SREE VIDYANIKETHAN ENGINEERING COLLEGE
(AUTONOMOUS)
Sree Sainath Nagar, Tirupati

Department of Electrical and Electronics Engineering

Supporting Document for 1.1.2

Syllabus Revision carried out in 2016

Program: M.Tech.- Electrical Power Systems

Regulations : SVEC-16

This document details the following:

1. Courses where syllabus has been changed 20% and more.
2. Course-wise revised syllabus with changes highlighted.

Note: *For SVEC-16 revised syllabus, SVEC-14 (previous syllabus) is the reference.*

List of Courses where syllabus content has been changed (20% and more)

S No.	Course Code	Name of the course	Percentage of content changed	Page Number in which Details are Highlighted
1.	16MT10702	High Voltage Engineering	100	3
2.	16MT10703	Power Electronic Converters	30	5
3.	16MT10706	EHVAC Transmission	100	9
4.	16MT10731	High Voltage Engineering Lab	100	11
5.	16MT13808	Research Methodology	100	12
6.	16MT20702	Intelligent Systems	20	14
7.	16MT20703	Power System Stability and Control	20	18
8.	16MT20732	Power Systems Simulation-II lab	100	22
9.	16MT23810	Intellectual Property Rights	100	23
		Average %**(A)**	74.44	
		Total No. of Courses in the Program **(T)**	28	
		No. of Courses where syllabus (more than 20% content) has been changed **(N)**	9	-
		Percentage of syllabus content change in the courses **(C)=(A x N)/100**	6.7	
		Percentage of Syllabus Content changed in the Program (P)= C/T	**23.93**	

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SREE VIDYANIKETHAN ENGINEERING COLLEGE
Sree Sainath Nagar, A. RANGAMPET
CHITTOOR (DT.)-517 102, A.P.

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SREE VIDYANIKETHAN ENGINEERING COLLEGE
(AUTONOMOUS)
Sree Sainath Nagar, A. RANGAMPET
Chittoor (Dist.) - 517 102, A.P., INDIA.

M. Tech. I-Semester

16MT10702: HIGH VOLTAGE ENGINEERING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Engineering Mathematics, Electromagnetic fields and Electrical Circuits at UG level.

COURSE DESCRIPTION:
Breakdown mechanisms in solids, liquids, gases and composite dielectrics materials; conventional methods of generation and measurement of high DC, AC, impulse voltages and currents; determine the ability of an electrical apparatus to meet guaranteed test procedures and standards.

COURSE OUTCOMES: On successful completion of the course, student will be able to CO1. demonstrate knowledge on

- behavior of various insulationmaterials,
- generation of high voltage andcurrents,
- measuring techniques for high voltage andcurrents,
- testing of various electricalapparatus,
- overvoltage phenomena and

protection against them. CO2. analyzethe

- behavior of insulationmaterials,
- circuits for generation and measurement of highvoltages,
- testing circuits for testing of high voltageequipment.

CO3. evaluate various high voltage generation, measuring and testing parameters of high voltage circuits.
CO4. initiate research skills in design of

- new methods of generation of high voltages,
- measuring and testing circuits for high voltagesystems,
- composite insulation systems to improve the dielectricstrength.

DETAILED SYLLABUS:

UNIT - I: BREAKDOWN PHENOMENA (12 Periods)
Introduction to HV technology, need for generating high voltages in laboratory, Industrial applications of high voltage. Classification of HV insulating media. Properties of important HV insulating media under each category. Gaseous dielectrics, Ionization: primary and secondary ionization processes. Criteria for gaseous insulation breakdown based on Townsend's theory. Limitations of Townsend's theory. Streamer's theory breakdown in non-uniform fields. Corona discharges. Breakdown in electro negative gases. Paschen's law and its significance. Time lags of Breakdown. Breakdown in solid dielectrics: Intrinsic Breakdown, avalanche breakdown, thermal breakdown, and electro mechanic breakdown. Breakdown of liquid dielectrics: Suspended particle theory, electronic Breakdown, cavity breakdown (bubble's theory), electro convection breakdown.

UNIT - II: GENERATION OF HIGH VOLTAGE AC AND DC & GENERATION OF IMPULSE VOLTAGE AND CURRENT (12 Periods)

GENERATION OF HIGH VOLTAGE AC AND DC: HVAC-HV transformer; Need for cascade connection and working of transformers units connected in cascade. Series resonant circuit - principle of operation and advantages. Tesla coil. HVDC- voltage doubler circuit, cock croft- Walton type high voltage DC set, Van de Graaff generator. Calculation of high voltage regulation, ripple and optimum number of stages for minimum voltage drop.

GENERATION OF IMPULSE VOLTAGE AND CURRENT: Introduction to standard lightning and switching impulse voltages. Analysis of single stage impulse generator -expression for Output impulse voltage. Multistage impulse generator working of Marx impulse. Rating of impulse generator. Components of multistage impulse generator. Triggering of impulse generator by three electrode gap arrangement. Trigatron gap and oscillograph time sweep circuits. Generation of switching impulse voltage. Generation of high impulse current

UNIT - III: MEASUREMENT OF HIGH VOLTAGES (10 Periods)

Electrostatic voltmeter - principle, construction and limitation. Chubb and Fortescue method for HV AC measurement. Generating voltmeter - Principle, construction. Series resistance micro ammeter for HVDC measurements. Standard sphere gap measurements of HVAC, HVDC and impulse voltages; Factors affecting the measurements. Potential dividers-resistance dividers capacitance dividers mixed RC potential dividers. Measurement of high impulse currents -Rogowsky coil and Magnetic Links.

