VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
Ibrahimbagh, Hyderabad – 500 031, Telangana State

M. Chakravarthy

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

SCHEME OF INSTRUCTION AND EXAMINATION FOR M.E. COURSE (WEF 2017-18) UNDER CBCS

S.No	Category	Subject Code	M.E. / M.TECH FIRST YEAR I SEMESTER								
			Subject Title	Instruction Hours per week			Examination			Total Marks	Credits
				L	T	P	Duration in Hrs	Max. Marks			
			THEORY					CIE	SEE		
1	PC	PC510EE	Application of Power Electronics to Power Systems	3	1	0	3	40	60	100	3
2	PC	PC530EE	Power System Stability	3	1	0	3	40	60	100	3
3	PC	PC560EE	Power Electronic Converters	3	1	0	3	40	60	100	3
4	PE	PEXXXEE	Professional Elective - I	3	0	0	3	40	60	100	3
5	PE	PEXXXEE	Professional Elective – II	3	0	0	3	40	60	100	3
6	PE	PEXXXEE	Professional Elective - III	3	0	0	3	40	60	100	3
7	EEC	MC500EH	Finishing School - I: Soft Skills	2	0	0	1.5	20	30	50	1
			LABS								
8	PC	PC511EE	Computer Simulation Lab	0	0	2	2	50	-	50	1
9	PC	PC521EE	Power Electronics and DSP Lab	0	0	2	2	50	-	50	1
10	PC	PC512EE	Seminar - I	0	0	2	-	25	-	25	1
			Total	**20**	**3**	**6**	**-**	**385**	**390**	**775**	**22**
			Grand Total	**29**							**22**

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BOS Chairman

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S.No	Category	Subject Code	M.E. / M.TECH FIRST YEAR II SEMESTER								
			Subject Title	Instruction Hours per week			Examination			Total Marks	Credits
				L	T	P	Duration in Hrs	Max. Marks			
			THEORY					**CIE**	**SEE**		
1	PC	PC520EE	Distribution System Planning and Automation	3	1	0	3	40	60	100	3
2	PC	PC540EE	Power Electronics Controlled Electric Drives	3	1	0	3	40	60	100	3
3	PC	PC550EE	Advanced Computer methods in Power Systems	3	1	0	3	40	60	100	3
4	PE	PEXXXEE	Professional Elective – IV	3	0	0	3	40	60	100	3
5	PE	PEXXXEE	Professional Elective – V	3	0	0	3	40	60	100	3
6	PE	PEXXXEE	Professional Elective - VI	3	0	0	3	40	60	100	3
7	EEC	MC510EH	Finishing School - II: Soft Skills	2	0	0	1.5	20	30	50	1
			LABS								
8	PC	PC531EE	Power System Power Electronics Lab	0	0	2	-	50	-	50	1
9	PC	PC541EE	Programmable Logic Controllers And Their Applications Lab	0	0	2	-	50	-	50	1
10	PC	PC522EE	Seminar - II	0	0	2	-	25	-	25	1
			Total	**20**	**3**	**6**	**-**	**385**	**390**	**775**	**22**
			Grand Total	**29**							**22**

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S.No	Category	Subject Code	M.E. / M.TECH FIRST YEAR III SEMESTER							Total Marks	Credits
			Subject Title	Instruction Hours per week			Examination				
				L	T	P	Duration in Hrs	Max. Marks			
	THEORY							CIE	SEE		
1	EEC	PC502EE	Dissertation Seminar	0	0	4	-	50	-	50	2
2	EEC	PC503EE	Dissertation – Phase I	0	0	16	-	100	-	100	8
			Total			20		150	-	**150**	**10**
			Grand Total	**20**						**150**	**10**

S.No	Category	Subject Code	M.E. / M.TECH FIRST YEAR IV SEMESTER						Total Marks	Credits
			Subject Title	Instruction Hours per			Examination			
				L	T	P	Duration in Hrs	Max. Marks		
	THEORY									
1	EEC	PC513EE	Dissertation – Phase II	0	0	30	-	Viva-voce (Grade)		**15**
			Total			**30**				**15**
			Grand Total	**30**						
								Total Credits		**69**

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CORE SUBJECTS		
1	PC510EE	Application of Power Electronics to Power Systems
2	PC520EE	Distribution system planning and automation
3	PC530EE	Power System Stability
4	PC540EE	Power Electronics Controlled Electric Drives
5	PC550EE	Advance Computer Methods in Power Systems
6	PC560EE	Power Electronic Converters

PROFESSIONAL ELECTIVES

POWER SYSTEMS		
1	PE570EE	Advanced Synchronous Machine Theory
2	PE580EE	Advanced Power System Protection
3	PE590EE	Real Time Applications in Power Systems
4	PE514EE	High Voltage D.C. Transmission
5	PE524EE	Renewable Energy Sources
6	PE534EE	Reliability Modeling in Power Systems
7	PE544EE	Energy Management
8	PE554EE	AI Applications to Power Systems
9	PE564EE	High Voltage Engineering
10	PE574EE	Smart Grid Technologies
11	PE584EE	Distributed generation and micro grids
POWER ELECTRONICS		
12	PE594EE	Power Semi-Conductor Devices Circuits
13	PE515EE	Machine Modeling and Analysis
14	PE525EE	Power Quality Engineering
15	PE535EE	Advanced topics in Power Electronics
16	PE545EE	Switched Mode power conversion
17	PE555EE	PWM converters and applications
18	PE565EE	Digital controllers in Power Electronics Applications
19	PE575EE	Static Control of Electric Drives
20	PE585EE	Application of Micro controllers to power electronics
21	PE595EE	Power Electronic Control Of Dc Drives
22	PE516EE	Power Electronic Control Of Ac Drives

COMMON TO POWER SYSTEMS AND POWER ELECTRONICS		
23	PE526EE	Advanced Microprocessors Systems
24	PE536EE	Digital Control Systems
25	PE546EE	Programmable Logic Controllers And Their Applications
26	PE556EE	Modern Control Theory
27	PE566EE	Microcontrollers

CORE SUBJECTS

PC510EE Application of Power Electronics to Power Systems

Instruction	:	3+1(T) Periods/Week
Duration of Univ.Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

Course Objectives	Course Outcomes
Acquire the knowledge on flexible AC Transmission System by using FACTS controllers and to understand the various FACTS controllers operation in FACTS systems to control the power system parameters.	1. An ability to apply knowledge of FACTS Controllers.
	2. An ability to design a Compensators within realistic constraints.
	3. An ability to identify, formulate, and solve real network problems with FACTS controllers
	4. Students are able to identify and apply the recent trends in FACTS technology to compensate reactive power.
	5. Students can be able to apply the different types of techniques for mitigation of harmonics.

UNIT I

General System considerations and FACTS: Transmission Interconnections, Flow of Power in an AC System, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, principles of series and shunt compensation, Basic Types of FACTS Controllers, Benefits from FACTS, Application of FACTS.

UNIT II

Shunt Compensators: Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, improvement of Transient Stability, Power Oscillation Damping, Static Var Compensators, SVC and STATCOM, The Regulation Slope, Transfer Function and dynamic Performance, Transient Stability Enhancement and Power Oscillation Damping

UNIT III

Series Compensators: Objectives of Series Compensation, concept of series capacitive compensation, voltage stability, improvement of transient stability, power oscillation damping, GTO thyristor controlled series capacitor, thyristor controlled series capacitor, SSSC.

UNIT IV

Combined Compensators: Introduction, unified power flow controller, basic operating principles, independent real and reactive power flow control, control structure, basic control system for P and Q control.

UNIT V

Mitigation of Harmonics: Power quality problems, harmonics, harmonic creating loads, harmonic power flow, and mitigation of harmonics, filters, passive filters, active filters, shunt, series and hybrid filters.

Suggested Reading:

1. Narain G. Hingorani, Laszlo Gyugyi, Understanding FACTS, IEEE press
2. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, Electrical Power Systems Quality, McGraw Hill,2003
3. Y.H.Song, A.T.Johns, Flexible A.C.Transmission System, IEE, London, 1999

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PC520EE Distribution System Planning and Automation

Instruction	:	3+1(T) Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Distribution System Planning: Introduction, Distribution system Planning: Factors effecting planning, present techniques, planning models, planning in the future, future nature of distribution planning, Role of computer in Distribution planning. Load characteristics and Load models–Wye connected loads, Delta connected loads.

UNIT II

Sub Transmission lines & Substations: Types of sub- transmission, Distribution substation, bus schemes, substation location, rating of substation, calculation of voltage drops with primary feeders, Derivation of the K constant, Application curves, Interpretation of the Percentage Voltage drop formula.

