Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Hingna Road, Wanadongri, Nagpur - 441 110

M. Tech.

SoE & Syllabus 2014

2 Semester

Department of Electrical Engineering

Integrated Power systems

Update on May 2017

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M. Tech. SCHEME OF EXAMINATION 2014

Department of Civil Engineering

Integrated Power Systems

Sl. No.	Course Code	Course Title	Contact Hours				Credits	% Weightage				ESE Duration Hrs.
			L	T	P	Total Contact Hrs.		MSE - I	MSE - II	TA	ESE	
I SEMESTER												
1	EL1901	Advance Power Electronics	3	0	0	3	3	15	15	10	60	3
2	EL1902	Analog & Digital Protection	3	0	0	3	3	15	15	10	60	3
3	EL1903	Digital Control System	3	0	0	3	3	15	15	10	60	3
4	EL1904	HVDC Power Transmission	3	0	0	3	3	15	15	10	60	3
5	EL1905	Power System Modelling	3	0	0	3	3	15	15	10	60	3
6	EL1906	Lab: Analog & Digital Protection	0	0	4	4	2			40	60	
8	EL1907	Lab: Advance Power Electronics	0	0	4	4	2			40	60	
Total			**15**	**0**	**8**	**23**	**19**					
II SEMESTER												
1	EL1911	Power System planning	3	0	0	3	3	15	15	10	60	3
2	EL1912	Application of Power Electronics to Power System	3	0	0	3	3	15	15	10	60	3
3	EL1913	Power Quality	3	0	0	3	3	15	15	10	60	3
4	**Professional Elective- I**		3	0	0	3	3	15	15	10	60	3
	EL1916	Electrical Drives and Controls										
	EL1918	Renewable Energy System										
5	**Lab: Professional Elective I**		0	0	4	4	2			40	60	
	EL1917	Lab: Electrical Drives and Controls										
	EL1919	Lab: Renewable Energy System										
6	**Professional Elective II**		3	0	0	3	3	15	15	10	60	3
	EL1920	Advanced Digital Signal Processing										
	EL1921	EHV Power Transmission										
	EL1922	Restructuring of Power System										
7	EL1914	Power System Simulation	0	0	4	4	2			40	60	
8	EL1915	Seminar	0	0	2	2	1			100		
Total			**15**	**0**	**10**	**25**	**20**					
III SEMESTER												
1	**Professional Elective - III**		3	0	0	3	3	15	15	10	60	3
	EL1933	Power System Stability										
	EL1934	Electrical Distribution Systems										
	EL1935	Power System Operation and Control										
	EL1936	[illegible]sients in Power Systems										
2	**Professional Elective - IV**		3	0	0	3	3	15	15	10	60	3
	EL1937	Distribtuted Automation										
	EL1938	Power Electronics for Renewable Energy Systems										
	EL1939	Control System Design										
3	EL1931	Lab.: Power System Design	0	0	4	4	2			40	60	
4	EL1932	Project Phase -I	0	0	16		8			100		
		Total	**6**	**0**	**20**	**10**	**16**					
IV SEMESTER												
1	EL1941	Project Phase-II	0	0	20	24	12			40	60	
Total			**0**	**0**	**20**	**24**	**12**					
Grand Total of Credits							**67**					

Chairperson		**Date of Release**	Sep. 2014	**Applicable for**
Dean (Acad. Matt.)		**Version**	**1.01**	**AY 2014-15 Onwards**

Integrated Power System

Second Semester

EL1911	Power System Planning	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 Hrs

Objectives: To understand the load forecasting for the planning of power generation. To do the generation planning considering reliability, environmental aspects. Students also understand how to design the optimal power availability .

UNIT-1: **Introduction**
Introduction of power planning, National and Regional Planning, structure of P.S., planning tools, Electricity Regulation

UNIT-2: **Load Forecasting & Generation Planning**
Electrical Forecasting, forecasting techniques modeling. Generation planning, Integrated power generation cogeneration/captive power, Power pooling and power trading.

