Sanjay Ghodawat University Kolhapur

Structure and Syllabus for M. Tech Electrical Engineering (2018-19) R0

SEMISTER I									
Course Code	**Course Title**	**Teaching Scheme**				**Evaluation Scheme for Theory and Practical**			
		L	**T**	**Pr**	**C**	**Component**	**Exam**	**WT**	**Pass (%)**
ELE501 (UC | ST) Version:1.0	Research Methodology	3	1	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE503 (PC | ST) Version:1.0	Power system Dynamics	4	-	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE505 (PC | ST) Version:1.0	Modeling and analysis of electrical machines	4	-	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE507 (PE | ST) Version:1.0	**Program Elective –I**	4	-	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE509 (PE | ST) Version:1.0	**Program Elective –II**	4	-	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE511 (PC | ST) Version:1.0	Modeling and analysis of electrical machines Lab	-	-	2	1	Pr (100)	FEP	50	Min 40
							POE	50	Min 40
ELE513 (PC | ST) Version:1.0	Power system Dynamics Lab	-	-	2	1	Pr (100)	FEP	50	Min 40
							POE	50	Min 40
ELE515 (UC | ST) Version:1.0	Disaster Management	2	-	-	NC	-	ESE	-	Pass/Fail
ELE517 (PC | ST) Version:1.0	Seminar	-	-	2	1	Pr (50)	FEP	50	Min 40
	Total	**21**	**1**	**6**	**23**	Total Hrs: 28, Total Credits: 23			

L: Lecture, T: Tutorial, Pr: Practical, C: Credits, Th. : Theory, WT: Weight Age, PC: Program Core, PE: Program Elective, UC: University Core, UE: University Elective, ST: School of Technology, SS: School of Sciences, SC: School of Commerce, SM: School of Management, SA: School of Arts, FET: Faculty Evaluation Theory, NC: Non Credit (Pass/Fail), CAT I: Continuous Assessment Test I, CAT – II: Continuous Assessment Test II, ESE End Semester Examination, TW : Term Work, POE : Practical Oral Examination, AU: Audit Course (Pass/Fail) No Credits, FET: Faculty Evaluation Theory, FEP: Faculty Evaluation Practical, * No Instructions.

SEMISTER II									
Course Code	**Course Title**	**Teaching Scheme**				**Evaluation Scheme for Theory and Practical**			
		L	**T**	**P**	**C**	**Component**	**Exam**	**WT**	**Pass (%)**
ELE502 (PC | ST) Version:1.0	Solar &Wind Energy Utilization	4	-	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE504 (PC | ST) Version:1.0	SCADA System And Applications	4	-	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE506 (PC | ST) Version:1.0	High Voltage Engineering	4	-	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE508 (PE | ST) Version:1.0	**Program Elective –III**	4	-	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE510 (PE | ST) Version:1.0	**Program Elective –IV**	4	-	-	4	Th (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
ELE512 (PC | ST) Version:1.0	Solar &Wind Energy Utilization Lab	-	-	2	1	Pr (100)	FEP	50	Min 40
							POE	50	Min 40
ELE514 (PC | ST) Version:1.0	SCADA System And Applications Lab	-	-	2	1	Pr (100)	FEP	50	Min 40
							POE	50	Min 40
ELE516 (UC | ST) Version:1.0	Pedagogy Studies	2	-	-	NC	-	ESE	-	Pass/ Fail
ELE518 (PC | ST) Version:1.0	Mini Project	-	-	2	1	Pr (50)	FEP	50	Min 40
	Total	**22**	**-**	**6**	**23**	Total Hrs: 28, Total Credits: 23			

SEMISTER III									
Course Code	**Course Title**	**Teaching Scheme**				**Evaluation Scheme for Theory and Practical**			
		L	**T**	**P**	**C**	**Component**	**Exam**	**WT**	**Min Pass %**
ELE519 (PC | ST) Version:1.0	Industry Internship	-	-	-	4	Report and Presentation	ISE	50	50
							ESE	50	
ELE521 (PC | ST) Version:1.0	Project Dissertation Phase-I	-	-	-	4	Presentation	ISE	100	50
ELE523 (PC | ST) Version:1.0	Project Dissertation Phase-II	-	-	-	8	Presentation, Report and Demo	ISE	50	50
							ESE	50	
Total Credits: 16									

SEMISTER IV									
Course Code	**Course Title**	**Teaching Scheme**				**Evaluation Scheme for Theory and Practical**			
		L	**T**	**P**	**C**	**Component**	**Exam**	**WT**	**Min Pass %**
ELE520 (PC | ST) Version:1.0	Project Dissertation Phase-III	-	-	-	8	Presentation & Demonstration	ISE	100	50
ELE522 (PC | ST) Version:1.0	Project Dissertation Phase-IV	-	-	-	8	Viva Voce Exam	ESE	50	50
ELE524 (PC | ST) Version:1.0	Dissertation outcome Dissemination	-	-	-	2	Publications and Patents	ESE	100	50
Total Credits: 18									

Total Credits =80

List of Elective Subject: Semester I

Program Elective –I	
ELE507.1 (PE | ST) Version:1.0	Electrical Power Distribution System
ELE507.2 (PE | ST) Version:1.0	Advance protection of power system
ELE507.3 (PE | ST) Version:1.0	Restructured power system

Program Elective –II	
ELE509.1 (PE | ST) Version:1.0	Smart Grid
ELE509.2 (PE | ST) Version:1.0	Power Electronics for Renewable Energy Systems
ELE509.3 (PE | ST) Version:1.0	Power Quality issues in power system

List of Elective Subject: Semester II

Program Elective –III	
ELE508.1 (PE | ST) Version:1.0	PWM Converters And Application
ELE508.2 (PE | ST) Version:1.0	Power System Operation And Control
ELE508.3 (PE | ST) Version:1.0	Advance Digital Signal Processing.

Program Elective –IV	
ELE510.1 (PE | ST) Version:1.0	Advance Control of electrical drives
ELE510.2 (PE | ST) Version:1.0	Advance Control system
ELE510.3 (PE | ST) Version:1.0	Energy Management and Audit

Semester -I

ELE501: Research Methodology

(Ver. 1.0, University Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
3	1	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Formulate[2] a** research problem.
CO2	**Analyze[2]** research related information.
CO3	**Connect[2]**research ethics.
CO4	**Select[1]** use of tools and techniques for Research.

Syllabus (Theory)

Units	Description	Hours
I	Introduction to Research and Problem Definition Meaning, Objective and importance of research, Types of research, steps involved in research, defining research problem.	04
II	Research Design, Methods of research design, research process and steps involved, Literature Survey.	05
III	Data Collection Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research.	07
IV	Data Analysis and interpretation Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results.	08
V	Technical Writing and reporting of research Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism	06
VI	Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like Latex/MS Office, Software for detection of Plagiarism	06

Tutorial

Two hours per week per batch tutorial is to be utilized for problem solving to ensure that student's have properly learnt the topics covered in the lectures. This shall include group discussions on problems other than class and any academic activity to strengthen fundamental concepts of the subject.

Text Books

1. C. R. Kothari, Gaurav Garg, "Research Methodology Methods and Techniques", New Age International publishers, Third Edition.

References

1. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005.
2. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approach. Page publications, 2013.

ELE503: Power System Dynamics

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Recite**[2] the system dynamics and its physical interpretation
CO2	**Develop**[2] mathematical models for synchronous machine
CO3	**Categorize**[2] Excitation system for different machines in power system.
CO4	**Analyse**[2] single machine system.