UNIT - IV: NON-DESTRUCTIVE INSULATION TESTING TECHNIQUES (09 Periods)

Dielectric loss and loss angle measurements using Schering Bridge, Transformer ratio Arms Bridge. Need for discharge detection and PD measurements aspects. Factors affecting the discharge detection. PD equivalent model, PD measuring circuits, straight and balanced detectors, Location and estimation of PD in power apparatus, PD measurement by non-electrical methods, Calibration of PD detectors.

UNIT - V: HIGH VOLTAGE TESTS ON ELECTRICAL APPARATUS (12 Periods)

Need for testing standards, Standards for porcelain / Glass insulator, Polymeric insulators Classification of porcelain / glass , Polymeric insulators ; insulator tests- Tests for cap and pin porcelain/ Glass insulators, Polymeric insulators. High voltage AC testing methods, power frequency tests- Over voltage tests on insulators, Isolators, Circuit Breakers and power cables. Impulse Testing: Impulse testing of transformers – Surge diverters and other apparatus. Contamination flashover phenomena – Contamination Severity, Artificial contamination tests.

Total Periods: 55

TEXT BOOKS:

1. M. S. Naidu and V. Kamaraju, *High Voltage Engineering*, 4th edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi,2008.
2. E. Kuffel, W.S. Zaengl and J. Kuffel, *High Voltage Engineering: Fundamentals*, 2nd edition, Newnes, Elsevier Press,2000.
3. C.L.Wadhwa, *High Voltage Engineering*, New Age Science,2010.

REFERENCE BOOKS:

1. Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy, Roshdy Radwan, *High Voltage Engineering Theory and Practice,* 2nd edition, Revised & Expanded, Marcel-Dekker Publishers (Special Indian Edn.),2000.
2. T J Gallagher and A J Pearmain, *High voltage: measurement, testing, and design*. John Wiley & Sons,1983.

M. Tech. I-Semester

16MT10703: POWER ELECTRONIC CONVERTERS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Power Electronics at UG level

COURSE DESCRIPTION:
Power semiconductor devices; Characteristics of power switching devices; Gate and base drive circuits; Multipulse controlled rectifiers; Power factor improvement techniques; Voltage source converters; Current source converters; Switching mode regulators; Resonant converters; Voltage control of single phase and three phase inverters; Multilevel inverters.

COURSE OUTCOMES: On successful completion of the course, student will be able to

CO1. demonstrate knowledge on

- operation and performance of power electronicconverters,
- control strategies of power devices andconverters.

CO2. analyze the performance of multi pulse AC/DC converters and DC/DC converters.

CO3. evaluate the power converter modules for various operating / control parameters.

CO4. initiate research in designing appropriate power converter schemes to meet/solve the industrial requirements/problems.

DETAILED SYLLABUS:

UNIT - I: POWER DEVICES ANDTHEIRCONTROL (11Periods)

Overview of power semiconductor devices-reverse recovery characteristics of power diodes, switching characteristics of Power MOSFET and IGBT. Basic construction and switching characteristics of GTO and IGCT.

Characteristics of power switching devices- control characteristics, ideal and practical characteristics, specifications of switches. Gate drive circuits for SCR, MOSFET, IGBT and base drive circuits for power BJT.

UNIT - II: MULTIPULSECONTROLLEDRECTIFIERS (11Periods)

Six pulse SCR rectifiers – Semi and full converters, operation with different firing angles, effect of line inductance, power factor and THD.

Twelve pulse SCR rectifiers - idealized 12 pulse rectifier operation, effect of line and leakage inductance, power factor and THD. 18 and 24 pulse SCR rectifiers, operation.

Single phase series converters. Power factor improvement- extinction angle control, symmetric angle control, PWM control-single and three phase control.

UNIT - III: VOLTAGE SOURCE AND CURRENTSOURCECONVERTERS (09Periods)

Self-commutated voltage source converters (VSC)-basic principles. Single phase full wave VSC- one phase leg circuit operation, voltage harmonics. Three phase full wave VSC-operation of a phase leg through four quadrants.

Current source converters-types, operation of thyristor based converter and current stiffconverter.

UNIT - IV: ANALYSIS OF DC-DC ANDRESONANT CONVERTERS(13Periods)

Voltage commutated chopper. Current commutated chopper. Switch mode regulators – buck, boost, buck-boost and Cuk regulators, condition for continuous inductor current and capacitor voltage - design of LC filter, comparison of regulators. Multi-output boost converters – advantages, applications, numerical problems. Resonant converters- concept of ZVS and ZCS, principle of operation, analysis of M-type and L-type converters.