UNIT III

Primary Feeders: Types of primary feeders, Primary feeder loading, Tie-lines, Distribution feeder exit — rectangular and radial type development, Design of radial primary feeders — Voltage drop calculations by A,B,C,D constants, Uniformly distributed load, Non uniformly distributed load. Distribution Feeder Analysis – the ladder Iterative technique.

UNIT IV

Secondary Feeders: Secondary voltage levels, Present design practice, Secondary Banking, Economic design of secondaries, Total annual cost equation, Voltage drop and Power loss calculations. Distribution system voltage regulation: Quality of services, voltage control, Application of capacitors in Distribution system.

UNIT V

Distribution Automation: Distribution Automation, project planning, Definitions, communication, sensors, Supervisory Control and Data Acquisition Systems (SCADA), Consumer Information Service(CIS), Geographical Information System (GIS), Automatic Meter Reading (AMR), Automation system.

Suggested Reading:

1. Ganen Turan, Electric Power Distribution System Engineering, CRC Press, 2007 2nd Edition
2. William.Kersting, Distribution Modelling & Analysis – CRC Press – third edition - 2002
3. A.S. Pabla, Electric Power Distribution, Tata Mc Graw Hill, 5 Edition, 2005.

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PC530EE Power Systems Stability

Instruction	:	3+1(T) Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

Course Objectives	Course Outcomes
1. To develop models of single machine and multi machine systems for stability studies	1. Able to model the power system and analyse power system behaviour
2. To design controllers for power system stabilization and voltage regulation.	2. Able to identify and discriminate power system disturbances
	3. Able to design controllers for improving power system stability

UNIT I

Steady state stability: Basic concept of stability-Types of stability- Stability criteria for single and multi-machine systems — Concept of voltage stability — Characteristics of network, generator and load, for voltage stability.

UNIT II

Transient stability: The swing equation for single and multi-machine system — Basic assumptions — Different methods of solution of swing equation — Solution by indirect methods — Runge- gutta method - Swing curve — Determination of critical time and critical angle.

UNIT III

Hydraulic power and governor models — IEEE standard models — Models for steam turbine. Improvement of Transient stability- potential energy function for SVC, SSSC & UPFC.

UNIT IV

Low frequency oscillation and supply controls: Transfer function of low frequency oscillation studies — Improving system damping with supplementary excitation — Design of supplementary excitation system — State equation for single machine system — Improving system model with governor control.

UNIT V

Sub Synchronous oscillation: Turbine generator torsional Characteristics, Torsional interaction with power system controls. Sub Synchronous resonance. Damping schemes.

Suggested Reading:

1. Yao-Nan-Yu, *Power System Dynamics,* Academic Press, 1983.
2. Prabha Kunder, *Power System Stability & Controi,* Tata Mc Graw Hill edition. 2006.
3. KR Padiyar, *FACTS Controllers in Power Transmission & Distribution* New AGE International Publishers First edition 2007.
4. Stagg and Elabiad, *Computer Methods in Power systems* - McGraw Hill., 1968.

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PC540EE Power Electronics Controlled Electric Drives

Instruction	:	3+1(T) Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Review of Power Converters: Commutation in Thyristor power converters – Principle of natural commutation – Principle of forced commutation – Discontinuous conduction in converters- DC choppers – Force commutated inverters – Frequency conversion – Inverter voltage control – Harmonic neutralization – Current source inverters – Phase controlled cyclo-converters – AC Voltage controller.

UNIT II

DC Motor Control: General considerations – Evaluation of a dc drive performance – Forced commutation schemes to improve the performance of the drives – Features and Steady state analysis of a separately excited dc motor fed from chopper – Current limit control – Regenerative braking of dc motors – Steady state performance of dc motors on phase controlled rectifiers – Dual converters – Reversible drives – State space model and digital simulation of dc motors.

UNIT III

Induction Motor Control: Speed control of induction motors – Analysis of induction motor on non-sinusoidal voltage waveforms – Analysis of current source inverter fed induction motor – Variable frequency operation of induction motors – Analysis of induction motor fed from AC voltage controller – Chopper controlled resistance in the rotor circuit of an induction motor – Static slip energy recovery schemes employing converter cascades in the rotor circuit – Dynamic behavior and Stability of induction motor fed from variable frequency supply.

UNIT IV

Microprocessors in the Control of Electrical Drives: Applications of microprocessors in variable speed drives (Block Diagram and Flowchart Approach only) – DC motor speed control using microprocessor – Microprocessor based firing scheme for a dual converter – Induction motor speed control – Synchronous motor speed control – Stepper Motor Control.

UNIT V

Brushless DC Motor and Switched Reluctance Motor Drives: Switched reluctance motor drive – Normalized torque-speed characteristics – Speed Control Schemes – Control Circuits – Brushless DC Motor – Construction – Working Principle – Control Schemes.

Suggested Reading:

1. Vedam Subramanyam, Thyristor Control of Electric Drives, Tata MGraw Hill Publishing Co., New Delhi, 2003.
2. S.B.Dewan, G.R.Slemon, A.Straughen, Power Semi Conductor Drives, Wiley Interscience, 1984.
3. B.K.Bose, Power Electronics and AC Drives – Prentice Hall, 1986.

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PC550EE Advanced Computer Methods in Power Systems

Instruction	:	3+1(T) Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Network graph, Incidence Matrices – Element node incidence matrix - Bus incidence matrix - Branch path incidence matrix - Basic and Augmented cut set incidence matrices - Basic and Augmented branch incidence matrices - Basic and Augmented loop incidence matrices - Primitive network - Formation of Y Bus, YBR & Z loop by singular transformation.

UNIT II

Matrix representation of power systems, Triangularization, Gaussian elimination method, LU, LOU factorization, Table of factors, optimal ordering. Algorithm for formation of ZBus matrix. Concept of branch and link addition -modification of bus impedance matrix for changes in the network, Z bus -sparse vector method.

UNIT III

Concepts of load flow -classification of buses, Representation of fixed tap setting and on load tap changing transformers, load flow solution using Gauss -Seidel, Newton-Raphson methods, Treatment of voltage controlled buses -Acceleration factors, Decoupled and fast decoupled method,- Flow chart and comparison of different methods.

UNIT IV

Representation and performance equation of 3 phase network elements -Three phase network elements with balanced and unbalanced excitation -Transformation matrices -Symmetrical and Clarke's components -Algorithm for formation of 3-phase bus impedance matrix -Modification of three phase ZBUS charges in network.

UNIT V

Basic assumption in short circuit studies -System representation - General equations for short circuit study in phase variables and Symmetrical components for fault current and node voltage – Short circuit calculations for balanced three phase network using ZBUS - Fault impedance and admittance matrices -Analysis of 3 phase, line to ground and double line to ground faults -Flow chart for short circuit study.

Suggested Reading:

1. Stagg & EI-Abiad. Computer methods in Power System Analysis, Tata McGraw Hill, 1968.
2. Kusic Gearge L -Computer Aided Power System Analysis, - Prentice Hall, 1986.
3. M.A.Pai -Computer techniques in Power System Analysis, Tata McGraw Hill, 2006.

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PC560EE POWER ELECTRONIC CONVERTERS

Instruction	:	3+1(T) Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

Course Objectives	Course Outcomes
1. To understand and acquire knowledge about various power semiconductor devices.	1. Acquire knowledge about fundamental concepts and techniques used in power electronics.
2. To prepare the students to analyze and design different power converter circuits.	2. Ability to analyze various single phase and three phase power converter circuits and understand their applications.
	3. Foster ability to identify basic requirements for power electronics based design application.
	4. To develop skills to build, and troubleshoot power electronics circuits.
	5. Foster ability to understand the use of power converters in commercial and industrial applications.

UNIT I

Analysis of power semiconductor switched circuits with R, L, RL, RC loads, d.c.motor load, battery charging circuit.

UNIT II

Single-Phase and Three-Phase AC to DC converters- half controlled configurationsoperating domains of three phase full converters and semi-converters – Reactive power considerations.

UNIT III

Analysis and design of DC to DC converters- Control of DC-DC converters, Buck converters, Boost converters, Buck-Boost converters, Cuk converters

UNIT IV

Single phase and Three phase inverters, Voltage source and Current source inverters, Voltage control and harmonic minimization in inverters.

UNIT V

AC to AC power conversion using voltage regulators, choppers and cyclo-converters, consideration of harmonics, introduction to Matrix converters.