Syllabus (Theory)

Units	Description	Hours
I	**Basic concepts:** Power system stability states of operation and system security system dynamics problems system model analysis of steady State stability and transient stability, simplified representation of Excitation control	06
II	**Modeling of synchronous machine:** synchronous machine, Park's Transformation, Transformation of flux linkages, Transformation of stator voltage equations and rotor equations, Analysis of steady state performance, per unit quantities, Equivalent circuits of synchronous machine - determination of parameters of equivalent circuits.	07
III	**Excitation system:** Excitation system modeling, excitation systems block Diagram system representation by state equations. Prime mover control system, Modeling of Transmission lines and loads.	05
IV	**Dynamics of a synchronous generator connected to infinite bus:** system model, Synchronous machine model, stator equations, rotor equations, Synchronous machine model with field circuit and one equivalent damper winding on q axis (model 1.1), calculation of Initial conditions.	08
V	**Analysis of single machine system:** small signal analysis with block diagram, Representation characteristic equation and application of Routh Hurwitz criterion, Synchronizing and damping torque analysis, small signal model State equations.	06
VI	**Application of power system stabilizers:** basic concepts in applying PSS, Control signals, structure and tuning of PSS, washout circuit, dynamic compensator analysis of single machine infinite bus system with and without PSS.	04

Text Book

1. Jan Machowski, Janusz Bialek, Dr Jim Bumby, "Power System Dynamics: Stability and Control" Wiley Publications.

References

1. K.R. Padiyar, "Power system dynamics", B.S. Publications, Hyderabad.
2. P.M. Anderson and A.A. Fouad, "Power system control and stability", 2nd edition. B.S. Publications Hyderabad.
3. Peter W. Sauer &M. A. Pai, "Power System Dynamics and Stability Prentice Hall".

ELE505: Modeling and Analysis of Electrical Machines

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: At the end of this course students will able to

CO1	**Explain**[1] the Basic Concepts of Modeling for analysis of electrical machines.
CO2	**Develop**[2] mathematical equivalent circuit of electrical machines.
CO3	**Develop**[2] mathematical model of DC and AC machines and perform dynamic analysis.

Syllabus (Theory)

Units	Description	Hours
I	**Basic Concepts of Modeling:** Basic two pole machine representation of commutator machines, 3-phase synchronous machine with and without damper bar and 3-phase induction machine, Kron's primitive machine-voltage, current and torque equations	06
II	**DC Machine Modeling:** Mathematical model of separately excited DC motor-steady state and transient state analysis, sudden application of inertia load, transfer function of separately excited DC motor, mathematical model of dc series motor, shunt motor, linearization techniques for small perturbations.	08
III	**Reference Frame Theory:** Real time model of a two phase induction machine, transformation to obtain constant matrices, three phase to two phase transformation, power equivalence	06
IV	**Dynamic Modeling of Three Phase Induction Machine:** Generalized model in arbitrary frame, electromagnetic torque, deviation of commonly used induction motor models-stator reference frames model, rotor reference frames model, synchronously rotating reference frames model, equations in flux linkages, per unit model, dynamic simulation	08
V	**Small Signal Equations of the Induction Machine:** Derivation of small signal equations of induction machine, space phasor model, DQ flux linkages model derivation, control principle of the induction motor	04
VI	**Transformer Modeling:** Introduction, single phase transformer model, three phase transformer connections, per phase analysis, normal systems, per unit	04

normalization, per unit three phase quantities, change of base, per unit analysis of normal system, regulating transformers for voltage and phase angle control, auto transformers, transmission line and transformers

Text Books

1. P.S.Bimbra, "Generalized Theory of Electrical Machines", 5 thEdition, Khanna Publications, 1995.

References

1. R. Krishnan, "Electric Motor Drives - Modeling, Ana lysis& Control", PHI Learning Private Ltd, 2009.
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive Systems", 2 ndEdition, Wiley(India),2010.
3. Arthur R Bergen and Vijay Vittal, "Power System Ana lysis", 2 nd Edition, Pearson, 2009.

ELE507.1: Electrical Power Distribution System

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[3] the importance of power distribution management system
CO2	**Describe**[2] the control and communication system for power distribution.
CO3	**Correlate**[2] the technical development in the field of Distribution Automation.

Syllabus (Theory)

Units	Description	Hours
I	Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting.	04
II	Advantages of Distribution Management System (D.M.S.), Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints Power Factor Correction	08
III	Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation	06
IV	SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA.	06
V	Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring.	07
VI	Maintenance of Automated Distribution System, Difficulties in Implementing Distribution. Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation. auto transformers, transmission line and transformers	05

Text Book

1. James Northcote- Green, Robert G. Wilson, "Control and Automation of Electrical Power Distribution Systems" Taylor & Francis Group.

References

1. Turan Gonen, "Electric Power Distribution System Engineering", 2nd Edition, BSP Books Pvt Ltd, 2010.
2. A.S, Pabla, "Electric Power Distribution System", 6thEdition, TMH, 2011.
3. Gorti Ramamurthy, "Hand Book of Electrical Power Distribution", University Press, 2ndEdition, 2009.

ELE507.2: Advance Protection of Power System

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Classify**[2] the different types of protective systems.
CO2	**Explain**[1] the protection of AC machines for various faults.
CO3	**Explain**[2] various protection for Power system components.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction:** Protective Relays; Basic requirements and type of protection, reviews of relay characteristics and operating equations, protective CTs, PTs, , phase and amplitude comparator, classification of Electromagnetic relays, Plug Setting Multiplier and Time Multiplier setting, Universal Torque Equation, Non Directional Relay, Directional relay, Distant relay, Differential relay	04
II	**Protection of Alternators:** Protection against Stator fault (Phase to Phase and Phase to Ground), Balanced earth fault protection, Stator inter turn protection, Unbalanced loading of Alternator, Prime Mover failure, Overvoltage protection, Overloading (or over current) Protection, Restricted Earth fault and standby earth fault protection, Rotor Fault Protection	08
III	**Protection of Transformer:** Over current and unrestricted Earth fault protection, Different CT connections, Balanced (Restricted) earth fault protection, Harmonic restraint, Frame leakage protection	06
IV	**Bus bar, Feeder, Transmission line Protection:** Bus bar Protection: Circulating Current Protection, Frame Leakage Protection. Feeder protection: Time Graded protection, Differential Protection. Transmission Line Protection: Introduction to distance relay, Simple Impedance relay, Reactance relay, Mho relays, comparison of distance relay – Choice between Impedance, Reactance and Mho relay, High speed Impedance relay, setting of distance relays. Pilot Relaying Schemes: Wire Pilot Protection, Carrier Current Protection.	08

V	**Static Relay** Introduction: Basic construction of static relays, advantages and disadvantages of Static Relay, different types of static relays (static over current, static time over current, static instantaneous over current, directional static over current, static differential and static distance relay) comparators and associated elements, system switching and transient effects.	06
VI	**Protection Of large Motors:** Differential protection, Earth fault Protection, Thermal overload protection, Starting and Stalling currents and effect of negative Sequence current. **Digital Relay**: Introduction, protection philosophy, basic hardware and protection schemes, protection algorithms, and micro processor based digital relaying.	04

Text Books

1. A. Chakrabarti, M.L. Soni, P. V. Gupta, U. S. Bhatnagar "A text book on Power System Engineering", Dhanpat Rai and Co.
2. Paithankar Y. G. and Bhide S. R, "Fundamentals of Power System Protection", Prentice-Hall of India.
3. Badri Ram and Vishwakarma D. N, "Power System Protection and Switchgear", Tata McGraw- Hill Publishing Company, 2002.
4. Arun K. Phadke, James. S. Thorp, "Computer relaying for Power system", John Wiley and sons, New York, 1998.

