DEPARTMENT OF ELECTRICAL ENGIEERING
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING
INDUS UNIVERSITY

M-TECH ELECTRIC POWER SYSTEM, SEMESTER –I TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017														
SR NO	CODE	SUBJECTS	TEACHING SCHEME			CREDITS	HOURS	EXAMINATION SCHEME						
								THEORY			PRACT		TOTAL
			L	T	P			CIE		ESE	CIE	ESE	
								MID	IE				
1	PS0101	Overvoltage Transients in Power system	3	2	0	4	5	30	10	60	00	00	100
2	PS0102	Power System Modeling & Analysis	3	2	0	4	5	30	10	60	00	00	100
3	PS0103	Modern Control System	3	0	2	4	5	30	10	60	40	60	200
4	PS0104	Advanced Power System Operation & Control	3	0	2	4	5	30	10	60	40	60	200
5	PS0105	Power Quality	3	2	0	4	5	30	10	60	00	00	100
6	PS0107	Solar & wind Energy system (Elective-I)	3	2	0	4	30	30	10	60	00	00	100
7	PS0106	Distributed Generation & Micro grid (Elective I)											
TOTAL			**19**	**08**	**06**	**25**	**33**	**180**	**60**	**360**	**80**	**120**	**800**

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

DEPARTMENT OF ELECTRICAL ENGIEERING
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING
INDUS UNIVERSITY

M-TECH ELECTRIC POWER SYSTEM, SEMESTER –II TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017														
SR NO	**CODE**	**SUBJECTS**	**TEACHING SCHEME**			**CREDITS**	**HOURS**	**EXAMINATION SCHEME**						
			L	**T**	**P**			**THEORY**			**PRACT**		**TOTAL**	
								CIE		**ESE**	**CIE**	**ESE**		
								MID	**IE**					
1	PS0201	Advanced Power System Protection	3	0	2	4	5	30	10	60	40	60	200	
2	PS0202	Optimization Techniques	4	2	0	5	6	30	10	60	00	00	100	
3	PS0203	Advanced Power System Stability	3	2	0	4	5	30	10	60	00	00	100	
4	PS0204	HVDC & FACTS	3	2	0	4	5	30	10	60	00	00	100	
5	PS0205	Substation Design & Automation	3	2	0	4	5	30	10	60	00	00	100	
	PS0206	Simulation Lab	0	0	2	1	2	00	00	00	40	60	100	
6	PS0207	Application of Artificial Intelligence (Elective-II)	3	2	0	4	5	30	10	60	00	00	100	
7	PS0208	Energy Management & Audit (Elective II)												
TOTAL			**19**	**08**	**06**	**25**	**33**	**180**	**60**	**360**	**80**	**120**	**800**	

DEPARTMENT OF ELECTRICAL ENGIEERING
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING
INDUS UNIVERSITY

M-TECH ELECTRIC POWER SYSTEM, SEMESTER –III TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017														
SR NO	CODE	SUBJECTS	TEACHING SCHEME			CREDITS	HOURS	EXAMINATION SCHEME						
								THEORY			PRACT		TOTAL
								CIE					
			L	T	P			MID	IE	ESE	CIE	ESE	
1	PS0301	Dissertation Phase I	00	00	40	20	40	00	00	00	150	150	300
TOTAL			**00**	**00**	**40**	**20**	**40**	00	00	00	150	150	300

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

DEPARTMENT OF ELECTRICAL ENGIEERING
INDUS INSTITUTE OF TECHNOLOGY & ENGINEERING
INDUS UNIVERSITY

M-TECH ELECTRIC POWER SYSTEM, SEMESTER –IV TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017														
SR NO	CODE	SUBJECTS	TEACHING SCHEME			CREDITS	HOURS	EXAMINATION SCHEME						
								THEORY			PRACT		TOTAL
								CIE					
			L	T	P			MID	IE	ESE	CIE	ESE	
1	PS0401	Dissertation Phase II	00	00	40	20	40	00	00	00	150	150	300
TOTAL			**00**	**00**	**40**	**20**	**40**	00	00	00	150	150	300

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Department of Electrical Engineering, IITE,

Indus University

1st Semester

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M-TECH ELECTRIC POWER SYSTEM, SEMESTER –I TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017														
SR NO	**CODE**	**SUBJECTS**	**TEACHING SCHEME**			**CREDITS**	**HOURS**	**EXAMINATION SCHEME**						
								THEORY			**PRACT**		**TOTAL**
			L	**T**	**P**			**CIE**		**ESE**	**CIE**	**ESE**	
								MID	**IE**				
1	PS0101	Overvoltage Transients in Power system	3	2	0	4	5	30	10	60	00	00	100
2	PS0102	Power System Modeling & Analysis	3	2	0	4	5	30	10	60	00	00	100
3	PS0103	Modern Control System	3	0	2	4	5	30	10	60	40	60	200
4	PS0104	Advanced Power System Operation & Control	3	0	2	4	5	30	10	60	40	60	200
5	PS0105	Power Quality	3	2	0	4	5	30	10	60	00	00	100
6	PS0107	Solar & wind Energy system (Elective-I)	3	2	0	4	30	30	10	60	00	00	100
7	PS0106	Distributed Generation & Micro grid (Elective I)											
TOTAL			**19**	**08**	**06**	**25**	**33**	**180**	**60**	**360**	**80**	**120**	**800**

Subject: **Overvoltage Transients in Power system**								
Program: **M.Tech. Electrical Power System**			Subject Code: PS0101			Semester: **I**		
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	60	0	40	0	100

Course Outcome:

1. **To aware about switching phenomena in power system.**
2. **To learn wave propagation, lightning phenomena and surge phenomena.**
3. **To learn Numerical simulation of electrical transients and Insulation Co-ordination**