Suggested Reading:

1. Ned Mohan, Undeland and Robbin, 'Power Electronics: converters, Application and design', John Wiley and sons.Inc, Newyork, 2006.
2. Rashid M.H., 'Power Electronics-Circuits, Devices and Applications ', Prentice Hall India, New Delhi, 2009.
3. P.C Sen., 'Modern Power Electronics', Wheeler publishing Company, 1st Edition, New Delhi, 2005.

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Power Systems

PE570EE Advanced Synchronous Machine Theory

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

The Synchronous machine - Park's transformation — Flux linkage equations — Voltage equations — Current formulation of state space equations — Per-unit conversion — Normalizing Voltage and torque equations — Torque and power — Equivalent circuits of synchronous machine — Flux linkage state space model — Treatment of saturation Synchronous machine connected to infinite bus — Current , Voltage and flux linkage models.

UNIT II

Sub-transient and transient reactances and time constants — Simplified models of the synchronous machine — Steady state equations and phasor diagrams — Machine connected to infinite bus with local load at machine terminals - Determining steady state conditions.

UNIT III

Linear models of the synchronous machine - Linearization of the generator state space current, voltage and flux linkage models.

UNIT IV

Linearization of the load equation for the one machine problem -- Simplified linear models — Effect of loading — State space representation of simplified model.

UNIT V

Representation of excitation systems, Different models of excitation systems — IEEE, 1, 2 & 3 systems — Representation of loads.

Suggested Reading:

1. Kimbark, E.W., *Power System Stability,* Vol. III, Dover, New York, 1968.
2. P.M.Anderson & A.A.Foud, *Power System Control & Stability,* Iowa State University Press, U.S.A. 1977.
3. Yao-Nan-Yu, *Power System Dynamics, Academic Press,* 1983.

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PE580EE Advanced Power System Protection

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Static relays- Comparators and static relay characteristics: Relays as comparators –Amplitude and Phase comparison schemes – General equation for comparators for different types of relays – Static comparators – Coincidence circuits – Phase splitting methods–Hall effect comparators – Operating principles – Use of level detectors – Time delay circuits – Filters – Thyristors – Triggering circuits and DC power supplies.

UNIT II

Static relay hardware: Operating principles: Static time current relays directional units based on phase and amplitude comparison– Differential relays – Distance relays – Quadrilateral relay – Elliptical relay – Relay response – Principle of R-X diagram – Convention for superposing relay and system characteristics – Power swings, Loss of synchronism and its effect on distance relays.

UNIT III

Generator, motor and transformer protection: Generator protection against short circuits using differential relays against inter-phase fault – Combined split-phase and overall differential relays – Protection against stator open circuits – Rotor and Stator overheating, Loss of excitation protection and field & ground fault protection. Digital protection scheme based upon second harmonic current induced in the rotor field circuit.

UNIT IV

Transformer differential protection: Effect of magnetizing in rush currents –Grounding transformers – Bus protection with differential relays. Line protection: 3 zone protection using distance relays – Switched schemes – Auto-reclosing – Single and multi-shot auto reclosing – Single pole and three pole auto reclosing.

UNIT V

Pilot wire and carrier protection: Circulating current scheme – Balanced Voltage scheme – Translay scheme – Half wave comparison scheme – Phase comparison carrier current protection –carrier transfer scheme – carrier blocking scheme – Digital protection EHV/ UHV transmission line based upon traveling wave phenomena.

Suggested Reading:

1. Badriram and Viswakarma D.N., *Power System Protection and Switchgear* — Tata McGraw Hill, 2004.
2. L.P.Singh, *Digital Protection*, Wiley Eastern Ltd., 1994.
3. Warrington A.R. Van C, *Protective Relays* ,Vol I & II Chapman & Hall, London and John Wiley & Sons, 1977.
4. Mason C.R. *The art and science of Protective Relaying,* Wiley & Sons, 1956.

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PE590EE Real Time Applications in Power Systems

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Power Flow Studies: Introduction, power flow problem, formulation of power flow equation, computational aspects of power flow problem, Gauss-Seidel iterative technique, Gauss elimination(Triangular factorization) method, Power flow solution using Zbus matrix, power flow solution by Newton-Raphson method, decoupled load flow, fast decoupled load flow, power flow control by regulating the operating conditions.

UNIT II

Contingency Analysis Techniques: Security in a power system, approximations in contingency analysis, simulation of addition and removal of multiple lines in a power system, simulation of tie lines in inter connected power systems, network reduction for contingency analysis, contingency analysis, approximate power flow method for simulating contingencies.

UNIT III

State Estimation Techniques: Data acquisition, role of a state estimator, rationale of state estimation, method of least squares for state estimation, estimation of power system state varables by the weighted least square estimation(WLSE) technique, statistical errors and bad data recognition, power system state estimator in noisy environment, composition of the Jacobian matrix H and the measurement vector Z

UNIT IV

Power System Security: Introduction, challenges for secure operation, methods of enhancing security, reliability criterion, enhancement of stability controls, online dynamic security assessment, management of system reliability, Future trends in dynamic security assessment, real time monitoring and control

UNIT V

Load Forecasting Technique: Forecasting methodology, estimation of average and trend terms, estimation periodic components, estimation of Ys(k): Time series approach, estimation of stochastic component: kalman filters approach, long term load predictions, reactive load forecast

Suggested Reading:

1. T.K.Nagsarkar, M.S.Sukhija, Power system analysis, Oxford publications
2. Prabha Kundur, Power system stability and control, TataMcGrawHill Edition, 2006
3. J.Arrillaga, C.P.Arnold, Computer modeling of electric power systems, John Wiley 1983

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PE514EE High Voltage D.C. Transmission (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

Course Objectives	Course Outcomes
To provide the knowledge on comparison of HVAC and HVDC transmission system, different types of AC and DC filters and control schemes for HVDC converters, different types of faults over voltages and over currents and its protection, AC and DC interaction system and different types of reactive power sources, different types MTDC system and current control schemes.	Students will be: 1. Able to differentiate the cost comparison of AC and DC system
	2. Able to comprehend the different types of AC and DC filters and control scheme for HVDC converters.
	3. Able to analyze different types of faults, such as over voltages and over current and its protection.
	4. Able to comprehend the AC and DC system interaction and different types of reactive power sources.
	5. Able to comprehend and analyze series and parallel MTDC systems and current control schemes.

UNIT I

Comparison of AC and DC Transmission systems, Applications of DC Transmission, Description of DC Transmission Systems, Modern trends in HVDC Technology. Static power conversion - Principle -Ideal / real commutation process - Rectifier operation - Inverter operation - Power factor and reactive power - Converter harmonics, Smoothing reactors.

UNIT II

Harmonic elimination - Design of ac. Filters- D.C. side filters - Alternative methods of harmonic elimination - Control of H.V.D.C. converters and systems - Individual phase control - Equidistant firing control - D.C. system control - Characteristics and direction of D.C power flow.

UNIT III

Fault development and protection - Converter disturbances -A.C system faults -Over current protection - Transient over-voltages - Harmonic over voltages excited by A.C disturbances - Fast transients generated on the D.C system - Surges generated on the a system insulation co-ordination. DC Circuit breakers.

UNIT IV

AC – DC system interactions: System models, Torsional, harmonic interactions with HVDC systems. Reactive power control: Requirements in steady state, Sources of reactive power and control during transients.

UNIT V

Study of MTDC systems, Multi-infeed DC systems, Types of MTDC systems, Existing a.c.transmission facilities converted for use with d.c. - Generator rectifier units- Forced commutation - Compact converter stations - Microprocessor based digital control.

Suggested Reading:

1. Arrillaga J., *High Voltage Direct Current Transmission,* Peter Peregrinus Ltd., London. 1983.
2. Padiyar KR., *HVDC Power Transmission Systems,* New Age International, New Delhi, 2010.

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PE524EE Renewable Energy Sources (Elective)

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

Course Objectives	Course Outcomes
To provide a survey of the most important renewable energy resources and the technologies for harnessing these resources within the framework of a broad range of simple to state- of -the-art energy systems.	1. Comprehend the generation of electricity from various Non-Conventional sources of energy, have a working knowledge on types of fuel cells.
	2. Estimate the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
	3. Absorb the concepts involved in wind energy conversion system by studying its components, types and performance.
	4. Comprehend geo-thermal energy, ocean energy and their operational methods.
	5. Acquire the knowledge on harnessing biomass as a source of energy and analyze photo synthetic efficiency.