References

1. Power System Protection, PM Anderson, IEEE Press Book.
2. Protective Relays Application and Guide, GEC Measurements.
3. Jones D., "Analysis and protection of electrical power systems", Pitman Publishing, 1971.
4. "Power system reference manual, Ray rolls protection", Orient press, 1982.
5. Stanley H., Horowitz (ED), "Protective relaying for power system", IEEE press, 1980.

ELE507.3: Restructured Power System

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Connect**[1]restructuring of the electricity market
CO2	**Analyze**[2] the requirement for deregulation of the electricity market
CO3	**Select**[2]Ancillary Service Management for regulated power system.
CO4	**Connect**[3] the energy trading & transactions in deregulated power system.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction To Restructuring of Power Industry** Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models, Market architecture, Case study.	08
II	**Transmission Congestion Management** Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.	06
III	**Location Marginal Prices and Financial Transmission Rights** Mathematical preliminaries: - Location marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality - Simultaneous feasibility test and revenue adequacy – FTR issuance process: FTR auction, FTR allocation – Treatment of revenue shortfall – Secondary trading of FTRs – Flow gate rights – FTR and market power - FTR and merchant transmission investment.	08

IV	**Ancillary Service Management and Pricing of Transmission Network** Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service - How to obtain ancillary service –Co-optimization of energy and reserve services -International comparison 16 Transmission pricing – Principles – Classification –Rolled in transmission pricing methods – Marginal transmission pricing paradigm – Composite pricing paradigm – Merits and demerits of different paradigm.	08
V	**Reforms in Indian Power Sector** Introduction – Framework of Indian power sector – Reform initiatives - Availability based tariff – Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future	06

Text Book

1. S. K. Gupta, “Power System Operation Control and Restructuring” I.K. International Publishing House Pvt. Limited, 2015.\

2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen,” Operation of restructured power systems”, Kluwer Academic Pub., 2001

References

1. Sally Hunt,” Making competition work in electricity”, , John Willey and Sons Inc. 2002.
2. Steven Stoft,” Power system economics: designing markets for electricity”, John Wiley & Sons, 2002.
3. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, “Restructured electrical power systems: operation, trading and volatility” Pub., 2001.

ELE509.1: Smart Grid

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[3] features of Smart Grid over existing system.
CO2	**Categorize**[2]the role of automation in Transmission and Distribution
CO3	**Analyze**[2] Evolutionary Algorithms for the Smart Grid in implementation for Distribution and Generation.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction:** Introduction to smart grid, electricity network, local energy networks, electric transportation, low carbon central generation, attributes of the smart grid, alternate views of a smart grid.	04
II	**Smart Grid to Evolve a Perfect Power System:** Introduction, overview of the perfect power system configurations, device level power system, building integrated power systems, distributed power systems, fully integrated power system, nodes of innovation.	06
III	**DC Distribution and Smart Grid:** AC Vs. DC sources, benefits of and drives of dc power delivery systems, powering equipment and appliances with DC, data centers and information technology loads, future neighborhood, potential future work and research. **Intelligrid Architecture for the Smart Grid:** Introduction, launching intelligrid, smart grid vision based on the intelligrid architecture, barriers and enabling technologies.	08
IV	**Dynamic Energy Systems Concept**: Smart energy efficient end use devices, smart distributed energy resources, advanced whole building control systems, integrated communications architecture, energy management, role of technology in demand response, current limitations to dynamic energy management, distributed energy resources, overview of a dynamic energy management, key characteristics of smart devices, key characteristics of advanced whole building control systems, key characteristics of dynamic energy management system.	06
V	**Energy Port as Part of the Smart Grid:** Concept of energy -port, generic features of the energy port. Policies and Programs to Encourage End – Use Energy Efficiency: Polices and	04

programs in action; multinational, national, state, city and corporate levels. Market Implementation: Framework, factors influencing customer acceptance and response, program planning, monitoring and evaluation

VI	**Efficient Electric End – Use Technology Alternatives:** Existing technologies ,lighting, space conditioning, indoor air quality, domestic water heating, hyper efficient appliances, ductless residential heat pumps and air conditioners, variable refrigerant flow air conditioning, heat pump water heating, hyper efficient residential appliances, data center energy efficiency, LED street and area lighting, industrial motors and drives, equipment retrofit and replacement, process heating, cogeneration, thermal energy storage, industrial energy management programs, manufacturing process, electro- technologies, residential, commercial and industrial sectors.	8

Text Book

1. Fereidoon Perry Sioshansi, “Smart Grid: Integrating Renewable, Distributed & Efficient Energy” Menlo Energy Economics.

References

1. Clark W Gellings, “The Smart Grid, Enabling Energy Efficiency and Demand Side Response”, CRC Press, 2009.
2. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”, Wiley, 2012.
3. James Momoh, “Smart Grid: Fundamentals of Design and Analysis”, Wiley, IEEE Press, 2012.

ELE509.2: Power Electronics for Renewable Energy Systems

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Prioritize**[2] the use of various types of Electrical Machines for Renewable Energy Conversion.
CO2	**Classify**[3] AC-DC-AC converters
CO3	**Distinguish**[1] Wind power and PV Systems.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction** Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems	06
II	**Electrical Machines for Renewable Energy Conversion** Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG	04
III	**Power Converters** Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters-selection Of inverter, battery sizing, array sizing Wind: three phase AC voltage controllers-	08
IV	**AC-DC-AC converters**: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters	06
V	**Analysis of Wind and PV Systems** Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS-Grid Integrated solar system	04
VI	**Hybrid Renewable Energy Systems** Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV-Maximum Power Point Tracking (MPPT).	8

Text Book

1. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications" Wiley Publications.

References

1. Rashid .M. H "power electronics Hand book", Academic press, 2001.
2. Rai G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Rai G.D," Solar energy utilization", Khanna publishes, 1993.
4. Gray L. Johnson, "Wind energy system", prentice hall linc, 1995.
5. Non-conventional Energy sources B. H. Khan Tata McGraw-hill Publishing Company, New Delhi.

ELE509.3: Power Quality Issues in Power System

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[2] the different power quality issues to be addressed.
CO2	**Categorize**[2] the severity of power quality problems in system.
CO3	**Differentiate**[1]issues of current and voltage related power quality.
CO4	**Point out**[1] the methodology to improve the power quality by various Power quality conditioners.

Syllabus (Theory)

Units	Description	Hours
I	**Electric power quality phenomena: -** Impacts of power quality problems on end users, Power quality standards, power quality monitoring	06
II	**Power quality disturbances:-** transients, short duration voltage variations ,long duration voltage variations, voltage imbalance, wave-form distortions, voltage fluctuations, power frequency variations, power acceptability curves	06
III	**Power quality problems:** poor load power factor, loads containing harmonics, notching in load voltage, dc offset in loads, unbalanced loads, disturbances in supply voltage	06
IV	**Transients:** Origin and classification- capacitor switching transient-lighting-load switching-impact on users-protection mitigation.	04
V	**Harmonics:** harmonic distortion standards, power system quantities under non sinusoidal conditions-harmonic indices-source of harmonics-system response characteristics-effects of harmonic distortion on power system apparatus – principles for controlling harmonics, reducing harmonic currents in loads, filtering, modifying the system frequency response- Devices for controlling harmonic distortion, inline reactors or chokes, zigzag transformers, passive filters, active filters.	08
VI	**Power quality conditioners:** Shunt and series compensators, Dstatcom-dynamic voltage restorer, unified power quality conditioners	06

Text Book

1. Surajit Chattopadhyay, Madhuchhanda Mitra, Samarjit Sengupta, "Electric Power Quality", Springer.

References

1. Ghosh Arindam and Ledwich Gerard, 'Power quality enhancement using custom power devices' Springer.
2. Arrillaga J., Watson N. R. and Chen S., 'Power System Quality Assessment' Wiley.
3. Caramia P, Carpinelli G and Verde P, 'Power quality indices in liberalized markets' – Wiley
4. Angelo Baggini 'Handbook of Power Quality' – Wiley.