UNIT-3 : Transmission planning and Power System Economics
Transmission and distribution planning, Power system Economics, Power sector finance, financial planning, private participation Rural Electrification investment, concept of Rational tariffs.

UNIT-4: Reliability
Power supply Reliablity, Reliability planning, Reliability evaluation, Functional zones, Generation reliability, Generation & Transmission reliability, Quality of Supply.

UNIT-5 : System Operation & Environmental Aspects in Planning
System operation planning, load management, load prediction, reactive power balance, online power flow studies, state estimation, computerized management, power system simulator.
Computer aided planning, wheeling, Environmental effects, Greenhouse effect, Technological impacts, Insulation coordination, Reactive compensation.

UNIT-6:Power System Security :
Operation in Power System Security :- Introduction, Factors affecting power system security, Contingency analysis, ac power flow security analysis, concentric relaxation, bounding area method.
State Estimation :- Introduction, Method of least squares, Maximum likelihood weighted least square estimation, State estimation by orthogonal decomposition, Detection and identification of bad measurements, network observability and pseudo-measurements.

Text books:				
1	Electrical Power System Planning	**Edition (Year of publication)**	A.S.Pabla	Macmillan India Ltd.
2	Power Generation, Operation & Control	**2011**	Allen J. Wood, B.F. Wollenberg	Wiley India, Reprint
3	Modern Power System Analysis	**4th Edition**	D.P. Kothari, I.J. Nagrath	Tata Mcgraw Hill Education Pvt. Ltd.
4	Electrical Power Systems – Analysis, Security and Deregulation	**Third Printing**	P. Venkatesh, B. V. Manikandan, S. Charles Raja, A. Srinivasan	PHI Learning Pvt. Ltd.

Chairperson		Date of Release	May 2017	Applicable for AY 2017-18 Onwards
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Integrated Power System

Second Semester

EL1912	Application of Power Electronics to Power System	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 Hrs

Objectives: To understand how the constraints of the AC power transmission can be solved and performance of AC transmission can be enhanced by different FACTS controllers. The objective is also study comprehensively different FACTS controllers like shunt, series, shunt-series and phase angle regulators.

UNIT-1:Introduction
Introduction of Semiconductor Devices , Steady state and Dynamic Problems in AC Systems, Flexible AC transmission system : Introduction , types of Facts controllers.

UNIT-2:Shunt FACT Controllers
TCR(Thyristor Controlled Reactor) , TSC(Thyristor Switched Capacitor) ,FC-TCR(Fixed Capacitor -thyristor controlled reactor),TSC-TCR(Thyristor Switched Capacitor Thyristor switched Capacitor),Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modelling of svc for power flow and transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping – Prevention of voltage instability.

UNIT-3 : Series FACT Controller
TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping-SSR Mitigation, TSSC, GCSC.

UNIT-4: Converter based Shunt and Series controllers
STATCOM – Different modes of operation of working, different control strategies. Comparison with Static VAR Compensator (SVC). Different advantages and the constraints.
SSSC- Introduction, Inductive and the capacitive modes of operations. Different control strategies. Comarison with Thyristor based series controllers. Constraints of the SSSC

UNIT-5:Phase Shifter and Phase angle Regulator
TCPAR, TCVR, Voltage Controlled Source Based Phase Shifter and Angle Regulator, Introduction working and control strategies.

UNIT-6 :Other FACTS Controller
UnifiedPower Flow Controller(UPFC), Interline Power Flow Controller(IPFC): Introduction ,Controlled Strategies and Application

Text books:

1	Thyristor – Based Facts Controllers for Electrical Transmission Systems	R.MohanMathur, Rajiv K.Varma		IEEE press and John Wiley & Sons, Inc
2	Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems	Narain G. Hingorani		Standard Publishers Distributors, Delhi
3	FACTS Controllers in Power Transmission and Distribution	K.R.Padiyar		New Age International(P) Limited, Publishers, New Delhi

Reference books:

1	Flexible A.C. Transmission Systems	1999	A.T.John	Institution of Electrical and Electronic Engineers (IEEE)
2	HVDC and FACTS controllers – Applications of Static Converters in Power System	APRIL 2004	V.K.Sood	Kluwer Academic Publishers

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Integrated Power System

Second Semester

EL1913	Power Quality	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 Hrs

Objectives: The objective is to understand the different power quality problems, its causes, effects and various mitigating custom power devices. Further the subject is concentrated to analyse the different control strategies and algorithm.