Unit 1 **[09]**

Fundamental concepts of switching transients in power system

Introduction, sources of electrical transients, Transient analysis of three phase power systems, Switching transients : The short line fault, Circuit breakers, Circuit breaker recovery voltage, Modelling of the switching arc of Circuit breakers

Unit 2 **[09]**

Wave Propagation on single and multi conductor system

Introduction, velocity of travelling waves and characteristics impedance ,wave equation, Wave propagation on multiconductor system, wave equation, Transition points in multi-conductor

system, Reflection and refraction of travelling waves, lattice diagram, Effect of dissipation on wave propagation, Effect of finite soil conductivity, Modal analysis, Ground impedance

Unit 3 **[09]**

Lightning phenomena and Switching surge phenomena

Mechanism of the lightning flash, Wave shapes of the lightning currents, Direct lightning stroke to transmission line tower and , Direct lightning stroke to a line, Grounding for protection against lightning, Steady state Tower-Footing resistance, Dynamic tower footing resistance, concentrated and extended grounding system,

Introduction, Current suppression or chopping, Switching surges in capacitive circuits, System performance under switching surges, mechanism of air breakdown, Critical flashover voltage of insulation under switching surges, Phase to phase switching surge

Unit 4 **[18]**

Response of overhead lines to lightning strokes

Direct lightning stroke to overhead lines without shielding wires, introduction, stroke to tower, Direct lightning stroke to overhead lines with shielding wires, stroke to tower, stroke to shield wire, Lightning induced voltages on overhead lines of finite length, Surge arrestors, introduction, and type.

Numerical simulation of electrical transients and Insulation Co-ordination

The electromagnetic transient program, The MNA program, The Xtrans program, Insulation co-ordination, Introduction ,terminology , basic requirement, Classification of insulation for insulation coordination, Application of insulation coordination, Insulation coordination in high voltage dc system

Text Books:

1. C.S.Indulkar & D.P.Kothari, Power System Transients: A statistical approach -Prentice Hall.

Reference Book

2. V. Venicov, Transient Processes in electrical power systems-Mir publishers
3. Lou Van Der Sluis, Transients in electrical power systems, John Wiley & Sons publishers

Web resource

1. www.ijssbt.org/volume2/pdf/11.pdf

Subject: **Power System Modelling & Analysis**								
Program: **M.Tech. Electrical Power System**				Subject Code: PS0102			Semester: **I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	60	0	40	0	100

Course Outcome:

1. **To aware about load flow analysis and modeling.**
2. **To learn wave machine modeling and excitation system.**
3. **To learn transmission line and load modeling.**

Unit 1 **[09]**

Power Flow Study & Modeling

Static Load flow Equation formation, Disturbance variables, control variables & state variables, practical constraints, types of buses, Gauss iterative method, algorithm, flow chart and programming, Gauss-Seidal without PV buses, algorithm, flowchart and programming, Gauss-Seidal with PV buses, algorithm, flowchart and programming, Newton-Raphson method without PV buses, algorithm, flowchart and programming, Newton-Raphson method with PV buses, algorithm, flowchart and programming, Fast Decoupled Load Flow method (FDLF), algorithm, flowchart and programming

Unit 2 **[12]**

Synchronous Machine Concept & Modeling

Physical Description, Armature & Field Structure, MMF waveforms, direct & quadrature axis, Mathematical Description of synchronous machine, review of magnetic circuit, Basic equation of synchronous machine, Parks transformation, Classification of synchronous machine modelling as per IEEE, Electrical Transient performance characteristics for Synchronous machine,3 phase short circuit at terminal of Synchronous machine, Magnetic saturation,
Improve of modelling of saturation, Equation of Motion.

Unit 3 **[12]**

Modeling of Speed Governing & Excitation System

Introduction, Modeling of Speed governing System, Mechanical and Electro hydraulic controlled speed governing system, General Model for speed governing system, Introduction to excitation system, Excitation System Schematic diagram with elements of excitation system, D.C. excitation systems, A.C. excitation systems, over excitation and under excitation limiters.

Unit 4 **[12]**

Transmission Line & Load Modeling

Introduction, Objective for AC transmission Line, Electrical Characteristics for overhead line and underground cables, Performance equation , surge impedance loading and Equivalent circuit of

transmission line, transmission line parameters, Performance requirement of Power transmission line, Power transfer and stability consideration.

Basic Concept of load modeling, Static Load Modeling, Dynamic Load modeling, Synchronous Motor Modeling, Acquisition of load model parameter, Measurement based Approach and Component based Approach, state estimation

Text Books

1. P. S. Kundur — Power System Stability and Control, McGraw Hill Inc, New York.
2. K.R.Padiyar - Power System Dynamics - Stability and Control, BS Publishers, Hyderabad

Reference Book

4. Power System Analysis - John J. Grainger and William D. Stevenson, Tata McGraw-Hill
5. Power System Analysis - T. K. Nagsarkar and M. S. Sukhija, Oxford University Press
6. I. J. Nagrath and D. P. Kothari - Modern Power Systems Analysis, Tata McGraw Hill.