ELE511: Modeling and Analysis of Electrical Machines

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Practical)			
				Component	Exam	WT	Pass
-	-	2	1	Practical (100)	FEP	50	Min 40
					POE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Understand**[2] the Basic Concepts of Modeling for analysis of electrical machines.
CO2	**Develop**[1] mathematical equivalent circuit of electrical machines.
CO3	**Analyze**[1]performance of AC and DC machines

List of Experiments:

1. DC motor Modeling using MATLAB.
2. 3-Phase Induction Motor Modeling using MATLAB.
3. 3-Phase transformer Modeling.
4. Performance analysis of DC machine using MATLAB.
5. Performance analysis of Induction Motor Modeling using MATLAB

ELE513: Power System Dynamics Lab

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Practical)			
				Component	Exam	WT	Pass
-	-	2	1	Practical (100)	FEP	50	Min 40
					POE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Describe** [2] the Basic Concepts of Modeling of power system.
CO2	**Describe**[2] Reactive power optimization and loss minimization
CO3	**Analyze**[3] PV & PQ curve for a given power system

List of Experiments:

1. Operator request load flow using voltage and frequency dependent load modeling and generator droop characteristic.
2. Contingency analysis and Ranking for a given inter connected power system having minimum ten buses and ten series elements.
3. Obtaining of PV & PQ curve for a given power system with load buses and Voltage instability analysis
4. Reactive power optimization and loss minimization studies for a given power system.
5. Economic dispatch problem taking into account the network loading constraints and computation of bus incremental cost.
6. Observability analysis, state estimation and bad data detection for a given power system using measurement data.
7. Sequence impedance diagram development and distribution of earth fault current computation in a practical power system having auto transformers with tertiary delta winding, star-delta and delta-star configurations.
8. Over current relay co-ordination with and without instantaneous setting for a given network with NI relay characteristic curves.
9. Harmonic analysis and voltage and current harmonic distortion computation for a given power system. Tuned filter design to eliminate the harmonic currents.

ELE515: Disaster Management

(Ver. 1.0, University Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
2	-	-	NC	-	ESE	-	Pass/ Fail

Course Outcomes: After the end of this course students will able to

CO1	**Demonstrate**[2] a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO2	**Critically**[2] evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO3	**Practice**[2] standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO4	**Analyze**[2] the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country

Syllabus (Theory)

Units	Description	Hours
I	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	03
II	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	05
III	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	04
IV	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	03

V	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	04
VI	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India	03

Text Book

1. Harsh K. Gupta, "Disaster Management", Universities Press.

References

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company.
2. Sahni, Pardeep ET. Al. (Eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

ELE517: Seminar

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
-	-	2	1	Practical (50)	FEP	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Select**[2] the tools and techniques for collection of technical data.
CO2	**Demonstrate**[2] the ability of effective communication, presentation and writing skills.

Evaluation Scheme

1. Students shall carry out an exhaustive literature review(research articles, technical articles, white papers, books etc.), on a chosen topic under the supervision of a Guide and present the findings in the form of a review paper in the department in front of a departmental faculty committee, as a part of the term work .
2. The article must be published in a National / International Conference/Journal as a part of the term work.

SEMESTER – II

ELE502: Solar & Wind Energy Utilization

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[1]the concepts of solar and PV system.
CO2	**Analyze**[2]wind energy conversion system.
CO3	**Comprehend**[2] various wind energy application and its environmental Impacts.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction to Solar Energy:** Solar radiation, availability, measurement and estimation, Solar thermal conversion devices and storage, solar cells, solar cell interconnection solar cell characteristics and photovoltaic conversion	04
II	**PV systems-** Analysis of PV systems MPPT Applications of PV Systems solar energy collectors and storages power electronics in solar Energy Utilization-DC converters for solar PV systems	07
III	**Introduction to wind energy-** Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics	05
IV	**WECS Design** Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip loss correction.	08
V	**Design of Wind Turbine** Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods.	06
VI	**Wind Energy Application** Wind pumps: Performance analysis, design concept and testing; Principle of	06

WEG; Stand alone, grid connected and hybrid applications of WECS; Economics of wind energy utilization; Wind energy in India; Case studies, Environmental Impacts of Wind Farms.

Text Book

1. Hafit Yüncü, E. Paykoc, Y. Yener, "Solar Energy Utilization: Fundamentals and Applications", NATO ASI series.
2. V. V. N. Kishore, "Renewable Energy Utilization: Scope, Economics, and Perspectives", Tata Energy Research Institute.

References

1. Wind energy Conversion Systems – Freris L.L. (Prentice Hall1990)
2. Wind Turbine Technology: Fundamental concepts of wind turbine technology Spera D.A. (ASME Press, NY, 1994)
3. Wind Energy Systems – G.L. Johnson (Prentice Hall, 1985)
4. Wind Energy Explained – J.F.Manwell, J.G. McGowan and A.L. Rogers (John Wiley & Sons Ltd.)
5. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progensa,1994.
6. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, Applied hotovoltaics, 2007, Earthscan, UK.
7. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook , CRC Press, 2011.

ELE504: SCADA System and Applications

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[2] the functioning of SCADA.
CO2	**Select**[2] appropriate SCADA architectures.
CO3	**Deploy**[3] SCADA applications.

Syllabus (Theory)

Units	Description	Hours
I	**General Theory:** Purpose and necessity, general structure, data acquisition, transmission and monitoring, general power system hierarchical structure, overview of the methods of data acquisition systems, commonly acquired data, transducers, RTUs, data concentrators, various communication channels, cables, telephone lines, power line carrier, microwaves, fiber- optical channels and satellites.	04
II	**Supervisory and Control Functions:** Data acquisitions, status indications, measured values, energy values, monitoring alarm and event application processing. Control function: ON/OFF control of lines, transformers, capacitors and applications in process industry, valve, opening, closing etc. Regulatory functions: set points and feed-back loops, time tagged data, disturbance data collection and analysis, calculation and report preparation.	08
III	Industries SCADA System Components, Schemes- Remote Terminal Unit (RTU),Intelligent Electronic Devices(IED),Programmable Logic Controller (PLC),Communication Network, SCADA Server, SCADA/HMI Systems.	07
IV	SCADA Architecture, Various SCADA architectures, advantages and disadvantages of each System, single unified standard architecture -IEC 61850.	05
V	SCADA Communication, various industrial communication technologies, wired and wireless methods and fiber optics, Open standard communication protocols.	06

VI	SCADA Applications: Utility applications, Transmission and Distribution sector operations, monitoring, analysis and improvement, Industries - oil, gas and water	06

Text Book

1. Stuart G McCrady, "Designing SCADA Application Software: A Practical Approach", Elsevier Insights

References

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and
3. Related Systems", Newnes Publications, Oxford, UK,2004
4. William T. Shaw, "Cyber security for SCADA systems", Penn Well Books, 2006. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", Penn Well 1999

ELE506: High Voltage Engineering

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Understand**[3] high voltage engineering and breakdown phenomenon in different medium.
CO2	**Understand**[2] different high voltage measurements and the necessary instruments.
CO3	**Analyze**[2]significance of high voltage engineering.