UNIT - V: PWM AND MULTILEVELINVERTERS(11Periods)

Voltage control of single phase inverters – single, multiple, sinusoidal, modified sinusoidal pulse width modulation, phase displacement control. Advanced PWM techniques-trapezoidal, staircase, stepped, harmonic injection, delta modulations. Voltage control of three phase inverter-sinusoidal PWM, 60 degree PWM, third harmonic PWM, space vector modulation. Harmonic reduction. Multilevel inverters-types-diode clamped, flying capacitor, cascaded-operation, features, applications.

Total Periods:55

TEXT BOOKS:

1. Muhammad H. Rashid, *Power Electronics circuits, devices and applications*, 3rd edition, Prentice Hall publications,2009.
2. Ned Mohan, Tore M. Undeland and William P. Robbin, *Power Electronics: Converters, Application and Design*, 3rd edition, John Wiley and sons Inc., New York,2009.

REFERENCE BOOKS:

1. Bin Wu, *High power converters and AC Drives,* John Wiley and Sons,2006.
2. P.C Sen., *Modern Power Electronics*, 1st edition, Wheeler publishing Co,1998.
3. Naran G. Hingorani, Laszlo Gyugyi, *Understanding FACTS*, IEEE Press., Standard Publishers Distributors, Delhi, 2001.

M. Tech. (EPS)I-Semester

(14MT10704) POWER ELECTRONIC CONVERTERS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Power Electronics at UG level.

COURSE DESCRIPTION:
Power Semiconductor Devices; Controlled Rectifiers; AC Voltage Controllers, operation and analysis of Cycloconverters; Analysis of DC-DC and Resonant Converters; Multi Level Inverters and PWM techniques

COURSE OBJECTIVES:
- To introduce the knowledge of advanced power devices and concepts of Power electronic converters.
- To develop analytical and design skills for various power converters.
- To apply various converters in industrial drives and power system applications.

COURSE OUTCOMES: After successful completion of course, the student will be able to
- acquire in-depth knowledge in advanced Power devices and converters.
- acquire analytical and design skills in power converter modules for various applications in power industry.
- extend the concepts of power electronic converters for HVDC and FACTS.

DETAILED SYLLABUS

UNIT-I: MODERN POWER SEMICONDUCTOR DEVICES

Power Diode - Reverse recovery characteristics, types. Steady state characteristics and switching characteristics of Power transistors (power MOSFET, IGBT) and Thyristors(GTO, IGCT). Gate drive circuits for SCR, MOSFET, IGBT and Base drive circuit for Power BJT. Comparison of power devices.

UNIT-II: MULTI-PULSE CONTROLLEDRECTIFIERS

Six pulse SCR rectifiers – semi and full converters, operation with different firing angles-Effect of line inductance - power factor and THD. Power factor improvement – extinction angle control, symmetric angle control, PWM control

– single and three phase control. Three phase dual converters. Single phase series converters. Twelve pulse SCR rectifiers – idealized 12 pulse rectifier operation, effect of line and leakage inductance, power factor and THD. 18 and 24 pulse SCR rectifiers, operation.

UNIT-III: AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS

Single phase AC voltage controllers with R, RL and RLE loads. AC voltage controllers with PWM Control. Effect of source and load inductances. Synchronous tap changers – Applications. Three Phase AC Voltage Controllers.Analysis of controllers with star and delta Connection, applications, numerical problems. Single phase and three phase cycloconverters – analysis with Mid- point and bridge configurations – Limitations – Advantages – Applications – numerical problems

UNIT-IV: ANALYSIS OF DC-DC AND RESONANT CONVERTERS

Voltage commutated chopper. Current commutated chopper. Switch mode regulators – buck, boost, buck-boost and cuk regulators – condition for continuous inductor current and capacitor voltage - design of LC filter – comparison of regulators. Multi-output boost converters – advantages, applications, Numerical problems Resonant Converters – Concept of ZVS and ZCS, principle of operation, analysis of M-type and L-type Converters

UNIT-V: PWM AND MULTI LEVEL INVERTERS

Voltage control of single phase inverters – single, multiple, sinusoidal, modified sinusoidal pulse width modulation, phase displacement control Advanced PWM techniques – trapezoidal, staircase, stepped, harmonic injection, delta modulations Voltage control of three phase inverter - sinusoidal PWM, 60 degree PWM, third harmonic PWM, space vector modulation. Harmonic reduction Multilevel inverters – Types – diode clamped, flying capacitor, cascaded – operation, features, applications.

TEXT BOOKS:

1. Rashid M.H., Power Electronics Circuits, Devices and Applications, 3rd edition, Prentice Hall publications, 2009.
2. Ned Mohan, Undeland and Robbin, Power Electronics: Converters, Application and Design, John Wiley and sons Inc., Newyork, 1995.

REFERENCE BOOKS:

3. Bin Wu, High power converters and AC Drives, John Wiley and Sons, 2006.
4. P.C Sen, Modern Power Electronics, 1stedition, Wheeler publishing Company, 1998.

M. Tech. I-Semester

16MT10706: EHVAC TRANSMISSION

(Professional Elective - 1)

Int. Marks	Ext. Marks	Total marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Transmission of electric power, Distribution of Electric Power and Power System Analysis at UG level.