Web Resource

nptel.ac.in/courses/108104051/chapter_1/1_18.html

Subject: **Modern Control System**								
Program: **M.Tech. Electrical Power System**			Subject Code: PS0103			Semester: **I**		
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**

3	0	2	4	60	60	40	40	200

Course Outcome:

1. **To aware about** State Space Analysis of Control Systems
2. **To learn** Controllability and Observability**.**
3. **To learn** State Feedback Control Design

Unit 1 **[12]**

Mathematical Background – Matrices: Definition of Matrices; Matrix Algebra; Matrix Multiplication and Inversion; Rank of a Matrix; Differentiation and Integration of Matrices. State Space Analysis of Control Systems: State Variables; State-Space Representation of Elec trical, Mechanical and Electromechanical Systems; State Space Representation of nth Order Linear Differential Equation; Transformation to Phase Variable Canonical Form; Relationship Between State Equations and Transfer Functions; Characteristic Equation; Eigen Values and Eigen Vectors; Transformation to Diagonal Canonical Form; Jordan Canonical Form;Controllability Canonical Form; Observabilty Canonical Form; Decomposition of Transfer Function-Direct, Cascade and Parallel Decomposition; State Diagram; Solution of the Time Invariant State Equation; State Transition Matrix and its Properties; Transfer Matrix; Transfer Matrix of Closed Loop Systems.

Unit 2 **[12]**

Controllability and Observability: Concept of Controllability and Observability; Kalman's Theorems on Controllability and Observability, Alternative Tests (Gilbert's Method) of Controllability and Observability; Principle of Duality; Relationship among Controllability, Observability and Transfer Function.

Unit 3 **[11]**

Liapunov Stability Analysis : Stability of Equilibrium State in the Sense of Liapunov; Graphical

Representation of Stability; Asymptotic Stability and Instability; Sign-Definiteness of Scalar Function; Second Method of Liapunov; Stability Analysis of Linear Systems; Krasovski's Theorem; Liapunov Function Based on Variable Gradient Method.

Unit 4 **[10]**

State Feedback Control Design:

Design of Robust Control Systems; State Feedback Control-Pole Placement Design, State Feedback with Integral Control. Observer Design: Design of Observer

Text Book

1. Modern Control Engineering, Fourth Edition, Prentice Hall, 2001- Katsuhiko Ogata
2. Automatic Control Systems, High Education Press, 2003- B. C. Kuo

Reference Book

3. Control Systems Engineering, Fifth Edition, New Age International Publishers, 2007- L. J. Nagrath & M. Gopal
4. Modern Control Systems, Sixth Edition, Addison-Wesley, 1993- Rich

Web Resource

nptel.ac.in/courses/108101037/

LIST OF EXPERTMENT

1. Introduction to Matlab for Control System Toolbox.
2. Introduction to Matlab for various matrix operations.
3. Matlab for various state space model.
4. Matlab program for the pole placement technique.
5. MATLAB program for controllability.
6. MATLAB program for Observability.
7. Matlab Program of Observer Design.

8. MATLAB program for Lyapunov's methods:

9. Stability of system using Lyapunov's direct method

10. To study different canonical form.

Subject: **Advanced Power System Operation & Control**								
Program: **M.Tech. Electrical Power System**			Subject Code: PS0104			Semester: **I**		
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	60	60	40	40	200

Course Outcome:

1. **To aware about Power System Security Analysis.**
2. **To learn Economic Load Dispatch and Optimal Power Flow**
3. **To learn** various **Load Forecasting Technique**

Unit 1 **[08]**

Power System Security and State Estimation

Introduction of power system security, The concept of system security, Long term And operational planning, online operation, security analysis, security enhancement, Transient security Analysis State estimator, static state estimation, Modeling of uncertainty, Least square estimation, Application of state estimation.

Unit 2 **[12]**

Economic Load Dispatch & Hydrothermal Scheduling

Introduction – input-output characteristics, cost curves, heat rate curve, incremental fuel rate curve, different constraints, Economic allocation of generation without transmission losses, algorithm and flowchart, programming, Transmission loss formula in terms of loss coefficients Economic allocation of generation with transmission losses, algorithm and flowchart, programming.

Unit 3 **[09]**

Optimal Power Flow and Unit Commitment

Optimal real and reactive power dispatch without inequality constraints, Optimal real and reactive power dispatch with inequality constraints, Introduction to UC, Comparison with Economic Load dispatch, Constraint in UC, Cost function formulation, Unit commitment solution by enumeration scheme, priority list method and Dynamic programing, Optimal Unit commitment with security Constraint

Unit 4 **[16]**

Optimal Frequency Control

P-f and Q-V control loops, Mechanism of real and reactive power control regulators, Steady state frequency error, dynamic frequency error, droop characteristics, P-f controller strategy for isolated area, steady state and dynamic frequency response, Two area tie-line bias control strategy, Flat frequency control, selective frequency control, tie line frequency control, Design of optimal state controller using Kalman method, State space representation of two area control, Sub-optimal and

decentralized controllers, Discrete-mode AGC ,Time-error and inadvertent interchange correction techniques

Load Forecasting Technique

Introduction, Forecasting Methodology, Estimation of average and Trend Terms, Estimation of Periodic Components, Time Series Approach, Estimation of Stochastic Components, Long Term prediction using Economic Models, Reactive Load forecast

Text books:

1. W. D. Stevenson - Elements of Power System Analysis, McGraw Hill Book Company, New York

2. S. S. Vadhera - Power System Analysis and Stability, Khanna Publishers, New Delhi.

Reference Book

3. O. I. Elgerd - Electric Energy System Theory: An Introduction, TMH Ltd., New Delhi.

4. L. K. Kirchmayer - Economic Operation of Power System, John Wiley and Sons, Inc., New York.

5. P. S. R. Murty - Power System Operation and Control, TMH Publications, New Delhi.

Web Resource

nptel.ac.in/downloads/108101040/

LIST OF EXPERIMENTS

1. To Perform load flow analysis for 8 Bus system with consideration of acceleration factor.
2. To Perform load flow analysis for 12 Bus system with consideration of jacobian matrix.
3. To perform AC load flow analysis.
4. To perform Economic load dispatch using B-coefficient method for 3 unit, 4 unit and 5 unit system
5. To perform short circuit analysis.
6. To perform single phase and 3 phase fault analysis.
7. To perform load frequency control using flat frequency control.
8. To perform load frequency control using Tie line frequency control.
9. To perform contingency analysis for line outage.