Syllabus (Theory)

Units	Description	Hours
I	**Over Voltages In Electrical Power Systems** Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against over voltages	08
II	**Dielectric Breakdown** Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.	08
III	**Generation of High Voltages And High Currents** Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.	06
IV	**Measurement Of High Voltages And High Currents** High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.	08

V	**High Voltage Testing & Insulation Coordination** High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination.	06

Text Book

1. C. L. Wadhwa, "High Voltage Engineering", New Age Internationals (P) Limited, 1997.

References

1. High Voltage Engineering: M. S. Naidu and V. Kamaraju, TMH Publications, 3rd Edition.
2. High Voltage Engineering: Fundamentals: E. Kuffel, W. S. Zaengl, J. Kuffel , Elsevier.
3. High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.

ELE508.1: PWM Converters and Application

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[2] the concepts and basic operation of PWM converters.
CO2	**Classify**[3] the steady-state and dynamic analysis of PWM converters.
CO3	**Evaluate**[1] the current ripple and torque ripple in inverter fed drives.
CO4	**Recite**[1]the different filtering methods.

Syllabus (Theory)

Units	Description	Hours
I	Use of Single-Pole-Double-Throw Single-Pole-Multi-Throw switches to describe Converter Topologies: Implementation of various switch schemes using available power semiconductor devices. Topologies of Inverters and Rectifiers--relation between Pole voltages, Line voltages and Line-to-load neutral voltages in multi-phase two-level inverters.	08
II	Basic modulation methods--duty ratio--sine-triangle modulation--implementation of unipolar and bipolar modulation--three-phase inverters-Space vector PWM - conventional sequence- 30 degree and 60 degree bus clamped PWM—relation between sine-triangle and space vector PWM--dc bus utilization of SPWM and SVPWM.	06
III	Synchronized and non-synchronized PWM-Multilevel Converters: Topologies. Neutral Point Clamped and Flying Capacitor Topologies. Cascaded Multilevel Inverters-Multilevel Converters Modulation - Conventional Space Vector Modulation for 3-level inverters. Applications of PWM converters.	06
IV	Active front end rectifier--vector control of front-end rectifier- Control of Shunt active filter - Current Control in inverters: Current controlled PWM VSI - Hysteresis Control - fixed band and variable band hysteresis. Selective Harmonic Elimination-Derivation of simultaneous transcendental equations for elimination of harmonics.	06

V	Estimation of current ripple and torque ripple in inverter fed drives. Line-side converters with power factor compensation.	04
VI	Active power filtering. Reactive power compensation. Harmonic current compensation. Selective harmonic elimination PWM technique for high power electric drives PWM Current Source Inverters--Current Space Vectors- Space Vector Modulation of CSI-Application of CSI in high-power drives-Fundamental principles of Hybrid schemes with CSI and VSI.	06

Text Book

1. D. Grahame Holmes, Thomas A. Lipo, "Pulse Width Modulation for Power Converters: Principles and Practice", IEEE press series on Power Engineering.

References

1. Mohan, Undeland and Robbins, "Power Electronics: Converters, Applications and Design", John's Wiley and Sons.
2. Erickson RW, "Fundamentals of Power Electronics", Chapman and Hall.
3. Vithyathil J, "Power Electronics: Principles and Applications", McGraw Hill.

ELE508.2: Power System Operation and Control

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[2] the concepts of System load variation with frequency effect.
CO2	**Construct**[1] mathematical model and algorithm scheduling of hydrothermal plants.
CO3	**Recite** [1] the concepts of Unit Commitment and Economic Dispatch.
CO4	**Recite** [1]advance control of Power System techniques.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction** System load variation: System load characteristics, load curves - daily, weekly and annual, load-duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation: Load forecasting, techniques of forecasting, basics of power system operation and control	06
II	**Real Power - Frequency Control** Fundamentals of speed governing mechanism and modeling: Speed-load characteristics – Load sharing between two synchronous machines in parallel; concept of control area, LFC control of a single-area system: Static and dynamic analysis of uncontrolled and controlled cases, Economic Dispatch Control. Multi-area systems: Two- 6 area system modeling; static analysis, uncontrolled case; tie line with frequency bias control of two-area system derivation, state variable model.	08
III	**Hydrothermal Scheduling Problem** Hydrothermal scheduling problem: short term and long term-mathematical model, algorithm. Dynamic programming solution methodology for Hydro-thermal scheduling with pumped hydro plant: Optimization with pumped hydro plant-Scheduling of systems with pumped hydro plant during off-peak seasons:	08

algorithm. Selection of initial feasible trajectory for pumped hydro plant-Pumped hydro plant as spinning reserve unit generation of outage induced constraint-Pumped hydro plant as Load management plant.

IV **Unit Commitment and Economic Dispatch** 06

Statement of Unit Commitment (UC) problem; constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints; UC solution methods: Priority-list methods, forward dynamic programming approach, numerical problems .Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. Base point and participation factors.-Economic dispatch controller added to LFC control.

V **Computer Control of Power Systems** 08

Energy control centre: Functions – Monitoring, data acquisition and control. System hardware configuration – SCADA and EMS functions: Network topology determination, state estimation, security analysis and control. Various operating states: Normal, alert, emergency, in-extremis and restorative-State transition diagram showing various state transitions and control strategies.

Text Book

1. P. Kundur, “Power System Stability & Control”, McGraw Hill Publications, USA.

2. Ramana N. V., “Power System Operation & Control”, Pearson Education India, 1992.

References

1. Olle I. Elgerd, Electric Energy Systems Theory – An Introduction“, Tata McGraw Hill Publishing Company Ltd, New Delhi, Second Edition, 2003.
2. D.P. Kothari and I.J. Nagrath, Modern Power System Analysis“, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
3. L.L. Grigsby, The Electric Power Engineering, Hand Book“, CRC Press & IEEE Press, 2001
4. Allen J. Wood and Bruce F. Wollenberg “Power Generation, Operation and Control”, John Wiley & Sons, Inc., 2003.

ELE508.3: Advance Digital Signal Processing

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Compare**[1] the concepts of Interpolation and Decimation.
CO2	**Evaluate**[2] AR, MA, ARMA model.
CO3	**Develop**[2] the concepts of Digital Signal Processor.
CO4	**Collaborate**[2] to Design of Decimation and Interpolation Filter.

Syllabus (Theory)

Units	Description	Hours
I	**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	08
II	**Estimation And Prediction 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, Linear prediction – Forward and backward predictions, Least mean squared error criterion – Wiener filter for filtering and prediction, Discrete Kalman filter.	08
III	**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	06
IV	**Application of DSP** Design of Decimation and Interpolation Filter, FFT Algorithm, PID Controller, Application for Serial Interfacing, DSP based Power Meter, Position control.	08
V	Basics on DSP system architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realization of MAC & Filter structure.	06

Text Book

1. John G. Proaks, Dimitris G. Manolakis, “Digital Signal Processing”, Pearson Education 2002.
2. S. Salivahanan, A. Vallavaraj and C. Gnanapriya “Digital Signal Processing”, TMH, 2000.

References

3. Bernard Widrow, Samuel D. Stearns, “Adaptive Signal Processing”, Pearson Education, third edition, 2004.
4. Dionitris G. Manolakis, Vinay K. Ingle, Stepen M. Kogon, “Statistical & Adaptive signal processing, spectral estimation, signal modeling, Adaptive filtering & Array processing”, McGraw-Hill International edition 2000.
5. Monson H. Hayes, “Statistical Digital Signal Processing and Modelling”, John Wiley and Sons, Inc.
6. Avatar Sing, S. Srinivasan, “Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx”, Thomson India, 2004.
7. Lars Wanhammer, “DSP Integrated Circuits”, Academic press, 1999, New York.
8. Ashok Ambardar,” Digital Signal Processing: A Modern Introduction”, Thomson India edition, 2007.
9. Lars Wanhammer, “DSP Integrated Circuits”, Academic press, 1999, New York.

