PARUL UNIVERSITY - FACULTY OF ENGINEERING & TECHNOLOGY

Department of Electrical Engineering

SYLLABUS FOR 1st Sem MTech PROGRAMME

Computer Methods in Power Systems (03203101)

Type of Course: MTech

Prerequisite: Power System Analysis and Fundamental knowledge of Power Electronics

Rationale: The Power system transmission network is now a day's heavily loaded and to enhance the existing active as well as reactive power transmission capacity of the line management and control of active and reactive power is crucial. The subject aims to develop thorough understanding of requirement of power management in power system by employing power electronics based reactive power supplying/absorbing devices

Teaching and Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					Total
				External		Internal			
L	T	P		Theory	Practical	Theory	*C.E.	Practical	
3	0	2	4	60	30	20	20	20	150

L-Lectures; **T-**Tutorial; **P-**Practical; **C.E.-**Continuous Evaluation

Contents:

Sr.	Topic	Weightage	Teaching Hrs.
1	**Load Flow Studies**: Introduction, Different techniques such as Gauss Seidel method, Newton–Raphson method, De-Coupled method, Fast Decoupled method, Modified Fast Decoupled, Concept of Optimal Power Flow, Linear Programming Methods for GS NR and FDLF method, DC load flow, Continuation Power flow	27%	13
2	**Power System Security**: Introduction, Factors Affecting Power System Security, Short Circuit Studies of a Large Power System Networks, Symmetrical Fault Analysis Using Bus Impedance Matrix, Algorithm for Formation of Bus Impedance Matrix, Contingency Analysis: Detection of Network Problems, Overview of security analysis, Linear Sensitivity Factors, Contingency Selection, Concentric Relaxation, Bounding	25%	12
3	**Load Forecasting & State Estimation**: Estimation of average, periodic, stochastic components of load, Power system state estimation, Maximum Likelihood Concept , Weighted Least Squares Estimation, Introduction, Matrix Formulation, State Estimation of an AC network, Detection and Identification of Bad measurements, Application of Power Systems State Estimation	21%	10
4	**Numerical Integration Techniques**: Numerical integration techniques: Taylor series based methods, Forward -Euler's method, Runge - Kutta methods, Trapezoidal method, backward-Euler's method, Power system applications: Transient stability analysis	10%	5

5	**Computer Control of Power System**: Need of real time and computer control of power system, Operating states of power system, SCADA & Energy Management Centers, Smart Grid.	17%	8

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

Reference Books:

1. Power Generation Operation & Control (TextBook)
   A. J. Wood and B. F. Wollenberg; John Wiley & Sons
2. Computer Methods in Power System Analysis (TextBook)
   Glenn Stagg and El-abiad; McGraw-Hill
3. Computer Modeling of Electrical Power Systems
   J. Arrillaga, C.P. Amold and S. J. Harker; John Wiley and Sons
4. Power System Analysis
   Stevenson and Grainger; TATA McGraw Hill
5. Power System Analysis
   Hadi Sadat; Tata McGraw Hill, New Delhi

Useful Links:

https://blogs.siemens.com/theenergyblog/stories/tags/hvdc/
http://www.dlr.de/blogs/en/desktopdefault.aspx/tabid-6192/10184_read-68/
http://ww.itimes.com/opinions/hvdc/blogs

Course Outcome:

After Learning the course the students shall be able to:

1. Develop proper mathematical models for analysis of a selected problem like load flow study or fault analysis.
2. Select and identify the most appropriate algorithm for load–flow and short circuit studies.
3. Prepare the practical input data required for load flow or fault calculations.
4. Develop power system software for static power system studies.
5. Give basic knowledge of SCADA system
6. Analyze role of smart grid in Power system.

List of Practical:

1. **Develop a program to solve simultaneous linear algebraic equations by Gauss elimination method.**
2. **Develop a program to solve simultaneous linear algebraic equations by Cholesky decomposition method.**
3. **Develop a program to form bus admittance matrix by using inspection method.**
4. **Develop a program to form bus admittance matrix by using sparsity method.**
5. **Develop the program for power flow analysis using GS method**
6. **Develop the program for power flow analysis using NR method**
7. **Develop the program for power flow analysis using FDLF method**
8. **Gain matrix formation on state estimation of power system network**

9. **Develop the program for WLS-SE method using DC load flow**

10. **Study of Application of Smart Grid in Power System**

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SYLLABUS FOR 1st Sem MTech PROGRAMME

Facts & Hvdc (03203102)

Type of Course: MTech

Prerequisite: Power System Analysis and Fundamental knowledge of Power Electronics

Rationale: The Power system transmission network is now a day's heavily loaded and to enhance the existing active as well as reactive power transmission capacity of the line management and control of active and reactive power is crucial. The subject aims to develop thorough understanding of requirement of power management in power system by employing power electronics based reactive power supplying/absorbing devices.