10. To perform contingency analysis for Generator outage.

11. To perform load frequency control for isolated system and interconnected system with MATLAB

12. Application of ANN tool box in MATLAB

13. Application of Fuzzy tool box in MATLAB.

Subject: **Power Quality**								
Program: **M.Tech. Electrical Power System**				Subject Code: PS0105			Semester: **I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	60	0	40	0	100

Course Outcome:

1. **To aware about Power Quality**
2. **To learn Voltage Variation and Power Quality Analysis**
3. **To learn Power Quality Monitoring and enhancement.**

Unit 1 **[09]**

Power Quality & Overview

Power Quality definition, PQ characterization: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation–Power acceptability curves: CBEMA, ITIC – Sources for Electric Power Quality problem in power system: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards and Guidelines.

Unit 2 **[10]**

Voltage Variation

Voltage Sags - Magnitude & duration-Types- Sources of sags - Estimation of Voltage sag performance: Transmission system and Utility distribution system, Effect of sag on AC Motor Drives, Single-Phase Domestic and Office Loads, Monitoring and mitigation of voltage sag. Origin of Long & Short interruption -influence on various equipments-Basic reliability indices related interruption-monitoring and mitigation of interruption.

Unit 3 **[10]**

Power Quality Analysis

Measurements of Voltage, Current, Power, Energy, power factor- Time domain methods and Frequency domain methods: Laplace's, Fourier and Hartley transform – The Walsh Transform – Wavelet Transform. Harmonic Distortion, Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads.

Unit 4 **[16]**

Power Quality Monitoring

Monitoring considerations: Power line disturbance analyser, power quality measurement equipment, harmonic / spectrum analyser, flicker meters, disturbance analyser. Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On–line extraction of fundamental sequence components from measured samples

Power Quality Enhancement

Utility-Customer interface –Harmonic filters: passive, Active and hybrid filters –Custom power devices: Network reconfiguring Devices, Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC –control strategies: P-Q theory, Synchronous detection method – Custom power park –Status of application of custom power devices.

Text Books:

1. Math H.J.Bollen, "Understanding Power Quality Problems-Voltage sag & Interruptions", IEEE Press, 2000.
2. Arindam Ghosh "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002.

Reference Books

3. Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.Wayne Beaty, "Electrical Power Systems Quality", McGraw Hill, 2003.
4. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994(2nd edition).

Jos Arrillaga, Neville R. Watson, " Power System Harmonics"- John Wiley & Sons, 2003.

Web Resource

nptel.ac.in/courses/108106025/

Subject: **Solar & wind Energy system**								
Program: **M.Tech. Electrical Power System**				Subject Code:PS0107			Semester: **I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	60	0	40	0	100

Course Outcome:

1. **To aware about solar energy and its application and design.**
2. **To learn grid connected system**
3. **To learn wind energy system**

Unit 1 **[06]**

Introduction

Characteristics of sunlight – Source of radiation – solar constant– Measurement of diffuse, global and direct solar radiation: pyrheliometer, pyranometer, pyregeometer, net pyradiometer-sunshine recorder

Unit 2

Solar collector & Application [09]

Solar Non-Concentrating Collectors- Design considerations – Classification air, liquid heating collectors – Derivation of efficiency and testing of flat plate collectors –Analysis of concentric tube collector - Solar green house. Design – Classification– Concentrator mounting –Focusing solar concentratorsHeliostats. Solar powered absorption A/C system, water pump, chimney, drier, dehumidifier, still, cooker

Unit 3 [15]

PV System

Solar modules – storage systems – power conditioning and regulation - protection – stand alone PV systems design – sizing Photo-voltaic cell – characteristics-cell arrays-power electric circuits for output of solar panels-choppers-inverters-batteries-charge regulators, Construction concepts.

Grid Connected PV System

PV systems in buildings – design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs

Energy Storage System

Impact of intermittent generation – Battery energy storage – solar thermal energy storage – pumped hydroelectric energy storage, solar ponds.

Unit 4 [15]

Wind energy System

Wind Energy: Basics & Power Analysis, Wind resource assessment, Power Conversion Technologies and applications, Wind Power estimation techniques, Principles of Aerodynamics of wind turbine blade, various aspects of wind turbine design, Wind Turbine Generators: Induction, Synchronous machine, constant V & F and variable V & F generations, Reactive power compensation. Site Selection,

Text Book

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

1. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progensa,1994.
2. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, Applied Photovoltaics, 2007,Earthscan, UK.

Reference Book

3. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook , CRC Press, 2011.
4. Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990
5. Solar Energy – S.P. Sukhatme, Tata McGraw Hill,1987.

Web Resource

nptel.ac.in/...Conventional%20Energy%20Systems-/Learning%20Materail%20-%20N..

Subject: **Energy Management & Audit**								
Program: **M.Tech. Electrical Power System**				Subject Code: PS0209			Semester: **II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	60	0	40	0	100

Course Outcome:

1. **To aware about energy management and energy audit process.**
2. **To learn energy cost management for Motors, Systems and Electrical Equipment.**
3. **To learn Metering for Energy Management and cogeneration.**

Unit 1 **[09]**

Introduction

Need for energy management – energy basics – designing and starting an energy management program – energy accounting – energy monitoring, targeting and reporting- energy audit process.

Unit 2 **[11]**

Energy Cost and Management

Important concepts in an economic analysis – economic models – time value of money –utility rate structures – cost of electricity – loss evaluation. Load management: demand control techniques – utility monitoring and control system-HVAC and energy management – economic justification.