ELE510.1: Advance Control of Electrical Drives

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[2] the concepts of Power devices and Motor Drive.
CO2	**Analyze**[1] the concepts of Reference frame theory and transformation.
CO3	**Develop**[2]Speed control schemes for Induction motor (IM) drives.
CO4	**Connect**[2] use of Microcontroller for electrical drives.

Syllabus (Theory)

Units	Description	Hours
I	**Power devices and Motor Drive:** An introduction to modern electrical drives, Power devices and their switching, Electric machines, Power converters, controllers and load.	08
II	**Reference frame theory and transformation:** Three phase transformation, abc-axis to dq-axis transformation, space vector and Transformation.	08
III	**Modeling and Control of DC Machines:** Electromechanical modeling, state-space modeling block diagram and transfer function, Control of separately excited dc motor drives for Inner current loop and speed control Design.	06
IV	**Speed control of Induction motor (IM) drives:** V/f control, dq0 model and state space model of three phase IM, Vector control of IM, Direct torque control (DTC) of induction motor drives, Comparison of DTC and Vector control.	06
V	**Brushless DC motor drives and an introduction to Microcontroller based control of electrical drives:** Brushless DC motor Drives, Introduction of Microcontroller and DSP based control of electrical drives and some industrial applications.	08

Text Book

1. Jacek Kabziński, “Advanced Control of Electrical Drives and Power Electronic Converters”, Studies in Systems, Decision and control.

References

1. B.K. Bose: Modern Power Electronics and AC Drives, 1st Edition, Pearson, 2002.
2. Bin-Wu: High-power Converters and AC Drives, IEEE Press, John Wiley & Sons, 2006.
3. R. Krishanan: Electric Motor Drives Mode.

ELE510.2: Advance Control System

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[2] the Overview of Control Systems.
CO2	**Recommend**[2] different controllers and its tuning.
CO3	**Compare**[1]State model for SISO & MIMO Systems.
CO4	**Explain**[2]Non-linear System with its characteristics.

Syllabus (Theory)

Units	Description	Hours
I	**Overview of Control Systems:** LTI Motion Control System; Temperature & Voltage Regulators; Modeling of Servo-motors, Hydraulic & pneumatic actuators. Computation of Relative stability using Bode plot and Nyquist method. Hierachical Control Of Power System; System Control; Load scheduler and Optimiser; Real Reactive power Flow Control; AVR and Turbine Speed governor set points.	08
II	**Control System Performance:** Improvement of System Performance through Compensation; Design of lag; Lead and Lag load Compensators; PI, PD & PID control; PID Controller Design and tuning; Disturbance rejection; System Uncertainty and performance Robustness.	07
III	**Analysis in state space:** State model for SISO & MIMO Systems; State Diagram; Solution of state equation; State Transformations; Jacobian Linearization Technique; Stability; Controllability &Observability; Perspective on State-Space design; Full-State Feedback Design of continuous time control system; Full Order observer System	08
IV	**Digital Control system:** Configuration of Digital Control System; Supervisory Control; Direct digital control; Single-Loop Digital controllers; Sampling Process; Sampling theorem; Data reconstruction; Digital transfer function & System response; Stability Tests ; Mapping between s-plane & z-plane; Bilinear transformation; Error constants; Pole assignment design based on full state feedback; Compensator design in w-plane using Bode plot.	05

V	**Non-linear System:** Common non-linearity ; Methods of Analysis; Linearization; Phase Plane method; Describing function Analysis; Limit Cycles; Relay with dead-zone and hysteresis; Stability analysis by Lyapunov's methods.	04
VI	**Optimal Control:** Characteristics of optimal control problems; Linear optimal Control with quadratic performance index; Selection of performance measure; State and Output regulators; Optimal state regulator problem with matrix Ricatti equation.	04

Text Book

1. Nagrath i.j, gopal m – control system engineering, new age publishing

References

1. Ogata, k – modern control engineering, p.h learning.
2. Kuo, b.c – automatic control systems, prentic hall.
3. Roy chowdhury, d – modern control engineering, prentic hall.
4. Gopal, m – digital control and state variable methods, tatamcgraw -hill.
5. Kuo, b.c. – digital control system, oxford university press.
6. Franklin f, powellj.d, emaminaeini, a- feedback control of dynamic systems, addisionweslay publication.
7. Peter dorato – robast control.
8. Gibson, j.e. – non-linear system, mcgraw –hill

ELE510.3: Energy Management and Audit

(Ver. 1.0, Program Elective, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
4	-	-	4	Theory (100)	FET	20	Min 40
					CAT I	15	
					CAT II	15	
					ESE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Explain**[2] the Overview of Energy Scenario.
CO2	**Assess**[1] on Energy Audit and Energy Saving calculations.
CO3	**Measure**[2] different protocols for Energy Control Centers.
CO4	**Explain**[2]Integration of Distributed and Renewable Energy Systems to Power Grids.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction:** Energy Scenario – global, sub continental and Indian, Energy economy relation, Future energy demand and supply scenario, Integrated energy planning with particular reference to Industrial Sector in India, Captive power units and others – demand v/s supply.	04
II	**Types of Energy:** Physical Aspects of Energy: Classification of energy – Hydro, Thermal, Nuclear, Wind, & from Waste Products. Efficiency and effectiveness of energy utilization in Industry. Energy and energy analysis. Renewable and nonrenewable energy, Conventional and unconventional energy.	06
III	**Demand Side Management:** Energy Demand Management: Energy utilization, Instrumentation and data analysis, Financial aspects of energy management, Energy management as a separate function and its place in plant management hierarchy. Energy Planning, Energy Staffing, Energy Organization, Energy Requirement. Energy Costing, Energy Budgeting, Energy Monitoring, Energy Consciousness, Energy Conversions, Energy Efficient Equipment, Energy Management Professionals, Environment Pollution due to Energy Use, Components of Pollution, Harmful Effects of Pollution, Measures taken to combat Pollution.	07
IV	**Energy Audit and Energy Saving:** Energy Audit and analysis, Energy load	08

	measurements, System evaluation and simulation, Energy saving techniques and guidelines: Administrative control, Proper Measurement and monitoring system, Process control, proper planning & scheduling, Increasing capacity utilization, Improving equipment control, waste heat recovery, Change of energy source. Up gradation of Technology. Change of product specifications, Use of High efficiency equipment, Design modification for better efficiency, Improved periodic maintenance.	
V	**Energy Control Centers:** Remote Telemetry; Remote Terminal Units; IEC TC 57 (870-5-1) Protocol Standard; Data Acquisition Procedure; Data Handling and Organization; Real Time Database; Alarm and Events; Disturbance Processing; Fault Locating Technology; Real Time Display; MIMIC Boards; Supervisory Remote Control; Load Dispatch Control Centers; Distribution Control Centers; Time Keeping Systems.	07
VI	**Integration of Distributed and Renewable Energy Systems to Power Grids:** DC-to-AC Converters; AC-to-AC Converters; DC-to-DC Converters; Plug-In Hybrid Electric Vehicles; Energy Storage Technologies; Micro grids.	04

Text Book

1. Barun Kumar De, “Energy Management, Audit and Conservation”, Vrinda Publications, 2007.

References

1. Paul W., O’callaghan; “*Energy Management”*, McGraw Hill Book Company
2. Steve Doty, Wayne C. Turner; “*Energy Management Handbook”*, Fairmont Press Inc., GA 30047.
3. Barny L. Capehart, Wainey C. Turner, William J. Kennedy; “*Guide to Energy Management*”, Fairmont Press Inc., GA 30047.
4. Handbook of Energy Engineering, Albert Thumann & Paul Mehta, the Fairmont Press, INC.
5. NPC energy audit manual and reports.
6. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council.