Teaching and Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					Total
				External		Internal			
L	T	P		Theory	Practical	Theory	*C.E.	Practical	
3	0	0	3	60	0	20	20	0	100

L-Lectures; **T-**Tutorial; **P-**Practical; **C.E.-**Continuous Evaluation

Contents:

Sr.	Topic	Weightage	Teaching Hrs.
1	**Reactive-Power Control in Electrical Power Transmission Systems:**: Reactive Power, Uncompensated Transmission Lines, Compensation : Shunt Compensation, Series Compensation, Series-Shunt Compensation,Series-series Compensation and Effect of compensation on power-Transfer Capacity	8%	4
2	**Principles of Conventional Reactive-Power Compensators:**: Introduction,The Thyristor-Controlled Reactor (TCR), The Thyristor-Controlled Transformer (TCT), the Fixed Capacitor-Thyristor-Controlled Reactor (FC-TCR), The Thyristor-Switched capacitor and Reactor, The Thyristor-Switched capacitor-Thyristor-Controlled Reactor (TSC-TCR),A Comparison of Different SVCs,STATCOM, Basic operation of UPFC & IPFC, Summary	23%	11
3	**HVDC Transmission-Development :**: Introduction, Historical Development, Equipment required for HVDC System, Comparison of AC and DC transmission, Limitation of HVDC Transmission Lines,Reliability of HVDC Systems,Standard Rated Voltages of HVDC and EHV AC systems, Choice of EHV AC and UHV AC lines and substation, Comparison of HVDC link with EHV AC link, HVDC-VSC Transmission System	10%	5
4	**HVDC Convertors:**: Introduction, Insulated Gate Bipolar Transistor (IGBT), HVDC Converter Valve and Valve Assembly, HVDC–VSC Operation and Principles, Three Phase Six Pulse Converter using SCRs, Twelve Pulse Bridge Converters	10%	5
5	**Control of HVDC converter and system:**: Introduction, Mechanism of AC power Transmission, Principles of Control,Necessity of Control in case of DC link, Rectifier Control Compounding Of Rectifier, Power Reversal in DC link, Voltage Dependent Current Order Limit-Characteristics of Converter, System Control Hierarchy and Basic Philosophy, Inverter Extinction Angle Control (EAG)	13%	6

6	**Transient Stability Analysis:**: Introduction, converter model, converter controller models, DC network models, solution methodology,	13%	6
7	**Harmonics in HVDC Systems:**: Introduction, Importance of Harmonic Study,Generation of Harmonics by Converters,Characteristics Harmonics on the DC Side, Characteristics Current Harmonics	10%	5
8	**Converter Faults & Protection:**: Introduction,Converter Faults,Protection against over currents,over voltages in a converter station,Surge arrester,protection against overvoltages	13%	6

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

Reference Books:

1. HVDC Transmission (TextBook)
   KAMAKSHAIAH,; Tata MC Graw Hill Education Pvt Ltd
2. Thyristor-based FACTS controllers for Electrical Transmission Systems (TextBook)
   R. Mohan Mathur, R K Verma,; Wiley IEEE Press

Useful Links:

https://blogs.siemens.com/theenergyblog/stories/tags/hvdc/
http://new.abb.com/about/hvdc-grid
http://blogs.dnvgl.com/utilityofthefuture/is-an-all-dc-electric-power-system-feasible

Course Outcome:

After Learning the course the students shall be able to:

1. Analyze reactive power requirement and management.
2. Assess and evaluate various compensators.
3. Simulate and design compensators.
4. Analyze various control schemes for various FACTS Controllers.
5. Learn about HVDC systems.
6. Analyze the characteristics of various power system loads and the power quality issues.

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SYLLABUS FOR 1st Sem MTech PROGRAMME

Power Electronics & Converters (03203103)

Type of Course: MTech

Prerequisite: Knowledge of Power Electronics up to BE level.

Rationale: This course will provide adequate knowledge of advance converter to students to develop the applications of power system and power electronics.