Unit 3 **[09]**

Energy management for Motors, Systems and Electrical Equipment

Systems and equipment – electric motors – transformers and reactors – capacitors and synchronous machines.

Unit 4 **[16]**

Metering for Energy Management

Relationships between parameters – Units of measure – typical cost factors – utility meters – timing of meter disc for kilowatt measurement – demand meters – paralleling of current transformers – instrument transformer burdens – multitasking solid-state meters – metering location vs. requirements – metering techniques and practical examples.

Lighting System & Co-Generation

Concept of lighting systems – the task and the working space – light sources – ballasts –luminaries – lighting controls – optimizing lighting energy – power factor and effect of harmonics on power

quality – cost analysis techniques – lighting and energy standards. Cogeneration: forms of cogeneration – feasibility of cogeneration – electrical interconnection.

Text Book

1. Eastop T.D and Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, 1990.

Reference Book

2. Reay D.A., "Industrial Energy Conservation", first edition, Pergamon Press, 1977.

3. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.

Web Resource

https://beeindia.gov.in/sites/default/files/1Ch3.pdf

2nd Semester

M-TECH ELECTRIC POWER SYSTEM, SEMESTER –II TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017													
SR NO	**CODE**	**SUBJECTS**	**TEACHING SCHEME**			**CREDITS**	**HOURS**	**EXAMINATION SCHEME**					
			L	**T**	**P**			**THEORY**			**PRACT**		**TOTAL**
								CIE		**ESE**	**CIE**	**ESE**	
								MID	**IE**				
1	PS0201	Advanced Power System Protection	3	0	2	4	5	30	10	60	40	60	200
2	PS0202	Optimization Techniques	4	2	0	5	6	30	10	60	00	00	100
3	PS0203	Advanced Power System Stability	3	2	0	4	5	30	10	60	00	00	100
4	PS0204	HVDC & FACTS	3	2	0	4	5	30	10	60	00	00	100
5	PS0205	Substation Design & Automation	3	2	0	4	5	30	10	60	00	00	100
	PS0206	Simulation Lab	0	0	2	1	2	00	00	00	40	60	100

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6	PS0207	Application of Artificial Intelligence (Elective-II)	3	2	0	4	5	30	10	60	00	00	100
7	PS0208	Energy Management & Audit (Elective II)											
TOTAL			**19**	**08**	**06**	**25**	**33**	**180**	**60**	**360**	**80**	**120**	**800**

Subject: **Advanced Power System Protection**								
Program: **M.Tech. Electrical Power System**			Subject Code: PS0201			Semester: **II**		
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	0	2	4	60	60	40	40	200

Course Outcome:

1. **To aware about various protection schemes.**
2. **To learn numerical protection.**
3. **To learn power apparatus protection.**

Unit 1 **[09]**

Principle of Power System Protection

Review of principles of power system protection, Classification of relay and control system, over current protection, Distance protection, Directional protection, Differential protection, System protection, Desirable Attributes of Protection.

Unit 2 **[10]**

Numerical (digital) Protection

Introduction, advantages of Numerical relays, Comparison of electromagnetic, static and digital relay, Block diagram and components of digital relay, Numerical over current protection, Numerical distance protection, Numerical impedance relay, Numerical reactance relay, Numerical mho relay, Block diagram and interface for directional relay.

Unit 3 **[10]**

Numerical Relaying Algorithm & Filtering

Architecture of Digital relays, Sampling theorem, Least Square Method for Estimation of Phasors, Co-Relation with reference wave, Fourier analysis of analogous Signals, Discrete fourier transform, Walsh–Hadamard analysis, Digital Filtering, Simple low-pass filter, Simple high-pass filter, FIR filter, IIR filters, Comparison between FIR & IIR filters.

Unit 4 **[16]**

Carrier Aided protection for Transmission Line

Requirement for carrier-aided protection, Coupling and trapping the carrier signals into the desired line section, Unit type carrier-aided directional comparison relaying, Carrier-aided distance schemes acceleration Zone II, Phase comparison relaying carrier protection.

Power apparatus Protection

Generator Protection-Stator-Rotor Earth Fault Protection, Protection against unbalanced loading and loss of Excitation, under frequency and over voltage protection Numerical approach for generator protection.

Transformer Protection-Concept of Gas operated relay, Restricted earth fault protection, Protection against over fluxing, Numerical Approach for Transformer protection, Bus zone Protection- Requirements, Unit and non-Unit protection, Breaker Back up protection.

Text Book:

1. Oza, Bhuvanesh, Nair, N.C., Mehta, R.P., Makwana V.H., "Power System Protection and Switchgear," Tata McGraw-Hill, New Delhi, 2010.
2. Rao, S.S., "Switchgear and Protection: theory, practice and solved problems," Khanna Publisher, New Delhi.
3. Paithankar, Y.G., Bhide, S.R., "Fundamentals of Power System Protection," PHI Learning Pvt. Ltd., New Delhi.

Reference Book

4. Mason C.R., "The Art & Science of Protective Relaying," Wiley Eastern Ltd.
5. Ravindranath, B., Chander, M., Power System Protection and Switchgear," New Age international (P) Ltd, New Delhi.
6. Badri Ram, Vishwakarma, D.N., "Power System Protection and Switchgear, "Tata McGraw-Hill, New Delhi.
7. Singh Ravindra P. "Switchgear and Power System Protection" PHI Learning Pvt.Ltd., New Delhi.
8. Bhavesh Bhalja, Maheshwari, Nilesh Chothani "Protection & Switchgear" OUP India.
9. J.B.Gupta "Switchgear and Protection" S. K. Kataria & Sons, India-2009.
10. Anderson, P.M., "Power System Protection," Wiley-IEEE Press, 1998.