COURSEDESCRIPTION:
Transmission Line Trends and Preliminaries, Voltage Gradients of Conductors, Corona Effects, Electrostatic Fields, Power-Frequency Voltage Control and Over Voltages.

COURSE OUTCOMES: On successful completion of the course, student will be able to
CO1. demonstrate knowledge on

- EHVAC conductor parameters, configurations, electrical and mechanicalaspects,
- corona interference, effects and relevant parameters in EHVACsystems,
- electrostatic field interference and effects,
- voltage control methods in EHVAC system.

CO2.analyze

- various electrical parameters of conductor with variousconfigurations,
- various parameters of corona phenomenon in EHVAC system.

CO3. demonstrate skills in evaluation of various parameters of EHVlines
CO4. initiate research in designing strategies to minimize adverse effects of EHVAC system.

DETAILED SYLLABUS:

UNIT - I: TRANSMISSION LINE TRENDSANDPRELIMINARIES (13 Periods)
Role of EHV AC transmission. Power handling capacity and line loss, costs of transmission lines and equipment. Mechanical considerations in line performance – numerical problems.
Line and Ground parameters:
Calculation of resistance of conductors. Properties of bundled conductors - bundle spacing, bundle radius and geometric mean radius of bundle. Inductance of EHV line configurations – Inductance of two conductors, multi-conductor lines and bundled conductor lines. Line Capacitance calculation - sequence inductances and capacitances – modes of propagation – Resistance and inductance of ground return – numerical problems.

UNIT - II: VOLTAGE GRADIENTSOFCONDUCTORS (12Periods)
Electrostatics, field of sphere gap, field of line changes and their properties, charge - potential relations for multi-conductors. Surface voltage gradient on conductors - distribution of voltage gradient on sub conductors of bundle - numerical problems.

UNIT - III:CORONAEFFECTS (14Periods)
Power loss: corona loss formulae, charge-voltage (Q-V) diagram.
Audible Noise (AN): Generation, characteristics, limits and measurements of AN, relation between 1-phase and 3-phase AN levels – numerical problems.

Radio Interference (RI): Corona pulses - generation, properties and frequency spectrum. Limits for radio interference fields. Lateral profiles of RI and modes of propagation, excitation function, measurement of RI, RIV and excitation functions – numerical problems.

UNIT - IV:ELECTROSTATIC FIELDS (10 Periods)

Electrostatic field: calculation of electrostatic field of EHV lines, effect on humans, animals and plants - electrostatic induction in un-energized circuit of Single circuit and double-circuit lines – meters and measurement of electrostatic fields– numerical problems.

UNIT - V: POWER-FREQUENCY VOLTAGE CONTROL AND OVERVOLTAGES (10 Periods)

No-load voltage conditions and charging currents, voltage control – synchronous condenser, shunt and series compensation. Static VAR compensation – Numerical problems.

Total Periods: 59

TEXT BOOK:

1. Rakosh Das Begamudre, *Extra High Voltage AC Transmission Engineering*, 3rd edition, New Age International Pvt. Ltd, 2009.

REFERENCE BOOKS:

1. S. Rao, *EHVAC, HVDC Transmission and Distribution Engineering*, 3rd edition, Khanna Publications,2001.
2. General Electric Company (GEC), Project EHV, *EHV Transmission line reference Book*, Edison House,1968.

M. Tech. I-Semester

16MT10731: HIGH VOLTAGE ENGINEERING LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	--	--	4	2

PRE-REQUISITES: High Voltage Engineering and Electrical Measurements at UG level.

COURSE DESCRIPTION:
To conduct experiments on Breakdown mechanisms in dielectrics materials; Generation & measurement of high DC, AC, impulse voltages and currents and testing high voltage electrical apparatus.

COURSE OUTCOMES: On successful completion of the course, student will be able to

CO1. demonstrate knowledge on

- behavior of various insulationmaterials,
- generation of high voltage andcurrents,
- measuring techniques for high voltage andcurrents,
- testing of various electricalapparatus.

CO2. analyze the behavior of insulation systems, circuits for high voltage generation, measurement and testing.

CO3. evaluate various parameters of high voltage generating, measuring and testing circuits.

CO4. initiate research to design a suitable setup for measuring and testing of High Voltage.

CO5. follow the IEC standards and safety measures for efficient operation and testing of high voltage equipment.

CO6. function effectively as an individual and as a member in a team

CO7. prepare laboratory report that clearly communicates the experimental information.

CO8. practice professional code of ethics.

LIST OF EXPERIMENTS:

Conduct any **TEN** experiments from the following

1. Generation and characteristics of Lightning Impulse Voltages.
2. Generation of High DC voltage using voltage doubler circuit.
3. Spark over characteristics of gaseous, liquid and solid insulation under uniform and non-uniform fields.
4. Measurement of HVAC and HVDC.
5. Breakdown strength of transformer oil using oil-testing unit.
6. Determination of the Flashover Characteristics of Insulators.
7. Determination of 50% Critical Impulse Flash-Over Voltages on the 11 kV type Insulator with Positive Impulse and Negative Impulse.
8. Determination of String Efficiency of Suspension Type Insulator.
9. Measurement of Capacitance and loss tangent.
10. Measurement of Earth and insulation resistance.
11. Partial discharge measurement in high voltage apparatus.
12. Calibration of meters by using Sphere Gap, Rod Gap and Point Gap method.