UNIT I

Review of Conventional and Non-Conventional energy sources - Need for non-conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2°2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells — Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind- Basic components of WECS -Classification of WECS -Site selection considerations -Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT IV

Energy from the Oceans - Ocean Thermal Electric conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages energy - Geo-thermal Energy - Types of Geo-thermal Energy Systems - Applications of Geo-thermal Energy. of wave

UNIT V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation -Thermal gasification of biomass -Biomass gasifies.

Suggested Reading:

1 Rai G.D, *Non-Conventional Sources of Energy,* Khanfla Publishers, New Delhi, 1999.

2. El-Wakil, M0M., *Power Plant Technology.* McGraw Hill, 1984.

Prof. K.V. Ramana Murthy
BOS Chairman

PE534EE Reliability Modeling in Power Systems

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Introduction: The Concept of reliability – Reliability Indices – Power System reliability- Component Reliability – Non-repairable components – Hazard Models – System Reliability – network methods – Logic Diagrams – Monotonic Structures.

UNIT II

Generating Capacity Reserve Evaluation: Planning for reliability – Outage definitions – Construction of reliability models — probability of capacity deficiency – Loss of load method – Loss of energy method – Frequency and duration method – Two level representation of the daily load - Merging the generation and load models – Multilevel representation of the daily load – Comparison of the reliability indices – Generation expansion planning.

UNIT III

Operating Reserve Evaluation: General concepts – PJM method –Outage replacement rate – Generation model – Unit commitment risk – Modified PJM method – Area risk curves – Modelling rapid start units – Modelling hot reserve units – Unit commitment risk – Security function approach – Security function model – Response risk – Evaluation techniques – Effect of distributing spinning reserve – Effect of Hydro – electric units.-interconnected systems

UNIT IV

Generation and Transmission Systems: Introduction – Radial configurations – Conditional probability approach – Network configurations – State selection – Systems and load point indices – Application to practical systems – Data requirements for composite system reliability evaluation – concepts – deterministic data – Stochastic data – Independent outages – Dependent outages – Common mode outages – station originated outages.

UNIT V

Distribution Systems: Introduction – Basic evaluation techniques – state space diagrams – approximate methods – Network reduction method – Failure modes and effects analysis – Temporary and transient failures – concepts – evaluation techniques – Common mode failures – Evaluation techniques – Sensitivity analysis – Total loss of continuity(TLOC) – Partial loss of Continuity(PLOC) – PLOC criteria – Extended load – duration curve – Effect of transferable loads – General concepts – Evaluation techniques – Economic considerations

Suggest Reading:

1. Endrenyi, Relaibility Modeling in Electrical Power Systems, Johnwiley & Sons,1978.
2. Roy Billiton, Ronold N.Allan, : Relaibility Evaluation of Power Systems, Plenum press, springer international edition
3. E.Balaguruswamy, Relaibility Engineering.

Prof. K.V. Ramana Murthy
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PE544EE Energy Management

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Essentials of Energy Management: Introduction – Scope of Energy Management – Necessary Steps of Energy Management Programme – General Principles of Energy Management – Qualities and Functions of an Energy Manager – The Language of the Energy Manager. Method of investment appraisal – Rate of return method - Pay back method – Net present value method (NPV) - Internal rate of return method (IRR)– Capital budgeting.

UNIT II

Energy Auditing: Introduction – Objective of Energy Audit – Control of Energy – Uses of Energy – Energy Conservation Schemes – Energy Index – Cost Index – Pie Chart – Sankey Diagram – Load Profile – Types of Energy Audit – General Energy Audit – Sankey Questionnaire – Sample Questionnaire – Energy Audit Case Studies

UNIT III

Energy Conservations: Introduction – Indian Energy Conservation Act, 2001(EC Act) – The Electricity Act 2003 – Rules for Efficient Energy Conservation of Energy and Materials – Technologies for Energy Conservation – Design of EC – Energy Flow Networks – Critical Assessment of Energy Use – Formulation of Objectives and Constraints.

UNIT IV

Improvement of Energy Efficiency: Waste Heat – Advantages of Recuperators – Air Preheaters and Economizers – Furnaces – Fans and Blowers – Compressors – Pumps – Energy Audits – Case studies, Tips for energy conservation in domestic and industrial sectors

UNIT V

Electrical Energy Management: Introduction – Power Factor Control – Tariff – Energy Efficient Motors – Case Study – Energy Efficient Lighting – Life cycle Cost Analysis (LCC analysis) – Equivalent Annual Worth(EAW) – Break Even Analysis.

Suggested Reading:

1. KV Sharma,P.Venkataseshaiah: Energy management and conservation IK International publishing house Pvt. Ltd.
2. Guide book for national certification examination for energy managers and energy auditors, Books1,2,3 &4-Bureau of Energy Efficiency, Ministry of power, Govt. of India
3. Turner W.C.: Energy management handbook

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PE554EE AI Applications to Power Systems

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Fundamentals of Genetic Algorithms: Introduction to GAs, Encoding, Fitness Function, Premature Convergence, Basic Operators, Selection, Tournament Selection, Truncation Selection, Linear Ranking Selection, Exponential Ranking Selection, Elitist Selection, Proportional Selection, Crossover, Mutation

UNIT II

Fundamentals of Particle Swarm Optimization Techniques : Introduction, Basic Particle Swarm Optimization, Background of Particle Swarm Optimization, Original PSO, Variations of Particle Swarm Optimization, Discrete PSO, PSO for MINLPs, Constriction Factor Approach (CFA), Hybrid PSO (HPSO), Lbest Model,

UNIT III

Ant Colony Search Algorithms : Introduction, Ant Colony Search Algorithm, Behavior of Real Ants, Ant Colony Algorithms, The Ant System, The Ant Colony System, The Max-Min Ant System, Major Characteristics of Ant Colony Search Algorithms, Distributed Computation: Avoid Premature Convergence, Positive Feedback: Rapid Discovery of Good Solution,, Use of Greedy Search and constructive Heuristic Information

UNIT IV

Differential Evolution: Introduction, Evolutionary Algorithms, Basic EAs, Virtual Population-Based Acceleration Techniques, Differential Evolution, Function Optimization Formulation, DE Fundamentals, Initial Population, Mutation and Recombination to Create New Vectors, Selection and the Overall DE, Key Operators for Differential Evolution, Encoding, Mutation, Crossover, Other Operators, An Optimization Example.

UNIT V

Applications to power systems: Distribution Network Expansion, Dynamic Planning of Distribution System Expansion: Reactive Power Planning at Generation–Transmission Level, Benders Decomposition of the Reactive Power Planning Problem, Solution Algorithm, Reactive Power Planning at Distribution Level, Application Examples, Optimal Power Flow Under Contingent Condition with Line Capacity Limit, Optimal Power Flow for Loss Minimization

Suggested Reading:

1. Kwang Y. Lee and Mohamed A. El-Sharkawi, "Modern heuristic optimization techniques" IEEE press, Wiley-Interscience Publication
2. Soliman, Soliman Abdel-Hady, Mantawy, Abdel-Aal Hassan, "Modern Optimization Techniques with Applications in Electric Power Systems" Springer publications
3. S.N.Sivanandam, S.N.Deepa, "Introduction to Genetic algorithms" Springer publications

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PE564EE High Voltage Engineering

Instruction	:	3 Periods/Week
Duration of Univ. Examination:	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks

UNIT I

Conduction and Breakdown of Gaseous Insulating Material: lionization processes and current growth – Townsend's criterion for breakdown – Breakdown in electronegative gases – Time lags for breakdown – Paschen's law – Corona discharges – Breakdown in non – uniform fields – Practical considerations for selecting gases for insulation purposes.

UNIT II

Conduction and Breakdown in Liquid and solid Dielectrics : Various mechanisms of breakdown in liquid dielectrics - Liquid dielectrics used in practice – Various processes – Breakdown in solid dielectrics – Solid dielectrics used in practice.

UNIT III

Generation of High Voltages and Currents : Generation of High DC Voltages using voltage multiplier circuits – Van de Graff generator. Generation of high alternating voltages using cascade transformers – Production of high frequency AC high voltages – Standard impulse wave shapes – Marx circuit – Generation of switching surges – Impulse current generation – Tripping and control of impulse generators.

UNIT IV

Measurement of High voltages and Currents: High DC Voltage measurements techniques – Methods of measurements for power frequency AC voltages – sphere gap measurements technique – potential divider or impulse voltage measurements – measurements of high DC., AC and impulse currents – Use of CRC for impulse voltage and current measurements.

UNIT V

High voltages Testing: Tests on insulators – testing on bushings – testing of isolators and circuit breakers – cable testing of transformers surge diverter testing – Radio interference measurement – Use of I.S.S. of testing.

