PG Program [M. Tech. Electrical]

Power Electronics And Power Systems

Curriculum Structure

w.e.f AY 2019-20 and Applicable for batches admitted from AY 2019-20 to 2022-23

Faculty Advisor (PG PEPS)

BoS Coordinator EED

HEED

PG Program [M. Tech.]
POWER ELECTRONICS AND POWER SYSTEMS
Curriculum Structure
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List of Abbreviations

Abbreviation	Title	No of courses	Credits	% of Credits
PSMC	Program Specific Mathematics Course	1	3	4.4
PSBC	Program Specific Bridge Course	1	3	4.4
DEC	Department Elective Course	3	9	13.2
MLC	Mandatory Learning Course	2	0	0
PCC	Program Core Course	6	18	26.5
LC	Laboratory Course	4	7	10.3
IOC	Interdisciplinary Open Course	1	3	4.4
LLC	Liberal Learning Course	1	1	1.5
SLC	Self Learning Course	2	6	8.8
SBC	Skill Based Course	2	18	26.5

Semester I

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme L	T	P	Credits
1.	PSMC	PEPS-19001	Mathematical Modeling of Electric Machines	3	--	--	3
2.	PSBC	PEPS-19002	Embedded Systems	3	--	--	3
3.	DEC-I	PEPS(DE)-19001 PEPS(DE)-19002 PEPS(DE)-19003 PEPS(DE)-19013	a. Wind and Solar Power b. Engineering Optimization c. EHV AC Transmission d. Automotive Embedded Product Development e. Any other course offered by faculty	3	--	--	3
4.	MLC	ML-19011	Research Methodology and Intellectual Property Rights	2	--	--	--
5.	MLC	ML-19012	Effective Technical Communication	1	--	--	--
6.	PCC	PEPS-19003	Advanced Control Theory	3	--	--	3
7.	PCC	PEPS-19004	Advanced Power Electronics	3	--	--	3
8.	PCC	PEPS-19005	Power System Analysis	3	--	--	3
9.	LC	PEPS-19006	Simulation Laboratory	--	--	4	2
10.	LC	PEPS-19007	Embedded Systems Lab	--	--	4	2
			Total Credits	21	--	8	22

Interdisciplinary Open Course (IOC): Every department shall offer one IOC course (in Engineering/Science/Technology). A student can opt for an IOC course offered by a department except the one offered by his /her department.

Semester II

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme L	T	P	Credits
1.	IOC	EE-19003	Engineering Optimization	3	--	--	3
2.	DEC-II	PEPS(DE)19004 PEPS(DE)19005 PEPS(DE)19006 PEPS(DE)19007 PEPS(DE)19011	a. Power System Transients b. Machine Learning c. Electrical Power Distribution Systems d. Restructured Power Systems e. Automotive Electronics Hardware Development f. Any other course offered by faculty	3	--	--	3
3.	DEC-III	PEPS(DE)19008 PEPS(DE)19009 PEPS(DE)19010 PEPS(DE)19012	a. Energy Storage Systems b. Power Quality Issues and Mitigation c. Smart Grid Technologies d. Automotive Electronics Software Development e. Any other course offered by faculty	3	--	--	3
4.	LLC	LL-19001	Liberal Learning Course	1	--	--	1
5.	PCC	PEPS-19008	Power Systems Dynamics and Stability	3	--	--	3
6.	PCC	PEPS-19009	HVDC and FACTS	3	--	--	3
7.	PCC	PEPS-19010	Digital Protection	3	--	--	3
8.	LC	PEPS-19011	DSP Application Lab	1	--	2	2
9.	LC	PEPS-19012	HIL Lab	--	--	2	1
			Total Credits	20	--	4	22

Semester-III

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1.	SBC	20001	Dissertation Phase – I	--	--	18	9
2.	SLC	20002	Project and Finance Management	3	--	--	3
			Total Credits	3	--	18	12

Semester-IV

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1.	SBC	20003	Dissertation Phase – II	--	--	18	9
2.	SLC	20004	Design of Internet of Things	3	--	--	3
			Total Credits	3	--	18	12

SEMESTER-I

[PEPS-19001] Mathematical Modeling of Electric Machines

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Analyze electromechanical devices and machines
2. Use reference frame theory to study and analyze the behavior of induction and synchronous machines
3. Calculate the machine inductances for use in machine analysis
4. Model the electrical machine from the terminal junction with transmission systems

Syllabus Contents:

Principle of unified machine theory, generalized torque equation, performance evaluation of DC machine and speed control, three phase induction motor- transformation methods, stationary, rotor and synchronous frames and corresponding equivalent circuits, three phase synchronous motor: representation, Park transformation, drives, various control techniques, concept of space vector, field oriented control and direct torque control of IM, permanent magnet synchronous motors- machine model (d-q) and control methods, reluctance machines models.

References:

1. P. C. Krause, "Analysis of Electric Machinery", McGraw Hill, New York, 1987.
2. Chee Mun Ong, "Dynamic simulation of Electrical Machinery using Matlab/Simulink" Prentice Hall PTR, 1997.
3. P. Vas, "Vector Control of A.C. Machines", Clarendon Press, Oxford 1990.
4. J .M. D. Murphy and F.G. Turnbull, "Power Electronic Control of AC motors", Pergamum Press, 1988.
5. W. Leonhard, "Control of Electrical Drives", Springer Verlag, 1985.

[PEPS-19002] Embedded Systems

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Discuss the embedded system concepts and architecture of embedded systems
2. Deploy low end applications using low and high level languages on microcontroller platform.
3. Test and debug peripherals in embedded system.
4. Identify, design and implement applications on embedded platform.