M. Tech. I-Semester

16MT13808: RESEARCH METHODOLOGY

(Common to all M. Tech. Programs)
(Audit Course)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	-	2	-	-

PRE-REQUISITES:

COURSE DESCRIPTION:
Overview of Research, research problem and design, various research designs, data collection methods, statistical methods for research, importance of research reports and its types

COURSE OUTCOMES: On successful completion of the course, student will be able to

CO1. demonstrate knowledge on

- research design and conducting good research,
- various data collectionmethods,
- statistical methods inresearch,
- report writingtechniques.

CO2. analyze various research design issues for conducting research in core or allied areas

CO3. formulate solutions for engineering problems by conducting research effectively in the core or allied areas

CO4. carryout literature survey and apply good research methodologies for the development of scientific/technological knowledge in one or more domains of engineering.

CO5. select and apply appropriate techniques and tools to complex engineering activities in their respective fields

CO6. write effective research reports.

CO7. develop attitude for lifelong learning to do research

CO8. develop professional code of conduct and ethics of research.

DETAILED SYLLABUS:

UNIT - I: INTRODUCTION TO RESEARCH METHODOLOGY (05 Periods)

Objectives and Motivation of Research, Types of Research, Research Approaches, Research Process, Criteria of good Research, Defining and Formulating the Research Problem, Problem Selection, Necessity of Defining the Problem, Techniques involved in Defining a Problem.

UNIT - II: RESEARCH PROBLEM DESIGN AND DATA COLLECTION METHODS (07 Periods)

Features of Good Design, Research Design Concepts, Different Research Designs, Different Methods of Data Collection, Data preparation: Processing Operations, Types of Analysis.

UNIT - III: STATISTICS IN RESEARCH (06 Periods)

Review of Statistical Techniques - Mean, Median, Mode, Geometric and Harmonic Mean, Standard Deviation, Measure of Asymmetry, ANOVA, Regression analysis.

UNIT - IV: HYPOTHESIS TESTING **(07 Periods)**

Normal Distribution, Properties of Normal Distribution, Basic Concepts of Testing of Hypothesis, Hypothesis Testing Procedure, Hypothesis Testing: t-Distribution, Chi-Square Test as a Test of Goodness of Fit.

UNIT - V: INTERPRETATION AND REPORT WRITING **(03 Periods)**

Interpretation – Techniques and Precautions, Report Writing – Significance, Stages, Layout, Types of reports, Precautions in Writing Reports.

Total Periods: 28

TEXT BOOK:

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, New Age International Publishers, New Delhi, 2nd revised edition, 2004.

REFERENCE BOOKS:

1. Ranjit Kumar, *Research Methodology: A step-by-step guide for beginners*, Sage South Asia, 3rd edition, 2011.
2. R. Panneerselvam, *Research Methodology*, PHI learning Pvt. Ltd.,2009.

M. Tech. II-Semester

16MT20702: INTELLIGENT SYSTEMS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Engineering Mathematics, Electrical Machines & Power Systems at UG level.

COURSE DESCRIPTION:
Neural Networks; Fuzzy Logic Systems; Genetic Algorithms; Hybrid Intelligent Systems; Swarm intelligence; Applications.

COURSE OUTCOMES: On successful completion of the course, student will be able to

CO1. demonstrate knowledge on soft computing techniques.
CO2. analyze complex engineering problems with intelligent techniques.
CO3. solve electrical engineering problems using intelligent systems.
CO4. initiate research related to applications of soft computing in the fields of electrical engineering and allied areas.
CO5. select and apply suitable intelligent techniques for engineering problems.

DETAILED SYLLABUS:

UNIT - I:NEURAL NETWORKS (11Periods)
Neural network Architectures, Perceptron model, Learning strategies: Supervised Learning, Radial basis function network, Back propagation Network. Unsupervised Learning: Kohonen's SOM, Reinforced learning. Load forecasting using neural networks

UNIT - II: FUZZYLOGICSYSTEMS (11Periods)
Fuzzy sets: Relations & Operations, Membership functions, Fuzzification, Rule base, Inference Mechanism, Defuzzification and design of Fuzzy control system, Speed control of separately excited DC motor using fuzzy logic.

UNIT - III:GENETIC ALGORITHMS (10 Periods)
Introduction to evolutionary computation, Genetic algorithms (GA): Biological background, Traditional optimization and search techniques, Basic terminologies, Simple GA, Flow chart, Operators in GA, Encoding, selection, crossover, mutation, Constraints in GA, Fitness function, Advantages and limitations of GA, Economic load dispatch using GA.

UNIT - IV: HYBRIDINTELLIGENTSYSTEMS (12Periods)
Introduction to hybrid intelligent systems: Adaptive Neuro-Fuzzy Inference Systems, Architecture and Learning. Fuzzy GA systems: rules generation. ANN Learning Using GA: Optimization of weights, Load forecasting problem using Neuro-fuzzy approach.

