perspective, An overview on the building blocks of future grids: distributed generations, digital controls, communications, energy storage and electric vehicles.

UNIT-II:

DISTRIBUTED GENERATION: Concept of distributed generations, distribution units: conventional- diesel engines, Micro turbines, Non-conventional-wind generators, photovoltaic generators, fuel cells, biomass and other technologies. Energy Storage – batteries, fly-wheels, ultra-capacitors.

UNIT-III:

DISTRIBUTED GENERATION INTERFACE AND ARCHITECTURE: Power electronics interfaces: multiple and single input dc-dc converters. ac-dc and dc-ac converters for various DG units, distributed and centralized connection in the system.

UNIT-IV:

DG AS INTEGRATED SYSTEM APPROACH: MICROGRID: Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, Modes of operation and control of microgrid: grid connected and islanded mode, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, Active and reactive power control, protection issues,Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

UNIT-V:

DISTRIBUTED GENERATION INTEGRATION ISSUES FOR MICROGRID OPERATION: Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with Non-Conventional Energy sources on existing power system: reliability, stability and power quality issues.

TEXT BOOKS:

1. Renewable Energy- Power for a sustainable future, third edition, Godfrey Boyle, Oxford University Press, 2013.
2. Voltage Source Converters in Power Systems: Modeling, Control and Applications, AmirnaserYezdani, and Reza Iravani, IEEE John Wiley Publications, 2009.
3. Power Switching Converters: Medium and High Power, DorinNeacsu, CRC Press, Taylor & Francis, 2006, New Delhi.

REFERENCES:

1. Microgrids: Architectures and Control, Nikos Hatziargyriou (Editor), ISBN: 978-1-118-72068-4, 340 pages, December 2013, Wiley-IEEE Press
2. Microgrids and Active Distribution Networks, S. Chowdhury, S.P. Chowdhury and P. Crossley, The Institution of Engineering and Technology, London, U.K, 2009.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Explore the differences of conventional and future microgrids where Distribution Generations forms the building blocks.
2 Learn various conventional and non-conventional DG sources and technologies that are employed in micro grid operation.
3 Explore various power electronic interfaces employed in DG integration
4 Study the DG as integrated system approach i.e. microgrid operation and explore various modes of operation with its limitation and advantages.
5 Study the impact of grid integration with Non-Conventional Energy sources on existing power system for system reliability, stability and power quality issues.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18EC04) ADVANCED DIGITAL SIGNAL PROCESSING
(Program Elective-V)

M.TECH: III-SEMESTER **L/T/P/C**
3/- / - /3

Prerequisite: Digital signal processing

UNIT–I:
DIGITAL FILTER STRUCTURES: Block diagram representation – Equivalent Structures – FIR and IIR digital filter Structures AII pass Filters - tunable IIR Digital Sine-cosine generator - Computational complexity of digital filter structures.

UNIT-II:
DIGITAL FILTER DESIGN: Preliminary considerations- Bilinear transformation method of IIR filter design –design of Low pass high pass – Band pass, and Band stop- IIR digital filters – Spectral transformations of IIR filters – FIR filter design – based on Windowed Fourier series – design of FIR digital filters with least – mean square-error – constrained Least – square design of FIR digital filters.

UNIT-III:
DSP ALGORITHM IMPLEMENTATION: Computation of the discrete Fourier transform Number representation – Arithmetic operations – handling of overflow – Tunable digital filters – function approximation.

UNIT-IV:
ANALYSIS OF FINITE WORD LENGTH EFFECTS: The Quantization process and errors Quantization of fixed –point and floating –point Numbers – Analysis of coefficient Quantization effects – Analysis of Arithmetic Round-off errors- Dynamic range scaling – signal –to- noise in Low –order IIR filters- Low – Sensitivity Digital filter – Reduction of Product round-off errors feedback – Limit cycles in IIR digital filter – Round – off errors in FFT Algorithms.

UNIT-V:
POWER SPECTRUM ESTIMATION: Estimation of spectra from Finite Duration Observations signals- Non-parametric methods for power spectrum Estimation- parametric method for power spectrum Estimation- Estimation of spectral form-Finite duration observation of signals- Non-parametric methods for power spectrum estimation – Walsh methods – Blackman and torchy method.

TEXT BOOKS:

1. Sanjit K. Mitra, Digital signal processing – TMH second edition
2. Alan V. Oppenheim, Ronald W, Shafer, Discrete Time Signal Processing – PHI 1996 1st Edition reprint
3. John G. Proakis, Digital Signal Processing principles – Algorithms and Applications – PHI – 3rd edition 2002.

REFERENCE:

1. S Salivahanan. A. Vallavaraj C. Gnanapriya, Digital Signal Processing – TMH – 2nd reprint 2001.
2. Lourens R RebinarandBernold, Theory and Applications of Digital Signal Processing.
3. Auntoniam, Digital Filter Analysis and Design, TMH.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Understand the operation and the complexity involved in FIR and IIR digital filters.
2 Explore various methods of designing IIR and FIR digital filters
3 Understand the digital signal program algorithm implementation for tuning filters
4 Analyse the round off errors, scaling and sensitivity of filters for different algorithms
5 Estimate the power spectrum for signals with various estimation methods

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18EE01) ENERGY AUDITING, CONSERVATION AND MANAGEMENT
(Open Elective)

M.TECH: III-SEMESTER **L/T/P/C**
3/- / - /3

Prerequisite: Electrical Distribution Systems

UNIT-I:
Basic Principles of Energy Audit: Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT-II:
Energy Management: Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

UNIT-III:
Energy Efficient Motors: Energy efficient motors, factors affecting efficiency, loss distribution, constructional details , characteristics - variable speed , variable duty cycle systems, RMS hp-voltage variation-voltage unbalance- over motoring- motor energy audit.