Suggested Reading:

1. M.S Naidu and V.Kamaraju, High voltage Engineering, Tata McGraw Hill, 1982.
2. E.Kufferl and M.Abdullah, High voltage Engineering, Pergamon Press, 1960.

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PE574EE SMART GRID TECHNOLOGIES

Instruction	:	3 Periods/Week
Duration of Univ. Examination:	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.

UNIT II

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAr control,Fault Detection, Isolation and service restoration, Outage management,High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT III

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits,AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection.

UNIT IV

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

Suggested Reading:

1. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.
3. Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, 'Smart Grid Technologies: Communication Technologies and Standards' IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
4. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang 'Smart Grid – The New and Improved Power Grid: A Survey' , IEEE Transaction on Smart Grids.

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PE584EE DISTRIBUTED GENERATION AND MICRO-GRIDS

Instruction	:	3 Periods/Week
Duration of Univ. Examination:	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

UNIT II

Grid integration of DGs – Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units. Energy storage elements: Batteries, ultra-capacitors, flywheels.

UNIT III

Technical impacts of DGs – Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

UNIT IV

Economic and control aspects of DGs –Market facts, issues and challenges - Limitations of DGs. Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis

UNIT V

Introduction to micro-grids – Types of micro-grids – autonomous and non-autonomous grids – Sizing of micro-grids- modeling & analysis- Micro-grids with multiple DGs – Microgrids with power electronic interfacing units. Transients in micro-grids - Protection of micro-grids – Case studies.

Suggested Reading:

1. H. Lee Willis, Walter G. Scott ,'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. M.Godoy Simoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.
3. Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004.
4. F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.
5. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson 'Facility Microgrids', Subcontract report, May 2005, General Electric Global Research Center, Niskayuna, New York.

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Power Electronics

PE594EE Power Semi-Conductor Devices & Circuits

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Switching characteristics: Power MOSFETs and IGBTs, limitations and Safe Operating Areas (SOAs), —Latching in IGBTs. Thyristors-Converter & Inverter grade, GTO, RCT, MCT.

UNIT II

Switch Mode D.C-D.C Converters: Step-down converter (Buck)—Step-up converter (Boost) — Buck-Boost converter Control of D.C-D.C converters — Cuk converter.

UNIT III

Switch Mode D.C-A.C Inverters: Pulse width modulated switching schemes — sinusoidal PWM and Square wave PWM of Single phase Inverters and Three phase Voltage source Inverters — Effect of Blanking time on output voltage in PWM Inverters.

UNIT IV

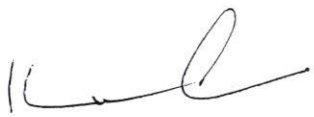
Resonant Converters: Classification — Basic resonant circuit concepts, Load resonant! Resonant switch converters — Resonant D.C Link Inverters with Zero-voltage switching — High frequency Link Integral half-Cycle converters.

UNIT V

Power supply Applications: overview of switching power supplies – DC-AC converters with electrical isolation, electrical isolation in the feed back loop, fly-back converters forward converters, push pull converters – full bridge converters, power supply protection, applications

Suggested Reading:

1. Mohan, Undeland, Robbins, *Power Electronics,* John Wiley, 1996.
2. Rashid M.H., *Power Electronics,* Prentice Hall of India, 1994.
3. Singh M.D and Khanchandani K.B, *Power Electronics,* Tata McGraw Hill, 1998.
4. Sen P.C, *Power Electronics,* Tata McGraw Hill Pvt. Ltd., New Delhi.



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PE515EE Machine Modeling and Analysis

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Basic Principles for Electric Machine Analysis: Magnetically coupled circuits, Electromechanical energy conversion, Basic Two pole DC Machine – primitive 2 axis machine – Voltage and Current relationship – Torque equation.

UNIT II

Theory of DC Machines: Mathematical model of separately excited DC Motor, DC Series Motor, DC shunt motor and D.C. Compound Motor in state variable form – Transfer function of the motor.

UNIT III

Reference Frame Theory: Equations of transformation - Change of variables, Stationary circuit variables Transformed to the Arbitrary Reference Frame, Commonly used reference frames, Transformation between reference frames, Transformation of a balanced set, Balanced steady state phasor Relationships, Balanced steady state equations, Variables observed from various frames.

UNIT IV

Theory of Symmetrical Induction Machines: Voltage and torque equations in machine variables, Equations of transformation for Rotor circuits, Voltage and torque equations in arbitrary reference frame variables, Analysis of steady state operation- state-space model of induction machine in'd-q' variables, Free Acceleration Characteristics, Dynamic Performance-during sudden changes in load- during a 3 phase fault at the machine terminals.

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UNIT V

Theory of Synchronous Machines: Voltage and Torque equations in machine variables, Stator Voltage equations in Arbitrary Reference Frame Variables, Voltage Equations in Rotor Reference Frame Variables: park's Equations, Torque Equations in Substitute Variables, Analysis of steady state operation, Dynamic performance - During sudden changes in Input Torque - During a 3 phase fault at the machine terminals.

Suggested Reading:

1. Paul C. Krause, Oleg Wasynczuk, Scott D.Sudhoff, "*Analysis of Electric Machinery and drive systems*" John Wiley and Sons, 2nd Edition, 2006
2. C.V. Jones, *"Unified Theory of Electrical Machines"* Butterworths Publishers.
3. P.S. Bhimbra, "*Generalized Theory of Electrical Machines"*, Khanna publishers, 2002.
4. J. Meisel, "*Principles of Electromechanical Energy Conversion" McGraw Hill, 1966.*

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PE525EE Power Quality Engineering

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Introduction: Power Quality (PQ),PQ problems , Sags, Swells, Transients, Harmonics, Interruptions, Flicker ,Voltage fluctuations, Notch. PQ Issues, Assessing PQ: Remedies - Customer side of meter, Utility side of the meter. Power quality monitoring – Monitoring considerations, Historical Perspective of PQ Measuring Instruments, PQ measurement equipment, Assessment of PQ measurement data, Application of intelligent systems, PQ monitoring standards.

UNIT II

Voltage Sag Analysis: Voltage sag characteristics - Methodology for computation of voltage sag magnitude and occurrence — Accuracy of sag analysis — Duration & frequency of sags — Faults behind transformers — Effect of pre-fault voltage — Simple examples — Voltage dip problems, fast assessment methods for voltage sags in distribution systems.

UNIT III

PQ Consideration in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications — Sources of power system harmonics — Mitigation of harmonics — Characterization of voltage sags experienced by three-phase ASD systems — Types of sags and phase angle jumps — Effects of momentary voltage dips on the operation of induction and synchronous motors .

UNIT IV

Harmonics: Harmonic distortion, Voltage versus current distortion, Harmonics versus Transients, Harmonic Indices, Harmonic sources from commercial loads, Harmonic sources from industrial loads, Locating Harmonic sources, System response characteristics, Effects of Harmonic distortion, Inter harmonics, Devices for controlling harmonic distortion.

UNIT V

Transient Overvoltages – Sources of Transient Overvoltages. Wiring and Grounding: Resources, Definitions, Reasons for Grounding, Typical wiring and grounding problems, Solutions to wiring and grounding problems.

Suggested Reading:

1. Math H.J. Bollen, Understanding Power Quality Problems, IEEE Press, 1999.
2. Roger C.Dugan, Mark F.McGranaghan, Surya Santoso, H.Wayne Beaty, Electrical Power Systems Quality, Second Edition, Tata McGraw-Hill Edition.
3. C.Sankaran, Power Quality, CRC Press, 2002.

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PE535EE ADVANCED TOPICS IN POWER ELECTRONICS

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks

UNIT I

Introduction to switches - Advanced Silicon devices - Silicon HV thyristors, MCT, BRT & EST. SiC devices - diodes, thyristors, JFETs & IGBTs. Gallium nitrate devices - Diodes, MoSFETs.

UNIT II

Advance converter topologies for PEE - Interleaved converters, Z-Source converters, Multi level converters (Cascaded H-Bridge, Diode clamped, NPC, Flying capacitor) Multi pulse PWM current source converters, Advanced drive control schemes.

UNIT III

Advances in reactive elements - Advanced magnetic material, technology and design (Powder ferrite, Amorphous, Planar designs) Advance capacitive designs (Multilayer chip capacitors, double layers for storage, Aluminum electrolytic)

UNIT IV

Advance storage systems - Developments in battery systems, Ultra capacitors, Fly wheel energy storage, Hybrid storage systems for EV/HEV, Power management in hybrid systems, Energy storage in renewables.