Teaching and Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					Total
				External		Internal			
L	T	P		Theory	Practical	Theory	*C.E.	Practical	
3	0	2	4	60	30	20	20	20	150

L-Lectures; **T-**Tutorial; **P-**Practical; **C.E.-**Continuous Evaluation

Contents:

Sr.	Topic	Weightage	Teaching Hrs.
1	**Review of Power Semiconductor Devices:**: Review of Semiconductor devices like Power BJT, SCR, MOSFET, IGBT, GTO, MCT; Static and dynamic characteristics of these devices; Single quadrant, Two quadrant and bid-directional switches.	8%	4
2	**Unity Power Factor Conversion**: Topologies, Steady-state Analysis, Dynamic Analysis, Modeling and Applications	19%	9
3	**Resonant Converter**: Introduction, Classification, Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant Switch Converter, Zero Voltage and Zero Current Switching, Clamped Voltage Topologies, Resonant DC link Inverter, High Frequency Link Integral Half Cycle Converters.	19%	9
4	**Multi Level Converters**: Need and Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded multilevel configurations; Features and relative comparison of these configurations, Controls and applications.	19%	9
5	**Other Advanced Converters**: Multi-pulse Converters, Matrix Converters, applications	19%	9
6	**Design of Magnetic Components**: Design and selection of magnetic components, inductor, high-frequency transformers, line and EMI filters.	16%	8

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

Reference Books:

1. High-Power Converters and AC Drives (TextBook)
Bin Wu; John Willey & sons

2. Power Electronics – Converters, Applications and Design
mauhmmad H Rashid; PEARSON PRENTICE HALL
3. Modern Power Electronics
by-P. C. Sen,; TATA MCGRAW HILL
4. Design Of Magnetic Components For Switched Mode Power Converters
L. Umanand and S.R. Bhat,; John Wiley & Sons Australia, Limited, 1992

Useful Links:

Overview of power electronic converters
1. Electronic switches. http://npteldownloads.iitm.ac.in/downloads_mp4/108108035/mod01lec01.mp4

2. DC - DC converters. http://npteldownloads.iitm.ac.in/downloads_mp4/108108035/mod01lec02.mp4

3. DC - AC voltage source inverter.
http://npteldownloads.iitm.ac.in/downloads_mp4/108108035/mod01lec03.mp4

4. Voltage source and current source inverters.
http://npteldownloads.iitm.ac.in/downloads_mp4/108108035/mod01lec04.mp4

5. Multilevel inverter - diode clamped inverter.
http://npteldownloads.iitm.ac.in/downloads_mp4/108108035/mod01lec05.mp4

6. Multilevel inverter - flying capacitor inverter.
Applications of voltage source converter
7. Applications of voltage source converter – I (motor drives, active rectifiers).
http://npteldownloads.iitm.ac.in/downloads_mp4/108108035/mod02lec06.mp4

8. Applications of voltage source converter – II (reactive current and harmonic compensation).
http://npteldownloads.iitm.ac.in/downloads_mp4/1081

Course Outcome:

After Learning the course the students shall be able to:

1. Understand the operation of basic semiconductor devices.
2. Define and classify applications of semiconductor devices in various power converters.
3. Analyze and construct various types of control strategies, comparison of control strategies for various power converters.
4. Provides advanced insights which could be useful for further technical work. (Matlab,PSIM)
5. Able to understand the use of Inductors and Capacitors design used in different Converters.
6. Simulate and design different converter (MLI ,VZS,ZCS etc.)

List of Practical:

1. **To obtain characteristics MOSFET and IGBT.**

2. **Evaluate the performance and operating modes of SLR/PLR dc-dc converter with the change in switching frequency**

3. **Simulate/Design a circuit for a Buck Converter with ZVS/ZCS to regulate the output voltage Vo with a given input voltage Vin**

4. **Compare the different carrier based PWM control strategies for CHB multilevel inverter and comment on the harmonic spectrum**

5. **To simulate NPC 5 Level multilevel inverter.**

6. **To simulate 5 Level flying capacitor multilevel inverter.**

7. **Study the operation and performance of Matrix converter**

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SYLLABUS FOR 1st Sem MTech PROGRAMME

System Identification & Control (03203104)

Type of Course: MTech

Prerequisite: Knowledge of Control System and Advanced Mathematics.