Web Resource

nptel.ac.in/downloads/108101039/

List of Experiment

1	Transinet Analysis of Linear circuit
2	Steady state Analysis of Linear circuit

3	Modeling of 3 Phase Unbalanced faults
4	Lightninig Arrester Modeling for 3 phase transmission line
5	Modeling of Ring Mains Distribution System
6	Saturation of Current Transformer
7	Motor Protection using Numerical Relay
8	Over Current Protection of Transmission Line
9	Distance Protection of transmission line
10	Bias-differential protection for transformer

Subject: **Optimization Techniques**								
Program: **M.Tech. Electrical Power System**			Subject Code: PS0202			Semester: **II**		
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
4	2	0	5	60	0	40	0	100

Course Outcome:

1. **To aware optimization techniques for linear and non linear application.**
2. **To learn unconstraint and constraints solutions.**

3. **To learn evolutionary techniques.**

Unit 1 **[9]**

Linear programming, formulation-Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems.

Unit 2 **[10]**

Unconstrained one dimensional optimization techniques -Necessary and sufficient conditions – Unrestricted search methods-Fibonacci and golden section method-Quadratic Interpolation methods, cubic interpolation and direct root methods.

Unit 3 **[10]**

Unconstrained n dimensional optimization techniques – direct search methods –Random search – pattern search and Rosen brooch's hill climbing method- Descent methods-Steepest descent, conjugate gradient, quasi -Newton method.

Unit 4 **[16]**

Constrained optimization Techniques- Necessary and sufficient conditions –Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method-penalty function method .

Dynamic programming- principle of optimality- recursive equation approach-application to shortest route, cargo-loading, allocation and production schedule problems.

Evolutionary techniques:

Hill climbing method, ant colony algorithm, simulated annealing, Genetic Algorithm, ANN.

Text books:

1. Rao,S.S., Optimization :Theory and Application‟ Wiley Eastern Press, 2nd edition 1984.

Reference Book

2. Taha,H.A., Operations Research –An Introduction, Prentice Hall of India,2003.

3. Fox, R.L., „Optimization methods for Engineering Design", Addition Welsey, 1971

Web Resource

nptel.ac.in/courses/105108127/pdf/Module_1/M1L2_LN.pdf

www.nptel.ac.in/courses/105108127/pdf/Module_1/M1L4_LN.pdf

Subject: **Advanced Power System Stability**								
Program: **M.Tech. Electrical Power System**				Subject Code:PS0203			Semester: **II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	60	0	40	0	100

Course Outcome:

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

1. **To aware about system stability.**
2. **To learn stability analysis for single machine and multi machine system.**
3. **To learn oscillation and transient stability analysis.**

Unit 1 **[07]**

Introduction to Power System Stability Problem

Introduction, Basic Concept of Power system stability problem, Rotor angle stability, Concept of Voltage collapse, mid-term and long term stability, classification of stability, Review of Stability Problem

Unit 2 **[12]**

Small Signal Stability for Single Machine & Multi Machine System

Small signal stability of single machine infinite bus system by means of Classical model, block diagram representation, effect of excitation system, effect of AVR and Damping torque component, Power System stabilizer, Small signal stability for multi machine system, Formulation of state Equation, representation of static load, Analysis of large system and AESOPS algorithms

Unit 3 **[10]**

Torsional Characteristics & Sub Synchronous Oscillation

Introduction, Turbine-generator torsional Characteristics, Shaft system Model
Torsional interaction with Power System Control, Sub synchronous resonance, Characteristics of series capacitor, Self excitation due to induction generator effect, analytical method and torsional interaction resulting SSR, Countermeasures to SSR Problems

Unit 4 **[16]**

Voltage Collapse & Stability

Basic concept of Voltage stability, Comparison of Angle and Voltage stability,
Typical scenario of voltage collapse, Classification if voltage stability, Voltage stability analysis, Modeling requirements, Dynamic Analysis

Transient Stability

Basic concept of transient stability, Simulation of dynamic system, structure of power system, excitation system representation, Analysis of unbalanced faults,

Symmetrical components, sequence impedances, Simulation of different types of faults, Case study of transient stability of large machine system

Text Books:

1. P. S. Kundur - Power System Stability and Control, McGraw Hill Inc, New York.
2. K.R.Padiyar - Power System Dynamics - Stability and Control, BS Publishers, Hyderabad

Reference Book

3.. J. Machowski, J.W. Bialek, J.R. Bumby - Power System Dynamics, Stability and Control, Wiley publishers

4.. P.Sauer and M.A.Pai - Power System Dynamics and Stability, Prentice Hall.

5. Ajarappa - The Techniques for Computation of Voltage Stability Assessment, Wiley IEEE Press

6. I. J. Nagrath and D. P. Kothari - Modern Power Systems Analysis, Tata McGraw Hill.

Web Resource

nptel.ac.in/courses/108106026/

Subject: **HVDC & FACTS**								
Program: **M.Tech. Electrical Power System**			Subject Code: PS0204			Semester: **II**		
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**

3	2	0	4	60	0	40	0	100

Course Outcome:

1. **To aware about HVDC transmission**
2. **To learn Reactive-Power Compensators.**
3. **To learn Metering for Energy Management and cogeneration.**

Unit 1 **[8]**

Introduction

Background, Electrical Transmission Networks, Conventional Control, Mechanisms, Flexible ac Transmission Systems (FACTS), Emerging Transmission Networks.