UNIT V

Thermal engineering with EMI/EMC techniques - Advanced thermal solutions (fan cooled, liquid cooled, heat pipes, hybrid techniques) EMC techniques (Conducted, Radiated emissions & Susceptibility), System design for EMC

Suggested Reading:

1. Andrzej M Trzynadlowski, 'Introduction to Modern Power Electronics, John Wiley and sons. Inc, New York, 1998
2. R D MiddleBrook & Slobodan CUK, 'Advances in Switched Mode Power Conversion', Vol I, II, & III, Tesla Co (
optimum power conversion)
3. B. Jayant Balinga, 'Advanced High Voltage Power Device Concepts', Springer New York 2011. ISBN 978-1-
4614-0268-8
4. BIN Wu, ' High Power Converters and AC Drives', IEEE press Wiley Interscience, a John wiley & sons Inc
publication 2006
5. Wurth Electronics, 'Trilogy of Magnetics, Design guide for EMI filter design in SMPS & RF circuits', 4th extended and revised edition.

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PE545EE SWITCHED MODE POWER CONVERSION

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Design constraints of reactive elements in Power Electronic Systems: Design of inductor, Transformer and capacitors for power electronic applications, Input filter design.

UNIT II

Basic concepts and steady state analysis of second and higher order Switched Mode power converters: PWM DC - DC Converters (CCM and DCM) - Operating principles, constituent elements, characteristics, comparisons and selection criteria.

UNIT III

Dynamic modeling and control of second and higher order switched mode power converters: Analysis of converter transfer functions, design of feedback compensators, current programmed, frequency programmed and critical conduction mode control.

UNIT IV

Soft-switching DC - DC converters: Zero-voltage-switching converters, zero-current - Switching converters, multi-resonant converters and load resonant converters.

UNIT V

Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of the current waveform, single phase and three phase converter systems incorporating ideal rectifiers and design examples - Non-linear phenomena in switched mode power converters: Bifurcation and Chaos.

Suggested Reading:

1. Robert W. Erickson and Dragan Maksimovic, 'Fundamentals of Power Electronics', Springer, 2nd Edition, 2001.

2. Marian K. Kazimierczuk, 'Pulse-width Modulated DC-DC Power Converters',John Wiley & Sons Ltd., 1st Edition, 2008.

3. Philip T Krein, 'Elements of Power Electronics', Oxford University Press, 2nd Edition, 2012.

4. Batarseh, 'Power Electronic Circuits', John Wiley, 2nd Edition, 2004.

5. H. W. Whittington, B. W. Flynn, D. E. Macpherson, 'Switched Mode Power Supplies', John Wiley & Sons Inc., 2nd Edition, 1997.

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PE555EE PWM CONVERTERS AND APPLICATIONS

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

AC/DC and DC/AC power conversion - Overview of applications of voltage source converters - Pulse modulation techniques for bridge converters.

UNIT II

Bus clamping PWM - Space vector based PWM - Advanced PWM techniques - Practical devices in converter - Calculation of switching and conduction losses.

UNIT III

Compensation for dead time and DC voltage regulation - Dynamic model of a PWM converter - Multilevel converters - Constant V/F induction motor drives.

UNIT IV

Estimation of current ripple and torque ripple in inverter fed drives - Line–side converters with power factor compensation.

UNIT V

Active power filtering - Reactive power compensation - Harmonic current compensation.

Suggested Reading:

1. Mohan, Undeland and Robbins, 'Power Electronics; Converters, Applications and Design', John Wiley and Sons, 1989.

2. Erickson R W, 'Fundamentals of Power Electronics', Chapman and Hall, 1997.

3. Vithyathil J, 'Power Electronics: Principles and Applications', McGraw Hill, 1995

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PE565EE DIGITAL CONTROLLERS IN POWER ELECTRONICS APPLICATIONS

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Introduction to the C2xx DSP core and code generation - The components of the C2xx DSP core - Mapping external devices to the C2xx core - Peripherals and Peripheral Interface - System configuration registers - Memory - Types of Physical Memory - Memory addressing Modes - Assembly Programming using C2xx DSP - Instruction Set - Software Tools.

UNIT II

Pin Multiplexing (MUX) and General Purpose I/O Overview - Multiplexing and General Purpose I/O Control Registers - Introduction to Interrupts - Interrupt Hierarchy - Interrupt Control Registers - Initializing and Servicing Interrupts in Software.

UNIT III

ADC Overview - Operation of the ADC in the DSP - Overview of the Event manager (EV) - Event Manager Interrupts - General Purpose (GP) Timers - Compare Units - Capture Units And Quadrature Enclosed Pulse (QEP) Circuitry - General Event Manager Information.

UNIT IV

Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA - Xilinx XC4000 series - Configurable logic Blocks (CLB) - Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming –overview of Spartan 3E and Virtex II pro FPGA boards- case study.

UNIT V

Controlled Rectifier - Switched Mode Power Converters - PWM Inverters - DC motor control - Induction Motor Control.

Suggested Reading:

1. Hamid.A.Toliyat and Steven G.Campbell, 'DSP Based Electro Mechanical Motion Control' ,CRC Press New York , 2004.
2. XC 4000 series datasheets (version 3.1). Xilinx, Inc., USA, 1998.
3. XC 4000 series datasheets (version 1.6). Xilinx, Inc., USA, 1999.
4. Wayne Wolf, 'FPGA based system design', Prentice hall, 2004.

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PE575EE STATIC CONTROL OF ELECTRIC DRIVES

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

DC Motor Control: Operation of Single phase and Three phase Full converter and Semi converter fed dc motors, Speed torque characteristics, Performance characteristics, Dual converter drives, Analysis of four quadrant chopper fed dc drive, Dynamic & Regenerative braking, Closed loop control of phase control and chopper dc drive.

UNIT II

Scalar Control: Stator voltage control, Static rotor resistance control, Slip power recovery schemes, Closed loop control, VSI & CSI fed Induction motor drives, Analysis of stepped and PWM waveform, Harmonic equivalent circuit and motor performance.

UNIT III

Vector Control: DC drive analogy, Equivalent circuit and Principle of Vector control, Direct vector control – Flux & Torque processor using Terminal voltages and Induced emf, Indirect vector control – Flow chart and Implementation.

UNIT IV

Principle of Sensor less vector control: Principle of Space vector Pulse width modulation & control, Direct torque and Flux control - Torque expression with Stator and Rotor fluxes - Control strategy of DTC.

UNIT V

Brushless D.C Motor: Unipolar and Bipolar Brushless D.C motors, Applications, Stepper Motors — Variable reluctance and Permanent magnet stepper motors — Characteristcs& Drive circuits, Switched reluctance motor.

Suggested Reading:

1. R.Krishnan, *Electric Motor Drives*, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
2. G.K.Dubey, *Fundamentals of Electrical Drives*, Narosa Publishing House, New Delhi, 1999.
3. W.Shepard, L.N.Hulley and D.T.W.Liang, *Power Electronics and Motor Control*, Cambridge University Press, 1995.
4. B.K.Bose, *Modern Power Electronics and A.C. Drives,* Prentice Hall, 2002.

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PE585EE MICRO CONTROLLER APPLICATIONS IN POWE CONVERTERS

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks

UNIT–I

8051 microcontroller – Architecture – Addressing modes – I/O ports - Instruction sets – Simple assembly language programming.

UNIT–II

Use of microcontrollers for pulse generation in power converters - Overview of Zero-Crossing Detectors – typical firing/gate-drive circuits – Firing/gate pulses for typical single phase and three phase power converters - PIC16F876 Micro-controller – Device overview – Pin diagrams.

UNIT–III

PIC16F876 micro-controller memory organization – Special Function Registers - I/O ports – Timers – Capture/ Compare/ PWM modules (CCP).

UNIT–IV

Analog to Digital Converter module – Instruction set – Instruction description – Introduction to PIC microcontroller programming – Oscillator selection – Reset – Interrupts – Watch dog timer.

UNIT–V

Introduction to MPLAB IDE and PICSTART plus – Device Programming using MPLAB and PICSTART plus – Generation of firing / gating pulses for typical power converters.

Suggested Reading:

1. PIC16F87X Datasheet 28/40–pin 8 bit CMOS flash Microcontrollers, Microchip technology Inc., 2001. and MPLAB IDE Quick start guide, Microchip technology Inc., 2007.
2. John B. Peatman, 'Design with PIC Microcontrollers', Prentice Hall, 2003.
3. MykePredko, 'Programming and customizing the PIC Microcontroller', Tata McGraw-Hill, 3rd Edition, 2008.
4. M.A. Mazidi, J.G. Mazidi and R.D. McKinlay, 'The 8051 microcontroller and embedded systems', Prentice Hall India, 2nd Edition, New Delhi, 2007.