Rationale: This course provides the modeling and classifications of control systems and analyzes the applications of adaptive control

Teaching and Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					Total
				External		Internal			
L	T	P		Theory	Practical	Theory	*C.E.	Practical	
2	2	0	4	60	30	20	20	20	150

L-Lectures; **T-**Tutorial; **P-**Practical; **C.E.-**Continuous Evaluation

Contents:

Sr.	Topic	Weightage	Teaching Hrs.
1	**MODELING AND SIMULATION OF PROCESSES**: Impulse response - Frequency response - Step response methods – Signal modeling - Discretisation techniques- Runge-Kutta method -Z-transform method -Use of Simulation packages - Simulation of 1st order, 2nd order systems with and without dead time.	22%	7
2	**MIMO SYSTEM IDENTIFICATION TECHNIQUES**: Recursive least squares - Modified recursive least squares techniques - RLS algorithm - Maximum likelihood-Problems	22%	7
3	**CLASSIFICATION OF ADAPTIVE CONTROL**: Introduction - Uses - Definitions - Auto tuning - Types of adaptive control- Recent trends in self-tuning – Multivariable systems – Model updating – General-purpose adaptive regulator	22%	7
4	**CONTROL POLICIES**: Approaches - The Gradient approach - Lyapunov functions - Passivity theory – Control policies - pole placement control	18%	6
5	**ISSUES IN ADAPTIVE CONTROL AND APPLICATIONS**: Stability-Convergence-Robustness-Application of adaptive control- Power systems – Electric drives – Process control- Distillation Column, Dryers, Pulp Dryer, Chemical Reactor	16%	5

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

Reference Books:

1. Adaptive Filter Theory (TextBook)
Simon O. Haykin, McMaster University, Ontario Canada; Prentice Hall

2. Digital Control Systems
   Isermann, Rolf; Springer
3. Adaptive Control Systems, Techniques & Applications
   V.V.CHALAN; Marcel Dekker, Inc.

Useful Links:

http://blogs.mathworks.com/seth/2012/03/28/estimating-continuous-time-transfer-functions-with-system-identification-toolbox/
http://in.mathworks.com/help/control/getstart/system-identification-of-plant-models.html

Course Outcome:

After Learning the course the students shall be able to:

1. Acquire knowledge in modeling and controller design
2. Appreciate Adaptive control and its applications.
3. Perform analytical procedures and find solutions.
4. Identify & construct different models either from theoretical or real world simulation data.
5. Evaluate the performance of a system with suitable controller design.
6. Anticipate with futuristic problems by developing new algorithms.

List of Tutorial:

1. Matlab/Simulink - a guided tour

The tour will be guided through selected Matlab/Simulink features such as: operation on matrices, accuracy, complex data, graphics, m-functions, debugging, and simulation environment, creating and masking Simulink blocks.

2. Basic operations of linear matrix algebra

This exercise is aiming to make students familiar with some abstract concepts such as eigen values and eigenvectors, null space and range of a matrix, quadratic forms, pseudo inverse, projection matrices and Singular Values Decomposition. All these terms and concepts will be further used.

3. Least squares and recursive least squares solutions to linear matrix equation

The students will investigate properties of error function while solving a set of linear equations. Various aspects of ordinary Least Squares (LS) and Recursive Least Squares (RLS) methods will be discussed and compared. All necessary operations and m-functions the students will write themselves.

4. Various models of dynamic systems

Various models of dynamic systems will be investigated: continuous and discrete time, discrete equivalence of continuous dynamics in particular step response equivalence, selection of sampling time, frequency responses and conversion between different representations.

5. Estimation of parameters of linear plant

Identification experiment will be set-up in Simulink and collected data will be processed via LS (RLS) methods to estimate parameters of discrete model of the plant.

6. Neural networks based function approximation

Function will be represented by a set of input/output pairs. One hidden layer network will be taught.

7. An example of adaptive control system

Plant with variable gain will be controlled.

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SYLLABUS FOR 1st Sem MTech PROGRAMME

Ai Techniques in Power Systems (03207130)

Type of Course: MTech

Prerequisite: Knowledge of probability theory, Preliminary details of Power Systems Analysis, Basic concepts of UG level mathematics, Basic knowledge about writing algorithms.

Rationale: This subject provides overall generalized concepts of various soft computing techniques which can be useful in solving various problems in the field of engineering which includes ANN, FLC, and Different Search Algorithm.