HVDC transmission and Converter Circuit

Comparison of AC and DC transmission, Advantages and Disadvantages of DC transmission, Kinds of DC links and its applications, MTDC System, Components of HVDC transmission, HVDC systems in world and India Valve Characteristics, Single phase converters, Three phase converters, Graetz Circuit, Additional six pulse converter circuits and twelve pulse converter

Unit 2 **[12]**

Principles of Reactive-Power Compensators:

Synchronous Condensers, The Saturated Reactor (SR), The Thyristor-Controlled Reactor (TCR), The Thyristor-Controlled Transformer (TCT), The Fixed Capacitor-Thyristor-Controlled Reactor (FC-TCR), The Mechanically Switched Capacitor-Thyristor-Controlled Reactor (MSC-TCR), The Thyristor-Switched capacitor and Reactor, The Thyristor-Switched capacitor-Thyristor-Controlled Reactor (TSC-TCR), A Comparison of Different SVCs, Summary.

Series Compensation, The TCSC Controller, Operation of the TCSC, The TSSC, Analysis of the TCSC, Open-Loop Control, Closed-Loop Control, Improvement of the System-Stability Limit, Enhancement of System Damping, Sub synchronous Resonance (SSR) Mitigation, Voltage-Collapse Prevention, TCSC Installations.

Unit 3 **[10]**

Concepts of SVC Voltage Control & its Application

Voltage Control, Effect of Network Resonances on the Controller Response, The 2nd Harmonic Interaction between the SVC and ac Network, Application of the SVC to Series-Compensated ac Systems, 3rd Harmonic Distortion, Voltage-Controlled Design Studies, Increase in Steady-State Power-Transfer Capacity, Enhancement of Transient Stability, Augmentation of Power-System Damping, SVC Mitigation of Sub synchronous Resonance (SSR), Prevention of Voltage Instability

Unit 4 **[15]**

Emerging FACTS Controllers

The STATCOM, The SSSC, The UPFC, Comparative Evaluation of Different FACTS Controllers, Future Direction of FACTS Technology.

Grid Control, Harmonics and Filters

Grid control and its characteristics, limitations of manual control, constant current versus constant voltage system, Actual control characteristics, individual and combined control

Measurement of DC current, voltage, power Reactive power requirements, Sources of reactive power, SVS

Generation of AC and DC harmonics, Characteristic Harmonics and uncharacteristic harmonics, Fourier analysis of valve currents and line currents on valve side Means of reducing harmonics, AC filters and DC filters

Text Books:

1. Thyristor-based FACTS controllers for Electrical Transmission Systems: R Mohan Mathur, R K Verma, Wiley IEEE Press.

Reference Book

2. Understanding FACTS, N.G.Hingorani and L.Gyugyi, Standard Publishers, Delhi, 2001.

3. FACTS Controllers in Power Transmission & Distribution: Padiyar K R, New Age International (P) Limited.

4. Reactive Power Control in Electric Systems: T J E Miller, John Willey.

5. Power System Stability and Control, Prabha Kundur, Tata McGrahill.

Web Resource

nptel.ac.in/courses/108104052/26

Subject: **Substation Design & Automation**								
Program: **M.Tech. Electrical Power System**				Subject Code: PS0205			Semester: **II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**

3	2	0	4	60	0	40	0	100

Course Outcome:

1. **To aware about substation design.**
2. **To learn about Air -Insulated Substations and Gas - Insulated Substation**
3. **To learn Substation Interface, Automation and Integration and communication.**

Unit 1 **[08]**

Introduction to substations and design process

Introduction, Background, Classification of substations Need determination, Budgeting, Financing, Traditional and Innovative substation design, Selection and location of site for a substation, Design, construction and commissioning process

Unit 2 **[10]**

Air -Insulated Substations and Gas - Insulated Substation

Bus/switching configurations, various types of Bus arrangements, Components and equipments, High voltage switching equipment: Disconnect and load break switches, High speed grounding switches, Circuit-breakers. Selection and ratings of various equipments for a particular substations, Introduction to GIS, Sulfur Hexafluoride Insulating gas, Construction and service life, Advantages and economics of GIS

Unit 3 **[12]**

Substation Grounding and SLD of substation

Reasons for substation grounding system, Accidental ground circuits, Permissible Body current limits, Tolerable voltages, Design criteria, Soil resistivity, grid resistance, grid current, Selection of electrodes and conductors for grounding system, Fire protection objectives and philosophies, Fire Hazards, Typical Fire protection measures Key diagrams of typical substations, Distribution substation, High Voltage substation, EHV substation.

Unit 4 **[15]**

Substation Interface, Automation and Integration

Introduction, Physical Considerations, Analog Data Acquisition, Status Control Functions, Communications Networks inside the Substation, Testing Automation Systems. Introduction, Definitions and Terminology, Open Systems, Architecture Functional Data Paths, Substation Integration and Automation System Functional Architecture, New vs. Existing Substations, Equipment Condition, Substation Integration and Automation Technical Issues, Protocol Fundamentals, Protocol Considerations, Choosing the Right Protocol, Communication Protocol Application Areas

Substation Communications

Introduction, Supervisory Control and Data Acquisition (SCADA) Historical Perspective, SCADA Functional Requirements, SCADA Communication Requirements, Components of a SCADA System, SCADA Communication Protocols: Past, Present, and Future, The Structure of a SCADA Communications Protocol, Security for Substation Communications, Electromagnetic Environment, Communications Media

Text Books:

1. J. D. McDonald (Ed). Electric Power Substations Engineering, CRC Press

Reference Book

2. P. S. Satnam and P. V. Gupta Substation Design and Equipment, Dhanpat Rai and Sons
3. M. S. Naidu Gas Insulated Substations, I. K. International Publishing House Pvt. Ltd., New Delhi

Web Resource

www.cbip.org/Elecrama/SC%20B3-Terry%20Krieg.pdf

Subject: **Application of Artificial Intelligence**								
Program: **M.Tech. Electrical Power System**				Subject Code: PS0207			Semester: **II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
3	2	0	4	60	0	40	0	100