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PE595EE POWER ELECTRONIC CONTROL OF DC DRIVES

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT–I: SINGLE-PHASE CONTROLLED RECTIFIERS FED DC MOTOR

Separately excited DC motors with rectified single –phase supply – single-phase semi converter and single phase full converter for continuous and discontinuous modes of operation – power and power factor.

UNIT–II: THREE-PHASE CONTROLLED RECTIFIERS FED DC MOTOR

Three-phase semi converter and Three phase full converter for continuous and discontinuous modes of operations – power and power factor - Addition of Free wheeling diode – Three phase double converter.

Three phase controlled bridge rectifier with passive load impedance, resistive load and ideal supply – Highly inductive load and ideal supply for load side and supply side quantities, shunt capacitor compensation, three phase controlled bridge rectifier inverter.

UNIT–III: PHASE, CURRENT & SPEED CONTROLLED DC DRIVE

Three-phase controlled converter, control circuit, control modeling of three phase converter – Steady state analysis of three phase converter control DC motor drive – Two quadrant, Three phase converter controlled DC motor drive – DC motor and load, converter.
Current and speed controllers - Current and speed feedback – Design of controllers – Current and speed controllers – Motor equations – filter in the sped feed back loop speed controller – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems – sixth harmonics torque.

UNIT–IV: CHOPPER CONTROLLED DC MOTOR DRIVES

Principle of operation of the chopper – Four – quadrant chopper circuit – Chopper for inversion – Chopper with other power devices – model of the chopper – input to the chopper – steady state analysis of chopper controlled DC motor drives – rating of the devices – Pulsating torque.

Closed loop operation: Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current controller.

UNIT–V: SIMULATION OF DC MOTOR DRIVES

Dynamic simulations of the speed controlled DC motor drives – Speed feedback speed controller – command current generator – current controller.

Suggested Reading:

1. Power Electronics and motor control – Shepherd, Hulley, Liang – II Edition Cambridge University Press.
2. Electronic motor drives modeling Analysis and control – R. Krishnan – I Edition Prentice Hall India.
3. Power Electronics circuits, Devices and Applications – MH Rashid – PHI – 1 Edition 1995.
4. Fundamentals of Electric Drives – GK Dubey Narosa Publishers 1995
5. Power Semiconductor drives – SB Dewan and A Straughen -1975.

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BOS Chairman

PE516EE POWER ELECTRONIC CONTROL OF AC DRIVES

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT-I: INTRODUCTION

Introduction to motor drives – Torque production – Equivalent circuit analysis – Speed – Torque Characteristics with variable voltage operation Variable frequency operation constant v/t operation – Variable stator current operation – Induction motor characteristics in constant torque and field weakening regions.

UNIT-II: STATOR SIDE CONTROL OF INDUCTION DRIVES

Scalar control – Voltage fed inverter control – Open loop volts/Hz control – speed control slip regulation – speed control with torque and flux control – current controlled voltage fed inverter drive – current – fed inverter control – Independent current and frequency control – Speed and flux control in Current –Fed inverter drive – Volts/Hz control of Current –fed inverter drive – Efficiency optimization control by flux program.

UNIT–III: ROTOR SIDE CONTROL OF INDUCTION DRIVES

Slip power recovery drives – Static Kramer Drive – Phasor diagram – Torque expression – speed control of Kramer Drive – Static Scheribus Drive – modes of operation.

Vector control of Induction Motor Drives: Principles of Vector control – Vector control methods – Direct methods of vector control – Indirect methods of vector control – Adaptive control principles – Self tuning regulator Model referencing control.

UNIT–IV: CONTROL OF SYNCHRONOUS MOTOR DRIVES

Synchronous motor and its characteristics – Control strategies – Constant torque angle control – Unity power factor control – Constant mutual flux linkage control.

Controllers: Flux weakening operation – Maximum speed – Direct flux weakening algorithm – Constant Torque mode controller – Flux Weakening controller – indirect flux weakening – Maximum permissible torque – speed control scheme – Implementation strategy speed controller design.

UNIT–V: VARIABLE RELUCTANCE MOTOR DRIVE

Variable Reluctance motor drive – Torque production in the variable reluctance motor Drive characteristics and control principles – Current control variable reluctance motor service drive.

BRUSHLESS DC MOTOR DRIVES: Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor- current controlled Brushless dc motor Servo drive.

Suggested Reading:

1. Electric Motor Drives Pearson Modeling, Analysis and control – R. Krishnan – Publications – 1st edition – 2002.
2. Modern Power Electronics and AC Drives B K Bose – Pearson Publications 1st edition
3. Power Electronics and Control of AC Motors – MD Murthy and FG Turn Bull pergman Press (For Chapters II, III, V) 1st edition
4. Power Electronics and AC Drives – BK Bose – Prentice Hall Eagle wood diffs New Jersey (for chapters I, II, IV) - 1st edition
5. Power Electronic circuits Deices and Applications – M H Rashid – PHI – 1995.
6. Fundamentals of Electrical Drives – G. K. Dubey – Narora publications – 1995 (for chapter II)
7. Power Electronics and Variable frequency drives – BK Bose – IEEE Press – Standard publications - 1st edition – 2002.
8. Power Electronics and Motor Drives Advances and Trends, Bimal Bose, Elesevier.

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Common to Power Systems and Power Electronics

PE526EE Advanced Microprocessor Systems

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

8086 Microprocessor Architecture - Segmented Memory - Addressing Modes - Instruction Set - 8086 Assembly Language Programming - 8087 Numerical Data Processor Architectural details - Data types - Floating point Operations - 8087 Instructions.

UNIT II

Architectural details of 80386 Microprocessor - Special registers - Memory management - Operation in protected mode and virtual 80386 mode - Memory paging mechanism - Special instructions of 80386 - Architectural details of 80486 - Special registers - Additional instructions - Comparison of 80386 and 80486 processors.

UNIT III

Introduction to Pentium Processor - Architectural features - Comparison with the workstations - Branch prediction logic - cache structure. - Special Pentium Registers. Memory management - virtual mode of operation - Comparison with the previous processors. Features of Pentium-II, Pentium-III and Pentium Pro-processors.

UNIT IV

RISC Microprocessors – RISC Vs CISC – RISC Properties – DEC Alpha AXP Architecture - Power PC – Architecture - Programming Model – Data Types – Addressing Modes – Instruction Set. Sun SPARC – Architecture – Data Types – Instruction Sets - Features of MIPS, AMD Microprocessors

UNIT V

Motorola Microprocessors – 68000 Microprocessor – Architecture – Registers – Addressing Modes – Features of 68020 – 68040 – 68040 Microprocessors.

Suggested Reading

1. Barry B Brey "Intel Microprocessors : 8086/88, 80186/188, 80286, 80386, 80486, Pentium, Pentium – II, Pentium – III and Pentium – IV, Architecture, Programming & Interfacing", Pearson Education, 2003.
2. Badri Ram, "Advanced Microprocessors and Interfacing", Tata McGraw Hill.
3. A.K. Ray & K.M. Bhurchandi, "Advanced Microprocessors & Peripherals, Architecture, Programming & Interfacing", Tata McGraw Hill.

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PE536EE Digital Control Systems

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Review of Z – Transforms: Introduction - Linear difference equations - Pulse response - Z - transforms, Theorems of Z – Transforms - Inverse Z – transforms - Modified Z- Transforms. Z-Transform method for solving difference equations - Pulse transforms function - Block diagram analysis of sampled data systems - mapping between s-plane and z-plan - Primary strips and Complementary Strips.

UNIT II

State Space Analysis : State Space Representation of discrete time systems - Pulse Transfer Function - Matrix solving discrete time state space equations - State transition matrix and it's Properties - Methods for Computation of State Transition Matrix - Discretization of continuous time state - space equations.

UNIT III

Controllability and Observability : Concepts of Controllability and Observability - Tests for controllability and Observability -Duality between Controllability and Observability - Controllability and Observability conditions for Pulse Transfer Function.
Stability Analysis (Discrete): Stability Analysis of closed loop systems in the Z-Plane. Jury stability test - Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion. Stability analysis using Liapunov theorems.

UNIT IV

Design of Discrete Time Control System by Conventional Methods: Design of digital control based on the frequency response method - Bilinear Transformation and Design procedure in the w-plane - Lead, Lag and Lead-Lag compensators and digital PID controllers – Design of digital control through deadbeat response method.