Teaching and Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					Total
				External		Internal			
L	T	P		Theory	Practical	Theory	*C.E.	Practical	
3	0	2	4	60	30	20	20	20	150

L-Lectures; **T-**Tutorial; **P-**Practical; **C.E.-**Continuous Evaluation

Contents:

Sr.	Topic	Weightage	Teaching Hrs.
1	**Introduction:**: Definition, Applications, Components of an AI program; production system. Problem Characteristics, Overview of searching techniques. Knowledge representation issues and overview. Representing knowledge using rules; procedural versus declarative knowledge. Logic programming.	13%	6
2	**Artificial Neural Network**: Introduction, History of neural network research, Basic concepts of Neural Networks, Human brain, Model of Artificial Neuron, Neural Network architectures, Single layer feed forward Network, Multi layer feed forward network, recurrent networks, characteristics of NN, Learning Methods Perceptron, ADALINE MADALINE Networks. Architecture of Back propagation Network, Non linear activation operators, single and multilayer ANN, learning methods like Back propagation, LM etc. training and testing of ANN, Hebbnet.	20%	10
3	**Fuzzy Logic and Fuzzy Systems**: Importance of Fuzzy Systems, Basic Concepts, Fuzzy Sets and Rules, Classical Operations of Fuzzy Sets, Membership function and membership values, Fuzzy Relations, Properties of Fuzzy Sets, Fuzzy Truth Value, Learning in Fuzzy Systems, Fuzzy Logic Controllers (FLC),Pattern Recognition in Fuzzy Systems, Relational Data, Adaptively features and Adaptive Controllers	17%	8
4	**Application of Artificial Neural Networks in Power Systems**: Introduction on ANN application, Major Applications, Power System Stabilizer, Load Forecasting, Security Assessment, State Estimation, Contingency Screening.	20%	10

5	**Application of Fuzzy Logic in the Power System**: Introduction on Fuzzy logic application, Major applications, Reactive Power Control, Transient Stability, Generator Operation and Control, State Estimation, Security Assessment, Fault Diagnosis.	15%	7
6	**Analysis of the Techniques**: Neural Network based Application, Design of Network, Training Set Generation, Hopfield Network, Training the Inputs, Knowledge Consistency and Interaction with the User.	15%	7

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

Reference Books:

1. Artificial Intelligence :A Modern Approach
   Stuart J. Russell and Peter Norvig; PEARSON EDUCATION LIMITED
2. Artificial Intelligence Techniques in Power Systems (TextBook)
   K. Warwick, Arthur Ekwue, Raj Aggarwal,; Institution of Electrical Engineers.
3. Artificial Intelligence and Intelligent Systems
   N. P. Padhy; OXFORD University Press, New Delhi

Useful Links:

http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Artificial%20intelligence/New_index1.html
http://www.myreaders.info/html/artificial_intelligence.html
http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-825-techniques-in-artificial-intelligence-sma-5504-fall-2002/lecture-notes/
http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-spring-2005/lecture-notes/
http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-spring-2005/
http://www.eecs.qmul.ac.uk/~mmh/AINotes/

Course Outcome:

After Learning the course the students shall be able to:

1. Bifurcate and apply the techniques to solve different problems with the help of expert systems, neural networks, Knowledge based methods, Fuzzy logic, Al Programming languages in artificial intelligence.
2. Understand and acquire clear concepts of expert systems, neural networks. Knowledge base methods, Fuzzy logic, Al Programming languages in artificial intelligence and Al Programming languages.
3. Differentiate and compare between algorithm based methods and knowledge based methods.
4. Use appropriate AI framework for solving real time (dynamic problem) application in Power System.
5. Analysis of the AI techniques and design of networks.
6. Assess the knowledge consistency in Power system applications employing the AI techniques.

List of Practical:

1. **Use of MATLAB tool box for ANN.**

   Use of MATLAB tool box for ANN.

2. **Use of MATLAB tool box for Fuzzy Logic**

   Use of MATLAB tool box for Fuzzy Logic

3. **Use of MATLAB tool box for Optimization.**

   Use of MATLAB tool box for Optimization.

4. **Use of MATLAB Programming for implementing NN.**

   Use of MATLAB Programming for implementing NN.

5. **Use of MATLAB Programming for generating different types of activation functions in ANN**

Use of MATLAB Programming for generating different types of activation functions in ANN

6. **Take a problem of power system/power electronics and make use of MATLAB Programming for training and testing same using ANN.**

   Take a problem of power system/power electronics and make use of MATLAB Programming for training and testing same using ANN.

7. **7 MATLAB program for generating different types of Fuzzy membership functions. Take a problem of power system/power electronics and make use of FUZZY Logic Tools to solve the same.**

   MATLAB program for generating different types of Fuzzy membership functions. Take a problem of power system/power electronics and make use of FUZZY Logic Tools to solve the same.