ELE513: Solar & Wind Energy Utilization Lab

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
-	-	2	1	Practical (100)	FEP	50	Min 40
					POE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Understand**[2] the measurement of various parameters in solar and wind systems.
CO2	**Develop**[1] the model of a PV module.
CO3	**Describe**[2] IV characteristics for different modules.

Experiment Titles:

1. Performance evaluation of different designs of wind mill.
2. Wind speed measurement at various sites and heights using portable anemometer and Plotting Wind Rose diagram using WR plot.
3. Measurement of Global, beam and diffuse radiation using pyrano meter and pyrohelio meter.
4. Measurement of sunshine hours using sunshine recorder.(solar meter)
5. Performance evaluation of various designs of solar still.
6. Performance evaluation of solar greenhouse dryer.
7. Performance evaluation of 36 W solar PV modules.
8. I-V characteristics of various solar photovoltaic modules.
9. Operation and Efficiency of a Gasified-Engine
10. Experiment to evaluate the Life time of the solar cell.

ELE514: SCADA System and Applications Lab

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
-	-	2	1	Practical (100)	FEP	50	Min 40
					POE	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Demonstrate** [2] SCADA modeling for real time system
CO2	**Develop**[2]advanced control methods using PLC and Intelligent Electronic Devices.
CO3	**Explain** [2] communication techniques of SCADA systems.

Experiment Titles:

1. Study and demonstration of SCADA applications in Utility Automation.
2. Study of Communication technologies in SCADA.
3. Study of SCADA system in industries.
4. Study and demonstration of Intelligent Electronic Devices.
5. Study and demonstration of RTU.
6. Study and demonstration of PLC & Communication networks.
7. Study of open standard communication protocols.
8. Case study of SCADA systems.

ELE516: Pedagogy Studies

(Ver. 1.0, University Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
2	-	-	NC	-	ESE	-	Pass/ Fail

Course Outcomes: After the end of this course students will able to

CO1	**Review**[1] existing evidence on the review topic to inform programme design and policy making undertaken by the Department for International Development (DfID), other agencies and researchers.
CO2	**Identify**[2] critical evidence gaps to guide the development.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions**.** Overview of methodology and Searching.	05
II	**Thematic overview**: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	03
III	Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies	05
IV	**Professional development:** alignment with classroom practices and follow-up support Peer support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes	05
V	**Research gaps and future directions** Research design, Contexts, Pedagogy, Teacher education, Curriculum and	04

assessment, Dissemination and research impact.

Text Book

1. Patricia Murphy, Kathy Hall, Janet Soler, "Pedagogy and Practice: Culture and Identities", the one university.

References

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31:245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic math's and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

ELE518: Mini Project

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
-	-	2	1	Practical (50)	FEP	50	Min 40

Course Outcomes: After the end of this course students will able to

CO1	**Understand**[2] practical importance of small scale electrical projects
CO2	**Develop**[1] the model of identifying problem
CO3	**Analysis**[1] of obtained result.

Prerequisite: Basic Knowledge of Electrical Engineering

Rationale: This is a laboratory oriented course which will provide a platform to students to enhance their practical knowledge and skills by development of small scale Electrical based projects**.**

Guidelines:

1. Students should select a problem which addresses some basic problems related to electrical based real life applications.
2. Students should understand/develop basic programming knowledge and simulation skill
3. Students should understand testing of various components.
4. Students should develop a necessary PCB for the circuit.
5. Students should see that final circuit submitted by them is in working condition.
6. 5-10 pages report to be submitted by students.
7. Group of maximum two students can be permitted to work on a single mini project.
8. The mini project must have hardware/software part.
9. Department may arrange demonstration with poster presentation of all mini projects developed by the students at the end of semester.

SEMESTER – III

ELE519: Industry Internship

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Practical)			
				Component	Exam	WT	Min Pass %
-	-	-	4	Report and Presentation	ISE	50	50
					ESE	50	

Course Outcomes: After the end of this course students will able to

CO1	**Get exposure**[2] to the industry culture and professional responsibility.
CO2	**Understand**[3] practical application of basic concepts in industry.
CO3	**Identify**[2] industry problem.
CO4	**Provide**[2] solution for identified problem.

All the students enrolled for M.Tech program irrespective of their program of study are required to undergo 4 weeks industry internship in industries pertaining to the respective domain of their program. This internship is aimed at giving sufficient exposure to the students regarding the working of business, various functional areas, norms of work, organization structure, products and services along with the work procedure and systems. This help the students to visualize the inter connectivity between what they learn in classes (theory) to the real world of work. It also helps to understand the expectation of industries regarding Code of Conduct, time management, commitment, planning and scheduling the work activities and meeting and analytical and critical thinking skills required. Industry internship is to be done by the students at the end of semester II (during the vacation) or students have option to carryout internship in the company where they will take up dissertation work.

Industry Internship Program with Dissertation

It is full one year two semester program in the second year of the program semester III and IV This course aims at giving students hands on experience to imbibe in them the skills and competencies required to make them competent post graduates for employment as per the

expectation of the industry where the students are expected to work as interns and carry out the individual project assigned to them by the company. The students learning progress is monitored by both industry person concerned and the supervisor assigned.

OUTCOME EXPECTED AT THE END OF INTERNSHIP

After the successful completion of the internship the student should be able to

1. Understand the functioning of the company in the terms of inputs, transformation process and the outputs (products and services)
2. Develop an attitude to adjust with the company culture, work norms, code of conduct.
3. Understand and follow the safety norms, Code of conduct.
4. Demonstrate the ability to observe, analyze and document the details as per the industry practices.
5. Understand the processes, systems and procedures and to relate to the theoretical concepts- studied.
6. Analyze the company with respect to its competitors.
7. Carry out SWOT analysis of the company
8. Improve the leadership abilities, interpersonal communication.
9. Demonstrate project management and finance sense

WORK DIARY

Each student should maintain a work which contains details regarding internship, do's and don'ts and evaluation scheme. Students is required to write the dairy regularly and get it signed by the industry guide periodically during the visit the faculty assigned to the student should be able to go through the dairy to access the work done and write the remarks/ instruction. At the end of the internship, the duly completed dairy to be submitted to the department.

CODE OF CONDUCT:

The students should strictly abide by the rules and regulations of the company with respective to safety, timing, discipline. Any violation of the norms will view seriously and the institute may take strict action in such situation and student may face a severe setback in both his academics and career.

EXPENSES OF THE INTERSHIP TRAINING and DISSERTATION IN COMPANY:

All the expenses of the training like travelling, boarding and lodging should be borne by the students. However, if the company offers, they are eligible to get subsidized canteen facility, transport facility.

EVALUATION OF INTERNSHIP: (4 CREDITS)

The assessment of the internship will be done jointly by the industry and the faculty assigned to the students. The tentative scheme of assessment will be

1.	Punctuality, behavior and following code of conduct (to be assessed by the company personal)	20%
2.	Initiative, observation and interest in learning new things (faculty in charge)	20%
3.	Familiarization with specific Department/shop/function assigned to student (to be assessed by the company personal)	20%
4.	Final evaluation based on presentation of work, internship report (By DPGC committee and Supervisors)	40%

Minimum 50% is mandatory for successful completion of internship or else the extension will be given to make the student to come up to the expectation.