Course Outcome:

1. **To aware about Artificial intelligence techniques.**
2. **To learn about Artificial neural network and its algorithm.**
3. **To learn about fuzzy logic system**
4. **To learn about Genetic algorithm.**

Unit 1 **[11]**

Artificial Neural Network

Introduction- basic concept- Model of Neuron- Neural Network Architecture – Characteristics, learning Methods-Models of Neural Network - Architectures – Knowledge representation- Application- Artificial Intelligence and Neural networks–Learning process-Rosenblatt perceptron-ADALINE network-MADALINE Network,

Unit 2 **[10]**

Back Propagation Network

Architecture of back propagation- Backpropogation Learning- Applications- Selection of various parameters in BPN- Variation of standards backpropogation algorithm Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network.

Unit 3 **[10]**

Fuzzy Logic

Introduction – Fuzzy versus crisp – Fuzzy sets - Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy cartesion Product –Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers-Fuzzy Inference- -Crisp logic-Predicate logic- Fuzzy Rule based system-Defuzzification method

Unit 4 **[14]**

Genetic Algorithm

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.

Text Book:

1. S.Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms"- PHI, New Delhi, 2003.
2. Da Ruan- "Intelligent hybrid System", Springer Science, business Media

Reference Book:

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

Web Resource

www.ioenotes.edu.np/notes/chapter-wise-notes-of-artificial-intelligence-ai-ioe-comput...

Subject: **Distributed Generation & Micro grid**								
Program: **M.Tech. Electrical Power System**				Subject Code: PS0106			Semester: **I**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation**	**Continuous Internal Evaluation**	**Total**

						(CIE)- Theory	(CIE)- Practical	
3	2	0	4	60	0	40	0	100

Course Outcome:

1. **To aware about Distributed generation and micro grid concept.**
2. **To learn about Impact of grid integration.**
3. **To learn about Control & Operation of Micro grid**

Unit 1 **[09]**

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.

Unit 2 **[10]**

Distributed Generation (DG)

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

Unit 3 **[10]**

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

Unit 4 **[16]**

Basics of Microgrid

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,

Control & Operation of Micro grid

Modes of operation and control of micro grid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, micro grid communication infrastructure, Power quality issues in micro grids, regulatory standards, Micro grid economics, Introduction to smart micro grids.

Text Book

1. Distributed generation Micro grid operation By Hatem Hussein Magdy Zeineldin, University of Waterloo (Canada)

Reference Book

2. Micro grids and Active Distribution Networks By S. Chowdhury, S.P. Chowdhury and P. Crossley - The Institution of Engineering and Technology, London.
3. Control and optimization of Distributed generation system By Magdi S Mahmoud – Springer
4. Distributed generation and its implications for the utility industry By Fereidoon P Sioshansi – Academic Press.

Web Resource

sers.ece.utexas.edu/~kwasinski/EE394V_DG_Week0.ppt

Subject: **Simulation Lab**								
Program: **M.Tech. Electrical Power System**				Subject Code: PS0206			Semester: **II**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**

0	0	2	1	0	60	0	40	100

LIST OF EXPERIMENT (MATLAB)

1. Load flow studies.

2. Short circuit studies.

3. Transient stability studies.

4. Simulation of IGBT inverters.

5. Simulation of thyristor converters.

6. Economic Load Dispatch with thermal power plants.

7. Economic Load Dispatch with Hydro thermal power plants.

8. Simulation of Facts controllers

9. Simulation of single -area and double -area Systems.

10. Load forecasting and unit commitment.

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Indus University

3rd Semester

M-TECH ELECTRIC POWER SYSTEM, SEMESTER –III TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017						
SR NO	CODE	SUBJECTS	TEACHING SCHEME	CREDIT	HOUR	EXAMINATION SCHEME

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

			L	T	P			THEORY			PRACT		TOTAL
								CIE		ESE	CIE	ESE	
								MID	IE				
1	PS0301	Dissertation Phase I	00	00	40	20	40	00	00	00	150	150	300
TOTAL			**00**	**00**	**40**	**20**	**40**	00	00	00	150	150	300

Subject**: Dissertation Phase I**

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

Program: **M-TECH ELECTRIC POWER SYSTEM**				Subject Code: PS0301			Semester**: III**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
0	0	40	20	00	150	00	150	300

Department of Electrical Engineering, IITE,

Indus University

4rd Semester

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

M-TECH ELECTRIC POWER SYSTEM, SEMESTER –IV TEACHING & EXAMINATION SCHEME WITH EFFECT FROM JULY 2017														
SR NO	CODE	SUBJECTS	TEACHING SCHEME			CREDITS	HOURS	EXAMINATION SCHEME						
								THEORY			PRACT		TOTAL
			L	T	P			CIE		ESE	CIE	ESE	
								MID	IE				
1	PS0401	Dissertation Phase II	00	00	40	20	40	00	00	00	150	150	300
TOTAL			**00**	**00**	**40**	**20**	**40**	00	00	00	150	150	300

Approved Vide Agenda Item No. 03 of Minutes of Meeting of Academic Council held on 11 July 17

Subject**: Dissertation Phase II**								
Program: **M-TECH ELECTRIC POWER SYSTEM**				Subject Code: PS0401			Semester**: IV**	
Teaching Scheme				**Examination Evaluation Scheme**				
Lecture	**Tutorial**	**Practical**	**Credits**	**University Theory Examination**	**University Practical Examination**	**Continuous Internal Evaluation (CIE)- Theory**	**Continuous Internal Evaluation (CIE)- Practical**	**Total**
0	0	40	20	00	150	00	150	300