UNIT V

State Feedback Controllers and Observers(Discrete): Design of state feedback controller through pole placement - Necessary and sufficient conditions - Ackerman's formula - State Observers - Full order and Reduced order observers - Min/Max principle, Linear Quadratic Regulators - Kalman filters - State estimation through Kalman filters - Introduction to adaptive controls.
Suggested Reading:

1. Discrete-Time Control systems - K. Ogata, Pearson Education/PHI, 2nd Edition
2. Digital Control and State Variable Methods by M.Gopal, TMH
3. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
4. Digital Control Engineering, M.Gopal

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PE546EE Programmable Logic Controllers And Their Applications

Instruction	:	3 Periods/Week
Duration of Univ. Examination:	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT-I:
PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

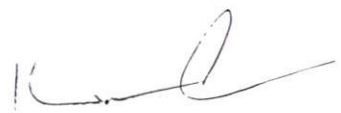
UNIT-II:
PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT-III:
PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT-IV:
Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT-V:
Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions.

Suggested Reading:
1. Programmable Logic Controllers – Principle and Applications by John W Webb and Ronald A Reiss Fifth edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR Hackworth and F.D Hackworth – Jr- Pearson, 2004.



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PE556EE Modern Control Theory

Instruction	:	3 Periods / Week
Duration of Univ. Examination	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT I

Review of state variable representation of systems - Controllability and Observability — Model control of single input — single output systems (SISO), Controllable and Observable companion forms — Effect of state feedback on Controllability and Observability, Pole placement by State feed back.

UNIT II

Classification of Non-linearities - Phenomenon exhibited by the nonlinearities - Limit cycles - Jump resonance Sub-harmonic oscillations - Phase plane analysis - Singular points - Construction of phase plane trajectories - Isocline method - Delta method - Measurement of time on phase plane trajectories.

UNIT III

Concept and definition of stability - Lyapunov stability - Lyapunov's first and second methods - Stability of linear time invariant systems by Lyapunov's second method - Generation of Lyapunov functions- Variable gradient method - Krasooviski's method.

UNIT IV

Formulation of optimal control problems - Calculus of variations — Fundamental concepts — Functionals — Variation of functionals — Fundamental theorem of calculus of variations - Boundary conditions - Constrained minimization — Dynamic programming – Hamilton Principle of optimality, Jacobi Bellman equation – potryagins minimum principle.

UNIT V

Introduction to adaptive control, types of adaptive control systems. Design of model reference adaptive control systems using M/T rule and Lyapunov stability theory.

Suggested Reading:

1. IJ Nagarath , M.Gopal *Control Systems Engineering fifth edition* - , New Age International Rablishess, 1984 Wiley Eastern Ltd.
2. Ogata K, *Modern Control Engineering,* Prentice Hall, 1997.
3. Donald E Kirk, optimal control thery An introduction
4. Karl J Astrom Bjron wihenmark, Adaptive control second edition – Peasson education

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PE566EE Microcontrollers

Instruction	:	3 Periods/Week
Duration of Univ. Examination:	:	3 Hours
Univ. Examination	:	60 Marks
Sessional	:	40 Marks
Credits	:	3

UNIT - I

Introduction and 8051 Architecture: Introduction to microcontrollers, comparing microprocessors and microcontrollers, 4,8,16 and 32 bit microcontrollers, Development systems for Microcontrollers, Architecture, Architecture of 8051, pin configuration of 8051 microcontroller, hardware input pins, output pins ports and external memory, counters and timers, serial data input and output and interrupts.

UNIT - II

Moving Data and Logical Operations: Introduction, Addressing modes, External Data moves, Code Memory Read-only Data Moves, PUSH and POP Op-codes, Data Exchanges, Logical Operations; Introduction, Byte-Level Logical Operations, Bit-Level Logical Operations, Rotate and Swap Operations.

Unit - III

Arithmetic Operations, Jump and Call Op-codes: Introduction, Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Jump and Call op-codes, introduction, The jump and call program range, Jumps, Calls and Subroutines, call and returns, Interrupts and Returns.

Unit - IV

8051 Microcontroller Design: Introduction, A microcontroller specification, A microcontroller Design, Testing the Design, Timing subroutines, Lookup Tables for the 8051, Serial Data Transmission.

Unit - V

Applications and Serial Data Communication: Introduction, Keyboards, Displays, pulse Measurement, D/A and A/D Conversions, Multiple Interrupts, Serial data Communication, Introduction, Network Configurations, 8051 Data Communication Modes.

Suggested Reading:

1. Kennth J. Ayala, The 8051 Microcontroller Architecture Program and Applications, 2nd edition, Penram International Publications, 1996.
2. Mohammed Ari Mazidi and Janci Gillispie, The 8051 Microcontroller andEmbedded Systems, Pearson Education Asia, New Delhi, 2003.

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PC511EE COMPUTER SIMULATION LABORATORY
(List of Experiments)

Instruction	:	2 Periods / Week
Internal Marks - CIE	:	50 Marks
Credits	:	1

1. Load flow studies
2. Short circuit studies
3. Transient stability studies
4. Simulation of IGBT inverters
5. Distribution load flow studies
6. Simulation of Facts controllers
7. Simulation of thyristor converters
8. Simulation of Resonant converters
9. Load forecasting and unit commitment
10. Simulation of reactive power compensation
11. Simulation of Buck, Buck-Boost converters
12. Simulation of single -area and Two -area Systems
13. Economic Load Dispatch with thermal power plants
14. Simulation of V/F controller for 3-phase induction motor
15. Economic Load Dispatch with Hydro thermal power plants

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PC531EE Power Systems & Power Electronics Lab

Instruction	:	2 Periods / Week
Internal Marks - CIE	:	50 Marks
Credits	:	1

Part-A (Power Systems)

1. Measurement of positive, negative and zero sequence reactances of synchronous machine
2. Measurement of Direct axis and quadrature axis reactances of synchronous machine
3. Fault analysis of Single Line To Ground Fault
4. Fault analysis of Line To Line Fault
5. Fault analysis of Three-phase fault
6. Microcontroller based Over current relay
7. Percentage biased Differential Relay
8. Microcontroller based Over Voltage Relay
9. Microcontroller based Under Voltage Relay
10. Measurement of positive, negative and zero sequence reactances of three-phase transformer

Part-B (Power Electronics)

1. Three phase step down cyclo-converter
2. Three phase controlled rectifier with R and RL loads
3. Three phase half controlled rectifier with R and RL loads
4. Three phase IGBT inverter
5. Single phase dual converter
6. Speed control of dc motor using chopper

Note: At least five experiments should be conducted in each part

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PC521EE Power Electronics And Digital Signal Processing Lab

Instruction	:	2 Periods / Week
Internal Marks - CIE	:	50 Marks
Credits	:	1

Course Objective:	Course Outcomes:
To comprehend power electronic circuits and evaluate their performance characteristics	At the end of the course student should be able to • Simulate the given power electronic circuits(s) in MATLAB/SIMULINK • Measure the results and compare them with the theoretical calculations wherever applicable • Solve the nonlinear transcendental equations using MATLAB command window • Simulate the mathematical model of the given power electronic circuit and compare the results with the circuit model

LIST OF EXPERIMENTS

1. Study and programming of C2000 to interface QEP module
2. Study and Programming of PWM Module
3. Study and Programming of ADC Module
4. Study and programming of CAN Module
5. Study of PFC stage and control of BLDC motor
6. Study & programming for buck/boost conversion
7. Study of PV inverter system using solar explorer kit
8. Study of lighting control using LED booster pack
9. Performance of half controlled thyristor rectifier with inductive load
10. Performance of full controlled thyristor rectifier with inductive load
11. To study the typical circuit waveforms of a simple 1 - ϕ diode bridge rectifier and to evaluate the performance of LC filter under continuous inductor current (CCM) operation, and compare the same with simulation results
12. To study the typical circuit waveforms of a simple single phase diode bridge rectifier and to evaluate the performance of the LC filter under discontinuous inductor current (DCM) operation, and compare the same with simulation results

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PC541EE Programmable Logic Controllers and their applications Lab

Instruction	:	2 Periods / Week
Internal Marks - CIE	:	50 Marks
Credits	:	1

1. Basic control function
2. Implementation of logic gates and Boolean functions
3. PLC timer functions
4. PLC counters functions
5. PLC Arithmetic functions
6. Number Comparison functions
7. Study of sequencer
8. Industrial Applications of PLC
9. Motor control using PLC
10. Sequential lighting of bulbs
11. Automatic Traffic control
12. SCADA applications

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