UNIT - V:SWARMINTELLIGENCE (11Periods)
Introduction to swarm intelligence, Swarm intelligence algorithms-Ant colony optimization: Biological and artificial ant colony systems, Applications of ant colony intelligence: Static & Dynamic combinatorial optimization problems, Algorithm of Ant colony system, Particle swarm optimization: The basic PSO method, characteristic features of PSO, PSO algorithm, Optimum parameter setting for the best performance of PSO, Comparison with other Evolutionary computing techniques, Engineering application of ANT colony intelligence in unit commitment problem

Total Periods: 55

TEXT BOOKS:

1. S.N. Sivanandam, S.N. Deepa, *Principles of Soft Computing*, Wiley–India Edition,2008.
2. N.P. Padhy, *Artificial Intelligence and Intelligent Systems*, Oxford University press, 10th Reprint, 2011.

REFERENCE BOOKS:

1. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning India Private Limited, Fifth Indian reprint,2013.
2. J.S.R. Jang, C.T. Sun, E. Mizutani, *Neuro-fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence*, Pearson Education Taiwan Limited,2004.
3. Fakhreddine O. karray, Clarence De Silva, *Soft computing and Intelligent systems Design, Theory, tools and applications,* Pearson Education Limited,2009.

M. Tech. EPS II-Semester
(14MT20705) INTELLIGENT CONTROL

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:
Engineering Mathematics, Power Systems, Power Electronic Drives and Electrical machines at UGlevel

COURSE DESCRIPTION:
Neural Networks; Fuzzy Logic Systems; Genetic Algorithms; Hybrid Intelligent Systems; Applications

COURSE OBJECTIVES:
- To impart advanced knowledge on computational intelligence for Electric drives and power systems.
- To apply skills in design and development of intelligent control systems.
- To apply the concepts of neural networks, Fuzzy logic and genetic algorithms in engineering.

COURSE OUTCOMES: After completion of the course, student will be able to
1. acquire in depth knowledge to identify and describe soft computing techniques and their roles in building intelligent systems.
2. design and analyze intelligent control systems for electrical engineering problems.
3. develop skills to identify and apply suitable soft computing techniques for engineering problems.

DETAILED SYLLABUS
UNIT I: NEURAL NETWORKS
Neural network Architectures, Perceptron model, Learning strategies – Supervised Learning – Radial basis function network, Back propagation Network–Unsupervised Learning – Kohonen's SOM, Full counter propagation Network – Reinforced learning.

UNIT II: FUZZY LOGIC SYSTEMS
Fuzzy sets– Relations & Operations, Membership functions, Fuzzification, Rule base, Inference Mechanism, Defuzzification and design of Fuzzy control system.

UNIT III: GENETIC ALGORITHMS
Introduction to evolutionary computation, History of genetics, Genetic algorithms(GA) – main components of GA – selection, crossover, mutation, survival of the fittest, population size, Evaluation of the fitness function and benefits of genetic algorithms.

UNIT IV: HYBRID INTELLIGENT SYSTEMS
Introduction to hybrid intelligent systems – Adaptive Neuro-Fuzzy Inference Systems – Architecture and Learning. Fuzzy GA systems – rules generation. ANN Learning Using GA – Optimization of weights.

UNIT V: APPLICATIONS
Speed control of separately excited DC motor using neural networks and fuzzy logic, Load forecasting problem using GA and Neuro-fuzzy approach, Load frequency control using fuzzy logic.

TEXT BOOKS:

1. Fakhreddine O. karray, Clarence De Silva, Soft computing & intelligent systems design, Theory, tools and applications, Pearson Education Limited, 2009.
2. S.N.Sivanandam, S.N.Deepa, Principles of soft computing, Wiley–India Edition, 2008

REFERENCE BOOKS:

3. Devendra K. Chaturvedi, Soft Computing: Techniques and Its Applications in Electrical Engineering, Springer.
4. J.S.R.Jang, C.T.Sun, E.Mizutani, Neuro-Fuzzy & Soft computing, Pearson Education Limited, 2004.

M. Tech. II-Semester

16MT20703: POWER SYSTEM STABILITY AND CONTROL

1nt. marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES: Electrical Machines, Control systems, Power system analysis, Power System operation and control at UG level and Advanced control systems and Power System Security and State Estimation at PG level.

COURSE DESCRIPTION:
Introduction to the synchronous machine classical model; state space models of synchronous machine; Methods of Excitation systems and modelling; Effect of excitation on stability; Analysis of Voltage stability

COURSE OUTCOMES: On successful completion of the course, student will be able to
CO1. demonstrate knowledge on

- various power system stability issues of a small and large power systemnetworks,
- modeling of SMIB, multi-machine and excitationsystems,
- voltage control and reactive power management concepts.

CO2. analyze the power system network for stability and control.
CO3. develop skills in evaluating power systemstability.
CO4. initiate research to develop / design new control strategies or methodology for enhancing stability of power system.