PARUL UNIVERSITY - FACULTY OF ENGINEERING & TECHNOLOGY

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SYLLABUS FOR 1st Sem MTech PROGRAMME

Transients in Power Systems (03207131)

Type of Course: MTech

Prerequisite: Knowledge of operation and construction of high voltage equipment and basic knowledge of power system operation

Rationale: This course provides detailed concepts of switching and lightning transient voltages which power system components may carry over and above the power frequency voltage. Modeling of transmission line for calculation of such voltages is described in this course. The design of insulation under such conditions will also be covered.

Teaching and Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					Total
				External		Internal			
L	T	P		Theory	Practical	Theory	*C.E.	Practical	
3	0	2	4	60	30	20	20	20	150

L-Lectures; **T-**Tutorial; **P-**Practical; **C.E.-**Continuous Evaluation

Contents:

Sr.	Topic	Weightage	Teaching Hrs.
1	**Introduction**: Source of transients, various types of power system transients, effects of transient on power system, importance of study of transient for insulation design.	10%	4
2	**Travelling waves on transmission line**: Lumped and distributed parameters, Wave equation, Reflection and Refraction, behaviour of travelling waves with line termination- lattice diagrams – Attenuation and distortion- Multi conductor system and velocity wave. Computation of power system transients : Statistical approach for transient's calculation, principle of digital calculation- matrix method of solution- modal analysis, Computation using EMTP – Simulation of Switches and non linear elements.	28%	15
3	**Lightning, Switching and temporary Over voltage**: Lightning- physical phenomenon of lightning, interaction between lightning and power system, Factors contributing to line design, Switching: Short line or Kilometric fault- Energizing transients –closing and reclosing of lines –Line dropping, load rejection, voltage induced by fault, very fast transient overvoltage (VFTO).	19%	8
4	**Behaviour of Winding Under Transient Condition**: Initial and final voltage distribution, winding oscillation, travelling wave solution, behaviour of transformer core under surge condition, Rotating machine- surge in generator and motor.	15%	6

5	**Protection of system and equipments against transients overvoltage and insulation co-ordination**: Introduction, Protection of transmission line against lightning, Lightning shielding of Substation, Surge suppressor and Lightning arrestors, Application of surge arrestor, Surge capacitors and surge reactors, Surge protection of rotating machine, Ground practices , Protection of control circuits, Basic Idea of insulation co-ordination, Equipment insulation level and insulation co-ordination of sub-stations, Insulation levels at substation at protective zones, Insulation co-ordination in EHV and UHV systems.	28%	15

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

Reference Books:

1. High Voltage Engineering
   M.S. Naidu and V. Kamaraju; Tata McGraw Hill
2. Electrical Transient in Power System
   Allan Greenwood; Willey Publication
3. Travelling waves in Transmission system
   L.V. Bewley
4. Power System Transient Theory and Application
   Akihiro Ametani, Naoto Nagaoka Yoshihiro baba, Teruo ohno; CRC Press
5. Extra High voltage AC Transmission Engineering
   R.D.Begamudre; New Age Internation
6. Power System Transients A statistical Approach
   C. S. Indulkar and D.P. Kothari; New Delhi

Useful Links:

http://halimnurrokhman.blogspot.com/2011/09/transients.html
http://engineering.electrical-equipment.org/electrical-distribution/what-are-transients-how-to-eliminate-them-from-power-system.html
http://top10electrical.blogspot.com/2014/09/causes-of-power-system-transients.html

Course Outcome:

After Learning the course the students shall be able to:

1. Visualize the effects of various change in circuit parameters
2. Foresee causes of transients analyse and simulate them.
3. Suggest alternate solution for problems like saturation effects, transmission line parameters changes, voltages across breakers, lightning arrester etc.
4. Study the effects of transient on insulation.
5. Can do travelling waves analysis.
6. Study behaviour of winding under transient

List of Practical:

1. **Introduction to MATLAB for various matrix operations.**
2. **Simulation of EMTP for parameter.**
3. **Transition line frequency dependent parameter identification.**
4. **calculation of specifications of protection equipment under the influence of various transients.**
5. **Ground wire calculation.**

6. **MATLAB program for transmission line modeling using distributed parameters**

7. **MATLAB simulation for generation of abnormal and normal switching transients.**

8. **MATLAB simulation of RL and RLC circuit**

9. **MATLAB simulation/Programming various type of fault in power system.**

10. **MATLAB simulation/programming for transmission line model.**

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SYLLABUS FOR 1st Sem MTech PROGRAMME

Distributed Generation & Micro Grid (03207132)

Type of Course: MTech

Prerequisite: Knowledge of Renewable Energy Power Plant

Rationale: To enable the students gain a fair knowledge on the concepts and technology of Distributed Generation and Micro Grid.