UNIT-1:**Introduction**
Introduction – Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT-2:**Non Linear Loads**
Single phase / Three phase static converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

UNIT-3: **Measurement and Analysis Method**
Voltage, Current, Power and Energy measurements, power factor measurements and definitions, event recorders, Measurement Error – Analysis: Analysis in the periodic steady state, Time domain methods, Frequency domain methods: Laplace's, Fourier and Hartley transform – The Walsh Transform – Wavelet Transform.

UNIT-4:Analysis and Conventional Mitigation Methods
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 – Harmonic indices.

UNIT-5 : Voltage Sag
Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

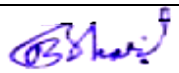
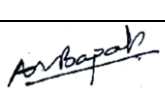
UNIT-6:Power Quality Improvement
Utility-Customer interface –Harmonic filters: passive,–Custom power devices: Network reconfiguring Devices, Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC – control strategies: P-Q theory, Synchronous detection method – Custom power park – Status of application of custom power devices.

Text books:

1	Power Quality Enhancement Using Custom Power Devices	2002	ArindamGhosh	Kluwer Academic Publishers
2	Electric Power Quality	1994(2nd edition)	G.T.Heydt	Stars in a Circle Publications
3	Power Quality	Edition (Year of publication)	R.C. Duggan	Publisher

Reference books:

1	Power system harmonics	A.J. Arrillga	Publisher
2	Power electronic converter harmonics	Derek A. Paice	Publisher
3	Title of the book	Author(s)	Publisher

Chairperson		Date of Release	May 2017	Applicable for AY 2017-18 Onwards
Dean (Acad. Matters)		Version	1.01	

Integrated Power System

Second Semester

EL1916	Electrical Drives And Controls	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 Hrs

Objectives:: To understand the mathematical modeling of drives and the latest technology. Stress is given on Vector control, space vector modulation control of induction motor and synchronous motor. Adaptive control and introduction to fuzzy and neural control of drives is introduced.

UNIT-1:**Analysis of DC Motor:** State variable representation of seperately excited DC motor and DC shunt motor, Converters for DC drives,Average value analysis of DC drive.Machine control with voltage controlled converter, Machine control with current controlled converter.

UNIT-2:**- Analysis of Induction Motor:**
Reference frame theory, Balanced Set,Transformation of resistance and flux linkages, Theory of symmetrical Induction motor, voltage and torque equations in machine variables and their transformation to arbitrary reference frame, state vector representation of the equations, free acceleration characteristics,

UNIT-3: **Induction motor control systems**
Voltage Source Inverter Drive with PWM,Current Source Inverter Drive, Forced commutated inverter drive control of Induction motor, Flux Vector control of Induction motors, Direct torque control.

UNIT-4:Synchronous motors Drives:
Synchronous machines equations in different reference frames,
Synchronous motor drives with sinusoidal waveforms, True Synchronous mode and Self controlled mode Load commutated inverter drives
Synchronous motor drive with trapezoidal waveforms(Brushless DC motor).,Vector Control of Synchronous motors, Switched reluctance motor and its control.

UNIT-5 : Space vectors:
Stator space current, stator voltage space vector, stator flux linkage space vector, transformation of space vector coordinates from one reference frame to another. Space vector Modulation ,Control of Induction motor by Space vector Modulation.

UNIT-6:Digital Control of Drives
Adaptive control principles,Gainscheduling,Self tuning control,Model referencing adaptive control,Sliding Mode control,Idea of Fuzzy and Neural Control.
Necessity and Application of Digital signal processors to control of AC/DC Drives.BasicArchitectoure of Texas Instruments TMS320LF2407 processor,Programming methods
Idea of Field Programmable Gate Arrays(FPGA) Technology.