ELE521: Project Dissertation Phase-I

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Min Pass %
-	-	-	4	Presentation	ISE	100	50

Course Outcomes: After the end of this course students will able to

CO1	**Literature**[2] Survey and Research related to corresponding organization in the context of the Problem Objectives.
CO2	**Study**[2] gap analysis from literature review
CO3	**Identify**[1] methodology of problem formulated
CO4	**Process**[1] data collection and techniques data analysis.

DISSERTATION PHASE I (SYNOPSIS SUBMISSION SEMINAR)

Dissertation is a program requirement for M. Tech wherein under the guidance of a supervisor/ co-supervisor from the industry in case of industry sponsored projects, a second year student is required to some innovative/ contributory/ developmental work with the application of knowledge earned while undergoing various theory and laboratory courses. A student has to exhibit both analytical and practical skills through dissertation work.

A student is expected to carry out intensive literature survey/ identification of a major issue or problem in case of industry projects with observations and discussions in the area of interest specific to the domain in consultation with the dissertation supervisor and industry co-supervisor. The objectives and scope of the dissertation will be expected at a higher level and the use of the new analytical and computer based tools for solving the identified problem is recommended.

A student is required to submit the dissertation synopsis duly signed by supervisor and co- supervisor to the M. Tech Co- coordinator of the department who schedules the synopsis presentation seminar in the DPGC (Departmental Program Committee).

The dissertation synopsis seminar presentation comprises of the following details:

- A Dissertation title
- General introduction to the area of the topic
- Relevance of the dissertation work

- Literature review/ prior work done in the area
- Dissertation objectives and scope
- Expected outcomes
- Methodology
- Phases of work and representation on a Gantt chart with deadlines
- Resources required to complete the work
- Commitment from the student (Ethical conduct)
- References

Based on the report and the presentation, the DPGC will give approval to the dissertation/ give suggestions/ suggest changes/modifications, additional scope etc. specific to make dissertation to come to the expected level of PG requirement. The student will incorporate the suggestions and resubmit the same for approval.

The final copy of the synopsis with approval seal will be issued to the student, supervisor and the co- supervisor of the company which becomes the guiding document for the dissertation.

The Evaluation Guidelines

1. Based on the initiative, the novelty and the skill in identifying the problem and collecting and analyzing the information and co-Supervisor : 50 %
2. Presentation, scope, outcomes, research compilation, relevance DPGC : 50%

ELE523: Project Dissertation Phase-II

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Min Pass %
-	-	-	8	Presentation, Report and Demo	ISE	50	50
					ESE	50	

DISSERTATION PHASE II

Followed by approval of the synopsis, this phase aims at completing at least 40 % of the dissertation work specified in the synopsis.

Phase II evaluation consists of a progress review based on the efforts put in by the student to carry out the work and results obtained thereof to seek suggestions and improvements and to ascertain that the student is going in the right direction.

This phase consists of both the In- semester evaluation by the supervisor and DPGC (ISE) and the end semester evaluation (consisting of presentation followed by demonstration) by a panel of examiners appointed by the COE of the university based on the panel of experts approved by BOS submitted to the COE.

The Evaluation Scheme	Weightage%
Supervisor and co- supervisor	25
DPGC of the program department	25
Panel of Examiners [Chairman, internal supervisor, external expert]	50

In the DPGC Evaluation, if the progress is not found satisfactory, the student will be given the grace period of 4 weeks to work on the dissertation and present it to the committee again and on approval the ESE will be conducted. In this case, the student has to suffer one grade penalty and the next semester Phase III starts only on satisfactory completion of Phase II.

ELE520 & ELE522: Project Dissertation Phase-III and IV

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Practical)			
				Component	Exam	WT	Min Pass %
-	-	-	16	Presentation & Demonstration, Viva Voce Exam	ISE	100	50
					ESE	50	50

Course Outcomes: After the end of this course students will able to

CO1	**Design**[2] and implement selected method
CO2	**Simulate**[1] or Fabricate the system
CO3	**Conclude**[3] the project and any future scope
CO4	**Generate**[2]technical report as per standards.

DISSERTATION PHASE III

This stage marks the final progress review which indicates the completion of all the defined phases of the dissertation satisfactorily on the periodic progress reviews by supervisor and co- supervisor. A student by this time has used an opportunity to present his dissertation work in a reputed international/national conference to receive the feedbacks/ comments on the work and any new dimension to be incorporated to make the work novel and worthy of publishing in peer reviewed journals and should also prepare a journal paper based on the complete work of dissertation with results, discussions and conclusions.

A student is required to prepare the draft dissertation report as per the format of the university and with approval of supervisor and co- supervisor submit the same to the PG program coordinator of department.

The Program coordinator will schedule the presentation of student (Pre submission) before the DPGC members once the student has completed all the academic requirements for the prescribed program.

1. Submission of Draft Dissertation Report
2. Completion of internship
3. Completion of the online/self-study.
4. Earning 100% credits of Sem I to III
5. Proof of presentation of the work in the International Conference (Certificate publication and draft paper in a template for an identified journal/uploading of same in peer reviewed journal)

Based on the recommendation of DPGC, the dissertation is processed further. Viva-Voce examination is to be scheduled preferably with the same external expert appointed for the Dissertation Phase II by COE.

The successful completion of the Viva- voce, the panel of examiners recommends the candidate as successfully completed and submits the evaluation in the sealed envelope.

Evaluation Scheme for Phase III

Sr. No.		Weightage %	Min.Passing %
1	Supervisor and Co supervisor	50	50
2	DPGC Committee	50	

Evaluation Scheme for Phase IV

	Weightage %	Min. for Passing%
External Viva-voce examination by a panel (ESE)	100	50%

If the DPGC committee is of the opinion that a student is required to work further to achieve the stated objectives and incorporate some additional work, an extension based on the work is given to the student to complete the work and the student is required to re-submit the dissertation and a presentation is to be given to DPGC. The DPGC will take a final decision on whether to schedule the final exam or give additional extension of the work.

ELE524: Dissemination of Outcomes' of Dissertation

(Ver. 1.0, Program Core, School of Technology)

Lect.	Tut.	Practical	Credits	Evaluation Scheme for (Practical)			
				Component	Exam	WT	Min Pass %
-	-	-	2	Publication and Patents	ESE	100	50

It is mandatory on the part of the student to

1. Participate and present a paper in a reputed national/ international conference organized by the premium institutions/ professional bodies. It is recommended to participate and publish in conferences whose proceedings are published by IEEE, Elsevier Springer, Materials Today or any other reputed conferences.
2. A paper for a peer reviewed journal is to be prepared as per the journal format and uploaded to the journal website. It is desirable that at least the paper will be selected in initial review regarding Scope and it enters the second phase of editor
3. If the work of a student is novel and patentable in this case, a student need not have to bring his research findings in public domain through publication but he can file the patent. Student should be able to get provisional registration of patent with patent office.
4. In case of NDA with company when student is pursuing his dissertation, publication may not be possible in public domain. These cases are to be treated as special cases. A rubrics is developed for evaluation.

The evaluation of the dissertation work of a student shall be carried out in four phases: First and third phase being evaluated for ISE by Department Post Graduate Committee (DPGC) while second and fourth phase by DPGC for ISE and by a panel of examiners for ESE. Except for phase I evaluation i.e. evaluation based on synopsis submission seminar, a student shall be evaluated for all other phases for his/her understanding, the work done and his/her presentation followed by demonstration.

DPGC shall consist of three faculty members from the department, Guide assigned to a student being one of the members. A panel of examiners for ESE shall consist of Chairman (who shall be one of the DPGC members and shall monitor the process as per norms), an Internal Examiner (who shall be the Guide) and an External Examiner (who shall be a subject expert from outside the institute).