Teaching and Examination Scheme:

Teaching Scheme (Hrs./Week)			Credit	Examination Scheme					Total
				External		Internal			
L	T	P		Theory	Practical	Theory	*C.E.	Practical	
3	0	2	4	60	30	20	20	20	150

L-Lectures; **T-**Tutorial; **P-**Practical; **C.E.-**Continuous Evaluation

Contents:

Sr.	Topic	Weightage	Teaching Hrs.
1	**INTRODUCTION:**: Conventional Power Generation: Advantages And Disadvantages, Energy Crises, Non-Conventional Energy (NCE) Resources: Review Of Solar PV, Wind Energy Systems, Fuel Cells, Micro-Turbines, Biomass, And Tidal Sources.	12%	6
2	**IMPACT OF GRID INTEGRATION:**: Requirements For Grid Interconnection, Limits On Operational Parameters, Voltage, Frequency, THD, Response To Grid Abnormal Operating Conditions, Islanding Issues. Impact Of Grid Integration With NCE Sources On Existing Power System: Reliability, Stability And Power Quality Issues.	21%	10
3	**MICROGRIDS:**: Concept And Definition Of Microgrid, Microgrid Drivers And Benefits, Review Of Sources Of Microgrids, Typical Structure And Configuration Of A Microgrid, AC And DC Microgrids, Power Electronics Interfaces In DC And AC Microgrids, Communication Infrastructure, Modes Of Operation And Control Of Microgrid: Grid Connected And Islanded Mode, Active And Reactive Power Control, Protection Issues, Anti-Islanding Schemes: Passive, Active And Communication Based Techniques.	25%	12
4	**POWER QUALITY ISSUES IN MICROGRIDS:**: Power Quality Issues in microgrids- Modelling and Stability analysis of Microgrid, regulatory standards, Microgrid economics	21%	10

5	**DISTRIBUTED GENERATIONS:**: Concept Of Distributed Generations, Topologies, Selection Of Sources, Regulatory Standards/ Framework, Standards For Interconnecting Distributed Resources To Electric Power Systems: IEEE 1547. DG Installation Classes, Security Issues In DG Implementations Energy Storage Elements: Batteries, Ultra-Capacitors, Flywheels. Captive Power Plants	21%	10

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

Reference Books:

1. Voltage Source Converters in Power Systems: Modeling, Control and Applications
   Amirnaser Yezdani, and Reza Iravani; IEEE John Wiley Publications
2. Power Switching Converters Medium and High Power
   Dorin Neacsu; CRC Press, Taylor & Francis.
3. Solar Photo Voltaics
   Chetan Singh Solanki; PHI learning Pvt. Ltd., New Delhi

Useful Links:

http://smartmicrogrid.blogspot.com/p/smart-microgrid-lab-project.html
http://smartmicrogrid.blogspot.com/
http://microgridnews.com/

Course Outcome:

After Learning the course the students shall be able to:

1.1. Implement wind, solar and fuel cell based System with microgrid.
2. Identify an appropriate system for standalone and grid connected operation and apply energy storage devices.
3. Define the new developments in Micro grids and applications.
4. Execute project works related to market pricing schemes followed in Indian context and suggest novel Algorithms for designing different types of distributed generation.
5. Optimize of stand alone as well as Grid connected line.
6. design different DG based hybrid system

List of Practical:

1. **Impact of Distributed Generations With Energy Storage Devices on the Electric Grid**
2. **Performance Analysis of Wind Turbine as a Distributed Generation Unit in Distribution System.**
3. **MATLAB/Simulink Based Modeling of Solar Photovoltaic Cell.**
4. **Simulation and Analysis of Wind Energy in distribution network.**
5. **Developing a MATLAB simulation program for a variable speed wind power generator and associate ac-dc-ac converter.**
6. **Investigating its transient and steady-state characteristics under different wind conditions.**
7. **Developing and simulating phase locking and control scheme for wind generator grid interface and control.**

8. **Simulation and Analysis of Wind Energy and Photo Voltaic Hybrid System in distribution network.**

9. **Power flow analysis of Solar Photo voltaic Cell connected to grid.**

10. **Power flow analysis of Wind connected with Grid Integration.**

11. **Modelling and Steady state stability analysis of Microgrid.**

12. **Analysis Power Quality Issues for a Micro grid.**

13. **Security Issues In DG Implementations.**

14. **Active And Reactive Power Control for a Non-Conventional Energy (NCE) sources connected to grid.**

15. **Modelling and Transient stability analysis of Microgrid.**

PARUL UNIVERSITY - Faculty of Engineering and Technology

Department of Applied Science & Humanities

SYLLABUS FOR 1st Sem MTech PROGRAMME

Research Methodology (03200101)

Type of Course: MTech

Prerequisite: Knowledge of Electronics and Communication Systems and Technologies. Basic Computer Skills Fundamental Knowledge of Area of Interest in relevant discipline.