Text books:

1	Analysis of Electric Machinery		Paul, C. Krause	McGraw Hill
2	Modern Power Electronics and AC Drives		B.K. Bose	Prentice Hall
3	Texas Instruments TMS320LF2407 processor Manual			
4	Variable frequency AC motor Drive system		David Finney	IEE Press
5	Control of Electrical Drives	1996	W. Leonhard	Springer Verlag
6	Electric Drive		VedamSubramanyam	Tata McGraw Hill

Reference books:

1	High-Power Converters and AC Drives	2006	Bin Wu	Wiley & IEEE Press
2	Power Electronics, Converters, Applications and Design	3rd Edition	Ned Mohan, T. M. Undeland, W. P. Robbins	Media Enhanced
3	'Power Semiconductor Controlled Drives	1989	G.K. Dubey	Prentice Hall, N. Jersey
4	Electric Drives	2002	Krishnan	Prentice Hall of India

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Second Semester

EL1917	Lab Electrical Drives and control	L=0	T=0	P=3	Credits=1.5

Evaluation Scheme	TA	ESE	Total
	40	60	100

List of Practicals

1. Study of program written in C to generate Pulse width modulated pulses with DSP
2. Closed Loop Speed control of separately excited D.C. motor
3. Closed Loop Speed control of Brushless DC motor
4. Closed Loop Speed control of Induction motor
5. Vector control of Induction motor
6. Control of Switched Reluctance motor with DSP program
7. To study the Simulation of DC Drive in MATLAB
8. To study the Simulation of Vector Control in MATLAB

Integrated Power System

Second Semester

EL1918	Renewable Energy System	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 Hrs

Objectives: To study the major renewable energy sources including solar, wind, Biomass for different applications.

UNIT-1:**Introduction to Energy Sources**
World Energy Futures, Conventional Energy Sources, Renewable Energy Sources, Prospects of Renewable Energy Sources. Environmental aspects of Electrical Energy Generation.

UNIT-2:**Solar Energy -**
a) Introduction to Solar Radiation and its measurement, Introduction to Solar Energy Collectors and Storage.
b) Applications of Solar Energy: Solar Thermal Electric Conversion, Thermal Electric Conversion Systems, Solar Electric power Generation
Solar Photo- Voltaics, Solar Cell Principle, Semiconductor Junctions, Conversion efficiency and power output, Basic Photo Voltaic System for Power Generation. Solar photovoltaic modules, maximum power point tracking and algorithms

UNIT-3: **Wind Energy:**
a) Introduction to wind energy Conversion, the nature of the wind, Power in the wind.
b) Wind Energy Conversion: Wind data and energy estimation, Site Selection Considerations, Basic Components of a Wind Energy Conversion System, Classification of WEC Systems, Schemes for Electric Generation using Synchronous Generator and Induction Generator, Wind energy Storage.

UNIT-4:Direct Energy Conversion Processes (Overview) :
a) Information on Magneto Hydro Dynamic Power Generation:
b) Thermo-Electric Generation: Basic principles of thermo-electric powergeneration, Seebeck, Peltier, Thomson effects, Thermo-Electric power generator, Analysis, materials.
c) Thermionic Generation: Thermionic emission and work function, Basic thermionic generation.
d) Fuel Cells H_2O_2**C**ell, Classification of fuel Cells, Types, Advantages, Electrodes, Polarization.
e) Thermo Nuclear Fusion Energy: The basic Nuclear Function and Reactions Plasma Confinement, Thermo Nuclear function Reactions.

UNIT-5 : Energy from Biomass:
a) Introduction: Biomass conversion technologies, photosynthesis, Bio-gas generation, types of bio-gas plants.
b) Biomass as a Source of Energy: Method for obtaining energy from Bio-mass, Biological Conversion of Solar Energy.