UNIT-IV:
Power Factor Improvement, Lighting and Energy Instruments: Power factor – methods of improvement, location of capacitors, Pf with non linear loads, effect of harmonics on power factor, power factor motor controllers - Good lighting system design and practice, lighting control ,lighting energy audit – Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers,lux meters, tongue testers ,application of PLC's.

UNIT-V:
Economic Aspects and Analysis: Economics Analysis-Depreciation Methods, time value of money, rate of return , present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting - Applications of life cycle costing analysis, return on investment.

TEXT BOOKS:
1. Energy management, W.R. Murphy, G. Mckay Butter worth, Heinemann publications.
2. Energy management, Paul O Callaghan, Mc-graw Hill Book company-1st edition, 1998.

REFERENCES:

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995.
2. Energy management hand book by W.C.Turner, John wiley and sons.
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO.

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Understand the basic principles of energy audit and energy conservation schemes
2 Generalize the methods of energy management
3 Explore the construction and characteristics of energy efficient motors
4 Analyze the power factor improvement methods and design a good illumination system
5 Analyze the economic aspects of various energy saving equipments

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18ME01) INDUSTRIAL SAFETY
(Open Elective)

M.TECH: III-SEMESTER **L/T/P/C**
3/- / - /3

Prerequisites: None

UNIT I:
Industrial safety-Importance and objectives of safety, safety programs – components and realisation. Evolution of modern safety concept, safety policy, safety organisation. implementation of safety procedures-periodic inspection and replacement.

UNIT II:
Accidents causes, types, results and control, mechanical and electrical hazards types, causes and preventive steps , describe salient points and factories act 1948 for health and safety ,wash rooms, drinking water layout, lights, cleanliness fire guarding etc. safety colour code, fire prevention and fire fighting equipments and methods.

UNIT III:
Fundamentals of maintenance engineering. Definition aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, types of maintenance, types of applications of tools used for maintenance, maintenance cost and its relations with replacement economy, service life of equipment.

UNIT IV:
Quality and safety in maintenance: needs for quality maintenance process, maintenance work quality, use of quality control, charts in maintenance work sampling, post maintenance testing, reasons for safety problems in maintenance, guidelines to safety in maintenance work, safety officers' role in maintenance work, Protection of maintenance workers.

UNIT V:
Periodic and preventive maintenance:- Periodic inspection – concept and need, degreasing, cleaning and repairing schemes, over hauling of mechanical components, overhauling of electrical motors, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

TEXT BOOKS:
1. Safety management in industries, Krishnan N.N, Jaico publishing house, Bombay, 1997.
2. Maintenance Engineering, H.P. Garg, S. Chand and company.

REFERENCE:
1. Handley,W. Industrial safety Hand book, Second edition, McGraw-Hill Book Company, 1969.
2. Higgins & Morrow ,Maintenance Engineering Handbook, Da Information Services.
3. Human Factors in Engineering and design, Mc Cornick, E.J., Tata McGraw-Hill, 1982 .

COURSE OUTCOMES:

After the completion of this course students should be able to

1 Know the need for safety in industries.
2 Know about factory acts and industrial safety regulations.
3 Analyse causes and types of different hazards on their preventions.
4 Assess quality maintenance processes and maintenance work quality.
5 Know about periodic and preventive maintenance activities in industries.

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VAAGDEVI COLLEGE OF ENGINEERING
(AUTONOMOUS)

(M18EE02) OPTIMIZATION TECHNIQUES
(Open Elective)

M.TECH: III-SEMESTER **L/T/P/C**
3/- / - /3

Prerequisite: None

UNIT-I:

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT-II:

Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

UNIT-III:

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. **Unconstrained Nonlinear Programming:** One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method

UNIT-IV

Unconstrained Optimization: Techniques Univariate method, Powell's method and steepest descent method.

Constrained Nonlinear Programming: Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

UNIT-V:

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

TEXT BOOKS:

1. Engineering optimization: Theory and practice, S. S.Rao, New Age International (P) Limited, Third edition, 1998.
2. Introductory Operations Research, H.S. Kasene & K.D. Kumar, Springer (India), Pvt. LTd.

REFERENCES:

1. Optimization Methods in Operations Research and systems Analysis, K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Operations Research, Dr. S.D.Sharma.
3. Operations Research: An Introduction, H.A. Taha, PHI Pvt. Ltd., Sixth edition
4. Linear Programming, G. Hadley

COURSE OUTCOMES:

After the completion of this course students should be able to

1	Study the need of optimization in electrical engineering problems
2	Learn the conventional or classical optimization techniques
3	Learn to formulate the problem with constrained and unconstrained cases
4	Explore various modern intelligent optimization techniques
5	Apply these techniques to real world problems such as transportation problem, travelling salesman problem

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