DETAILED SYLLABUS:

UNIT - I: THE ELEMENTARYMATHEMATICALMODEL (13 Periods)
A Classical model of one machine connected to infinite bus – Problems. System Response to small Disturbances: Types of problems studied, Block diagram of unregulated and regulated synchronous Machine, methods of studies – Effect of small changes of speed. Regulated synchronous machine – voltage regulator with one time lag – Governor with one time lag Classical model of multi-machine system – Modes of oscillation of unregulated Multi machine system – Problems

UNIT – II: THE SYNCHRONOUSMACHINE MODEL (10 Periods)
Introduction – Clarkes's and Park's Transformation – flux linkage equations, self and mutual inductances of stator and rotor, transformation ofinductances, voltage equations. Formulationsof state space model of one machine system connected to infinite bus, voltage, current equations.

UNIT – III:EXCITATIONSYSTEMS (11 Periods)
Simplified view of excitation control, control configuration. Excitation system response -Non-continuously regulated systems, and continuously regulated systems. Excitation system compensation- state space description of the excitation system - simplified linear model only.
Types of Excitation systems: Type -1system: Continuously acting regulator, Type - 2system: rotating rectifier system, Type - 3 system: Static with terminal potential and current supplies, Type-4system: non–continuous acting - Block diagram representation – state space representation.

UNIT – IV: EFFECT OF EXCITATIONON STABILITY (10 Periods)

Introduction – effect of excitation on generator power limits – effect of the excitation system on transient stability, effect of excitation on dynamic stability – examination of dynamic stability by routh'scriterion. Block diagram of the linear generator with exciter, supplementary stabilizing signals, approximate model of the complete exciter-generator system, Lead compensation

UNIT – V: VOLTAGESTABILITYANALYSIS (11 Periods)

Voltage stability – Factors affecting voltage instability and collapse – Comparison of Angle and voltage stability – Analysis of voltage in stability collapse – Control of voltage instability.

Review of Lyapunov's stability theorems of non-liner systems using energy concept – Method based on first concept – Method based on first integrals – Quadratic forms – Variable gradient method – Zubov's method – Popov's method, Lyapunov function for single machine connected to infinite bus.

Total Periods: 55

TEXT BOOKS:

1. P. M. Anderson, A. A. Fouad, *Power System Control and Stability*, 2nd edition, IEEE Press, 2003.
2. K. R. Padiyar, *Power System Dynamics Stability & Control*, 2nd edition, B.S.Publications, Hyderabad, India,2008.

REFERENCE BOOKS:

1. Prabha Kundur, Neal J. Balu, Mark G. Lauby, *Power System Stability and Control*, 2nd edition, McGraw-Hill,1994.
2. M. A. Pai, *Power System Stability: Analysis by the direct method of Lyapunov*, North Holland Publishing Company, Newyork,1981.

M. Tech. (EPS)I-Semester

(14MT10703) ADVANCED POWER SYSTEM STABILITYANALYSIS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	--	--	4

PRE-REQUISITES:

Power System operation and control, Power system Analysis at UG level Control systems at UG level

COURSE DESCRIPTION:

Introduction to the synchronous machine classical model; state space models of synchronous machine; Methods of Excitation systems and modelling; Effect of excitation on stability; Analysis of Voltagestability

COURSE OBJECTIVES:

- To introduce various power system stability, control and reactive power managementconcepts.
- To develop skills to carry out the stability studies for large scale multi- area powersystems.
- To apply, analyze and implement algorithms for power system stability enhancement.

COURSE OUTCOMES: On successful completion of the course, the student would be able to

1. gain knowledge on:
   - transient and dynamic stability studies for large power systems.
   - modeling of SMIB, multi-machine systems and excitation systems.
   - voltage control and reactive power management concepts.
2. ability to assess various control schemes for better performance of the interconnected power system with economic considerations.
3. design and develop efficient control techniques for enhancement of voltage stability, rotor-angle stability and reactive power control in large interconnected power systems.

DETAILED SYLLABUS:

UNIT-I: THE ELEMENTARY MATHEMATICAL MODEL

A Classical model of single machine connected to infinite bus – Problems. System Response to small Disturbances: Block diagram of unregulated and regulated synchronous machine, methods of studies – Effect of small changes of speed. Regulated synchronous machine – voltage regulator with one time lag – Governor with one time lag.

Classical model of multi-machine system – modes of oscillation of unregulated Multi-machine system – Problems.

UNIT-II: THE SYNCHRONOUS MACHINE MODEL

Introduction – Clarkes's and Park's Transformation – flux linkage equations, selfandmutualinductancesofstatorandrotor,transformationofinductances – formulations of state space model of one machine system connected to infinite bus, voltage, current equations – effect of excitation on Dynamic stability – examination of dynamic stability by Routh's criterion.

UNIT-III EXCITATION SYSTEMS

Simplified view of excitation control – Control configuration – Excitation system response – Non-continuously regulated systems – continuously regulated systems – Excitation system compensation – state space description of the excitation system - simplified linear model.

Types of Excitation systems: Type-2 system: rotating rectifier system, Type-3 system: Static with terminal potential and current supplies, Type-4 system: non–continuous acting - Block diagram representation – state space representation.

UNIT-IV: EFFECT OF EXCITATION ON STABILITY

Introduction – effect of excitation on generator power limits – Effect of the excitation system on Transient stability. Approximate model of the complete exciter – generator system – Supplementary stabilizing signals – Block diagram of the linear system – Lead compensation – Stability aspect using Eigen valueapproach.