UNIT-6:
Applications of Renewable energy
Wind Farms: Grid interfacing of wind farm, methods of grid connection, grid system and properties. Small hydro power, Hybrid systems: Wind- solar, wind photovoltaic etc,

Text books:				
1	Non-Conventional Sources of Energy	4th Edition, 2010	G.D. Rai	Khanna Publishers
2	Non Conventional Energy Sources	2nd Edition.2009	B. H. Khan	The McGraw Hill Companies
3	Renewable energy sources and conversion technology	1990	N.K. Bansal, M. Kleemann, M. Heliss	Tata McGraw Hill
Reference books:				
1	Direct Energy Conversion		R. A. Coombie	Pitman
2	Renewable energy sources and emerging technologies	1st Edition,2008	D. P. Kothari	PHI
3	Related IEEE/IEE Publications			

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Second Semester

EL1919	Lab : Renewable Energy System	L=0	T=0	P=3	Credits=1.5

Evaluation Scheme	TA	ESE	Total
	40	60	100

List of Practical's

Integrated Power System

Second Semester

EL1920	Advanced Digital Signal Processing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 Hrs

Objectives:

UNIT-1:**Introduction**

Mathematical description of change of sampling rate – Interpolation and Decimation, Filter implementation for sampling rate conversion – direct form FIR structures, DTFT, FFT, Wavelet transform and filter bank implementation of wavelet expansion of signals

UNIT-2:**Estimation Techniques**

Discrete Random Processes – Ensemble averages, Stationary processes, Autocorrelation and Auto covariance matrices, Parseval's Theorem, Wiener-Khintchine Relation – Power Spectral Density**,** AR, MA, ARMA model based spectral estimation, Parameter Estimation,

UNIT-3: **Prediction Techniques**

Linear prediction – Forward and backward predictions, Least mean squared error criterion – Wiener filter for filtering and prediction, Discrete Kalman filter.

UNIT-4:Digital Signal Processor

Basic Architecture – Computational building blocks, MAC, Bus Architecture and memory, Data Addressing, Parallelism and pipelining, Parallel I/O interface, Memory Interface, Interrupt, DMA.

UNIT-5 : APPLICATION OF DSP

Design of Decimation and Interpolation Filter, FFT Algorithm, PID Controller, Application for Serial Interfacing, DSP based Power Meter, Position control.

UNIT-6:VLSI IMPLEMENTATION

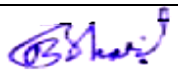
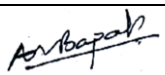
Basics on DSP sytem architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realisation of MAC & Filter structure.

Text books:

1	Adaptive Signal Processing	Third edition, 2004	Bernard Widrow, Samuel D. Stearns	Pearson Education
2	Statistical & Adaptive signal processing, spectral estimation, signal modeling, Adaptive filtering & Array processing	2000	**Author(s)**	McGraw-Hill International
3	Statistical Digital Signal Processing and Modelling	**Edition (Year of publication)**	Monson H. Hayes	John Wiley and Sons, Inc

Reference books:

1	Digital Signal Processing	2002	John G. Proaks, Dimitris G. Manolakis	Pearson Education
2	Digital Signal Processing		S. Salivahanan, A. Vallavaraj and C. Gnanapriya	TMH
3	Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx	**2004**	Avatar Sing, S. Srinivasan	Thomson India
4	DSP Integrated Circuits	1999	Lars Wanhammer	Academic press, New York
5	Digital Signal Processing: A Modern Introduction	2007	Ashok Ambardar	Thomson India edition, 2007.

Chairperson		Date of Release	May 2017	Applicable for AY 2017-18 Onwards
Dean (Acad. Matters)		Version	1.01	

Integrated Power System

Second Semester

EL1921	EHVAC Power Transmission	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 Hrs

Objectives: Mention the objectives of the course here. Not more than 5 lines

UNIT-1:Introduction
Standard transmission voltages – different configurations of EHV and UHV lines – average values of line parameters – power handling capacity and line loss – costs of transmission lines and equipment – mechanical considerations in line performance.