Rationale: The objective of the course is intended to develop the research skills in a systematic manner which will impart the ability to select appropriate research methodology, experimental design, follow professional ethics and academic integrity, and develop oral and written presentation skills.

Teaching and Examination Scheme:

Teaching Scheme			Credit	Examination Scheme					Total
				External		Internal			
Lect Hrs/ Week	Tut Hrs/ Week	Lab Hrs/ Week		T	P	T	CE	P	
1	2	0	3	-	60	-	20	20	100

Lect - Lecture, **Tut** - Tutorial, **Lab** - Lab, **T** - Theory, **P** - Practical, **CE** - CE, **T** - Theory, **P** - Practical

Contents:

Sr.	Topic	Weightage	Teaching Hrs.
1	**How to Start Research**: **Find what is expected of the you** Identify specific requirements for evaluation/review and what constitutes completion of your work. **Decide which sources you will need:** Differentiate between journals, conferences, books, magazines and their Quality ,Understand how to establish their quality and authenticity. **Finding Information** How to conduct effective searches, How to find relevant papers related to your area of research, How to capture critical information. **Identify main ideas in scholarly literature** Understand and identify the bias, theoretical position and evidence produced. **Write notes to organize your ideas** Compare ideas and concepts from different papers **Ethical Issues related to Research** Plagiarism, Intellectual Property rights, Copyrights, Patent. **References** Understand the importance of distinguishing your work from others work and acknowledging such references, Learn international standards of referencing.	30%	4
2	**Focus to Problem & Understand the Direction of Research**: **Identify Problem and Methods to Solve it**. Analyze the question, Identify key areas in your field, Determine the nature and extension of papers that you should read. **Identify the gaps** Learn to Critique existing knowledge and how to find the gap. **Formulate the Problem Statement** Understand what should be the key aspects of your problem statement. Examples of effective and ineffective titles. **Validation** Identify problem and experimental/theoretical data for comparison with your model, earn how to extrapolate/scale data for validation, Find what is acceptable level of error and justification thereof.	40%	6

3	**Publishing Research**: **Writing your Assignment** Identify the key features of any written work, Structure your assignment. **Build your argument** Recognize the importance of emphasizing your point ,Distinguish between your point and the evidence available, Acknowledge the evidence. **Review and finalize your work** Know and follow the Process of reviewing and proof reading your work.Use feedback to improve your work.	20%	3
4	**Showcasing the Research**: **Delivering Your Presentation** **Check the logistics of your presentation** Identify the key message of your presentation, Understand the expectations and what will be the key review points. **Develop the structure of your presentation** Understand the key components of an oral presentation, Know the usual structure of a good presentation. **Putting together the support material** Identify all the material you need to carry as supporting material. **Get feedback on oral presentation** Prepare for delivery of your Oral presentation, Rehearse and time your presentation.	10%	2

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

Reference Books:

1. Research Methodology: Methods and Techniques (TextBook)
   C.R. Kothari; New Age Publishers
2. Research Methodology (TextBook)
   R.Paneerselvam; PHI Learning Private Limited

Useful Links:

http://thomsonreuters.com
http://www.elsevier.com/online-tools/scopus
http://computationalengineering.mit.edu/research/methodology
https://www.ieee.org/index.html
http://www.asce.org/
http://www.asme.org/

Course Outcome:

After Learning the course the students shall be able to:

Upon completion of the subject, students will be able to:
1. Understand and Describe importance of research.
2. Classify and select appropriate resources for Research.
3. Analyze the contents of literature and identify further scope.
4. Formulate a Research Problem.
5. Develop effective written and oral Presentation skills.

List of Tutorial:

1. Understand the Impact factor and H factor.
2. Identify 5 good research papers based on I and H factor of your area of interest in relevant discipline.
3. Write critical review of each paper and summary of strength and gaps of above referred papers.
4. Narrowing the area of research through systematic analysis and Find out the research gap.
5. Write briefly on how the Problem statement is identified. Identify the future scope in the area of research.
6. Describe the various methods for validating the research problem from the papers referred.
7. Write a paper on the Literature Review conducted.
8. Presentation of Problem formulation and Literature Review