UNIT-V: VOLTAGE STABILITY ANALYSIS

Voltage stability – factors affecting voltage instability and collapse – Comparison of angle and voltage stability – Analysis of voltage instability collapse – Control of voltage instability.

Review of Lyapunov's stability theorems of non-linear systems using energy concept – Method based on first concept – Method based on first integrals – Quadratic forms – Variable gradient method – Zubov's method – Popov's method, Lyapunov function for single machine connected to infinite bus.

TEXT BOOKS:

1. P.M. Anderson, A.A. Fouad, Power System Control and Stability, 2ndedition, IEEE Press, 2003.
2. K.R. Padiyar, Power System Dynamics (Stability & Control), 2ndedition, B.S. Publications, Hyderabad, India, 2008.

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1. Prabha Kundur, Neal J.Balu, Mark G.Lauby, Power System Stability and Control, 2ndedition, McGraw-Hill, 1994.
2. M.A. Pai, Power System Stability – Analysis by the direct method of Lyapunov, North Holland Publishing Company, New York, 1981.

M. Tech. II-Semester

16MT20732: POWER SYSTEMS SIMULATION-II LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	--	--	4	2

PRE-REQUISITES: Power system analysis, FACTS, Power system operation & control, Power quality and Switchgear and protection at UG and PG level.

COURSE DESCRIPTION:
Modelling, simulation and analyze operation and control of power system networks.

COURSE OUTCOMES: On successful completion of the course, student will be able to

CO1. demonstrate knowledge on various power system problems through modern tools and disseminate them using software packages in field of power system and power electronics.
CO2. analyze the simulated observations of power system networks, power electronic circuits and their behavior through theoretical perspective.
CO3. evaluate various parameters of the power systems
CO4. interpret the observations of power system network and design a suitable control strategy to meet the required specifications.
CO5. select and apply modern software tools for solving real time problems in the existing power system
CO6. function effectively as an individual and as a member in a team
CO7. prepare laboratory report that clearly communicates the experimental information.
CO8. practice professional code of ethics.

LIST OF EXPERIMENTS:

Conduct any **TEN** Experiments from the following using **MATLAB/PSCAD/MIPOWER**

1. Transient Response due to capacitor switching.
2. Transformer inrush currents measurement.
3. Load flow analysis.
4. Analysis of Short circuit studies with and with fault impedance.
5. Load frequency control problem for an interconnected power system.
6. Voltage stability analysis.
7. Stability analysis of SMIB.
8. Simulation of FACTS controllers.
9. Characteristics and Coordination of Relays.
10. Simulation of power quality problems (Sag/Swell, interruption, transients, harmonics, flickers etc.)
11. Harmonic analysis and tuned filter design to mitigate harmonics.
12. Demonstration of MATLAB tool boxes (Fuzzy, Neural, GA, PSO etc.) for power system applications.

M. Tech. II-Semester

16MT23810: INTELLECTUAL PROPERTY RIGHTS

(Common to all M. Tech. Programs)
(Audit Course)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	-	2	-	-

PRE-REQUISITES: -

COURSE DESCRIPTION:
Introduction to Intellectual Property; Trade Marks; Law of Copy Rights; Law of Patents; Trade Secrets; Unfair Competition; New Development of Intellectual Property.

COURSE OUTCOMES: On successful completion of the course, student will be able to

CO1. demonstrate knowledge on

- IntellectualProperty,
- Trade Marks &Secrets,
- Law of Copy Rights,Patents,
- New development of Intellectual Property.

CO2. analyze the different forms of infringement of intellectual property rights.
CO3. solve problems pertaining to Intellectual Property Rights.
CO4. stimulate research zeal for patenting of an idea or product.
CO5. write effective reports required for filing patents.
CO6. develop life-long learning capabilities.
CO7. develop awareness of the relevance and impact of IP Law on their academic and professional lives.
CO8. develop attitude for reflective learning.

DETAILED SYLLABUS:

UNIT - I: INTRODUCTION TO INTELLECTUAL PROPERTY **(05 Periods)**
Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT - II: TRADE MARKS **(05 Periods)**
Purposeandfunctionoftrademarks,acquisitionoftrademarkrights,protectablematter,selecting and evaluating trade mark, trade mark registration processes.

UNIT - III: LAW OF COPY RIGHTS **(06 Periods)**
Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right,international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT - IV: TRADE SECRETS **(06 Periods)**
Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

UNIT - V: NEW DEVELOPMENT OF INTELLECTUAL PROPERTY (06 Periods)

New developments ın trade mark law; copy rıght law, patent law, ıntellectual property audıts. International overview on intellectual property, international - trade mark law, copy rightlaw, ınternatıonal patent law, ınternatıonal development ın trade secrets law.

Total Periods: 28

TEXT BOOKS:

1. Deborah, E. Bouchoux, *Intellectual property right*, cengagelearning.
2. Prabuddha Ganguli, *Intellectual property right - Unleashing the knowledge economy*, Tata Mc Graw Hill Publishing CompanyLtd.