UNIT-2:Calculation of Line Parameters
Calculation of resistance, inductance and capacitance for multi-conductor lines – calculation of sequence inductances and capacitances – line parameters for different modes of propagation – resistance and inductance of ground return, numerical example involving a typical 400/220kV line using line constant program.

UNIT-3: Voltage Gradients Of Conductors
Charge-potential relations for multi-conductor lines – surface voltage gradient on conductors – gradient factors and their use – distribution of voltage gradient on sub conductors of bundle - voltage gradients on conductors in the presence of ground wires on towers.

UNIT-4:Corona Effects-I :
Power losses and audible losses: I^2R loss and corona loss - audible noise generation and characteristics - limits for audible noise - Day-Night equivalent noise level- radio interference.

UNIT-5 : Corona Effects – II :-
Corona pulses (their generation and properties),Frequency spectrum,Properties of pulse trains and filter response ,Limits for radio interference fields ,the CIGRE formula,The RI excitation functionProcedure for obtaining excitation fudnction from CIGRE Formula,Design of filter, television Interference.

UNIT-6:Electrostatic Field Of EHV Lines
Effect of EHV line on heavy vehicles - calculation of electrostatic field of AC lines- effect of high field on humans, animals, and plants - measurement of electrostatic fields - electrostatic Induction in unenergised circuit of a D/C line - induced voltages in insulated ground wires - electromagnetic interference.

Text books:

1	Extra High Voltage AC Transmission Engineering	Second Edition, 1990	Rakosh Das Begamudre	New Age International Pvt. Ltd
2	Power Engineer's Handbook	6th Edition, Oct. 2002		TNEB Engineers' Association
3	Microtran Reference Manual www.microtran.com		Microtran Power System Analysis Corporation	

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Second Semester

EL1922	Restructuring of Power System	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 Hrs

UNIT-1:Deregulation of Electricity Market

Introduction to Power System Deregulation, Reform Motivations, Traditional Model, Separation of Ownership, Competition and Direct Access in the Electricity Market, Role of ISO, Retail Market, International Experiences

UNIT-2:Electricity Market Characteristics

Direct Access and Power Wheeling, Pool & Bilateral trading, Bidding and Auction Mechanisms, Market Timing, Sequential and Simultaneous Markets, Scheduling, Gaming, Congestion Management

UNIT-3: Transmission Open Access

Transmission Open Access, Transmission Pricing, Impact of Congestion and Management, ATC and Factors affecting ATC, Determination of ATC, Ancillary Services and their management, Electricity Bill 2003 and its impact.

UNIT-4 Optimal Power Flow

OPF and its Formulation, Constraints, Different solution Techniques, Non Linear Programming (NLP) and Genetic Algorithm.

UNIT-5: SCADA and Distribution Automation

SCADA & Distribution Automation, Energy management system

UNIT-6: Power System Communication

Analog and Digital Communication, communication architecture, Power system communication, PLCC, Optical Fibre etc

Text books:

1	Power System restructuring and deregulation	2001	Loi Lei Lai	John Wiley and Sons, UK.
2	Operation of Restructured Power Systems	2001	K. Bhattacharya, MHT Bollen and J.C Doolder	Kluwer Academic Publishers, USA
3	Power System Operation and Control		A.J Wood and B.F Wollenberg	John Wiley and Sons

Reference books:

1	Computational Methods for large Sparse Power System Analysis: An Object Oriented Approach	**Edition (Year of publication)**	S.A Soman, Khafasok, ShubhaPandit	S.A Kluwer Academic Publishers

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Second Semester

EL1914	Power System Simulation	L=0	T=0	P=4	Credits=2

Evaluation Scheme	TA	ESE	Total
	40	60	100

Development of algorithms & flowcharts and digital simulation of the following using ETAP/MATLAB Software package:

1. Z-bus and Y-bus formulation
2. Load flow studies
3. fault analysis
4. Transient stability studies.

Second Semester

EL1915	Seminar	L=0	T=0	P=2	Credits=1

Evaluation Scheme	TA	ESE	Total
	100		100