Syllabus Contents:

Introduction to Embedded System and Embedded System Design Flow. Signal Conditioning & Various Signal Chain Elements, Critical Specifications, How to smartly choose elements from wide choice available in market. Various elements include OPAMPs, Comparators, Instrumentation OP AMPs, ADCs, DACs, DC-DC Converters, Isolators, Level Shifters, ESD Protection Devices. Use Case Analysis. Systems on Chip, Memory Subsystem , Bus Structure, Interfacing Protocol, Peripheral interfacing, Testing & Debugging, Power Management, Software for Embedded Systems, Design of Analog Signal Chain from Sensor to Processor with noise, power, signal bandwidth, Accuracy Considerations. Software Programming Optimization, Concurrent Programming. Real Time Scheduling, I/O Management, Embedded Operating Systems. RTOS, Developing Embedded Systems, Building Dependable Embedded Systems.

References:

1. Steve Heath, "Embedded Systems Design", Publisher Butterworth-Heinemann.
2. Wyne Woff “Principles of Embedded computing system design”, Morgan Koffman publication 2000
3. Rajkamal, “Embedded Systems- Architecture, Programming and Design”, 2007- TMH.
4. Qing Li, “Real Time Concepts for Embedded Systems”, Elsevier, 2011.
5. Shibu K.V, “Introduction to Embedded Systems”, Mc Graw Hill.
6. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley.
7. Lyla “Embedded Systems”, Pearson, 2013.

[PEPS(DE)-19001] Wind and Solar Power

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1, T2 – 20 marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Demonstrate the importance of energy security and sustenance
2. Design standalone solar PV system and solar thermal system for various applications
3. Design standalone wind energy system
4. Design the grid connected solar PV and wind energy system

Syllabus Contents:

Historical development and current status, characteristics of wind power generation, network integration issues, generators and power electronics for wind turbines, power quality standards for wind turbines, technical regulations for interconnections of wind farm with power systems, isolated wind systems, reactive power and voltage control, economic aspects, impacts on power system dynamics, power system interconnection experience in the world, introduction of solar systems, merits and demerits, concentrators, various applications, solar thermal power generation, PV power generation, cost effectiveness.

References:

1. Thomas Ackermann, Editor, "Wind power in Power Systems", John Willy and sons ltd.2005.
2. Siegfried Heier, "Grid integration of wind energy conversion systems", John Willy and sons ltd., 2006.
3. K. Sukhatme and S.P. Sukhatme, "Solar Energy", Tata MacGraw Hill, Second Edition, 1996
4. Mukund Patel, "Wind and Solar Power Systems", CRC Press, 1999.
5. Gilbert M. Master, "Renewable and efficient electric power systems" John Wiley and Sons, 2004.

[PEPS(DE)-19002] Engineering Optimization

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1, T2 – 20 marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Explain and use the basic theoretical principles of optimization and various optimization techniques.
2. Develop and select appropriate models corresponding to problem descriptions in engineering and solve them correctly.
3. Solve and analyze complex optimization problems in power system/ control system/ machine drive
4. Implement various optimization software tools to solve power system/ control system/ machine drive problems and develop algorithms to solve electrical problems.

Syllabus Contents:

Introduction to optimization, Classical Optimization: Single variable optimization, Multivariable optimization with no constraints, Multivariable optimization with equality constraints, Multivariable optimization with inequality constraints. Linear Programming: Simplex Method, Duality, Transportation problems. Nonlinear Programming: One dimensional minimization methods, unconstrained and constrained optimization. Dynamic Programming: Development of dynamic programming, Principle of optimality.

Practical Aspects of Optimization: Reduced basic techniques, Sensitivity of optimum solution to problem parameters, advanced optimization techniques, applications of optimization techniques to power system/control systems/power electronics and machine drives.

References:

1. R. Fletcher, "Practical Optimization", Second edition, John Wiley and Sons, New York, 1987.
2. S. S. Rao, "Engineering Optimization-Theory and practice", fourth edition, Wiley Easter Publications, January 2009.
3. K. V. Mital and C. Mohan, "Optimization Methods in Operations Research and System Analysis", New age International Publishers, Third edition, 1996.
4. Bazaraa M. S., Sherali H.D. and Shetty C. "Nonlinear Programming Theory and Algorithms", John Wiley and Sons, New York 1993.
5. Bertsekas D. P., "Constrained Optimization and Lagrange Multiplier Methods", Academic Press, New York, 1982.Durga Das Basu, "Introduction to the Constitution of India" Prentice Hall EEE, 19th/20th Edn., 2001. (Students Edn.)

[PEPS(DE)-19003] EHV AC Transmission

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Know the necessity, merits and demerits of EHVAC transmission and mechanical aspects
2. Evaluate the Inductance and capacitance of two conductor and multi conductor lines
3. Analyze the effect of corona, electrostatic field of EHVAC lines
4. Analyze the surface gradient on two conductor and bundle with more than 3 sub conductors
5. Demonstrate EHV AC transmission system components, protection and insulation level for over voltages

Syllabus Contents:

Introduction: Engineering aspect and growth of EHV_ AC Transmission line trends and preliminaries, power transferability, transient stability and surge impedance loading. Calculation of line and ground parameters: Resistance, power loss, temperature rise properties of bundled conductors, inductance and capacitance of EHV lines, positive, negative and zero sequence impedance and line parameters for modes of propagations. Voltage gradients of conductor: Charge potential relations for multi-conductor lines, surface voltage gradients on the conductor line, distribution of voltage gradients on subconductors of bundle. Corona in E.H.V. lines – Corona loss formulae- attenuation of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona – properties of radio noise – frequency spectrum of RI fields – Measurements of RI and RIV. Theory of the Travelling and standing waves, Lighting and lighting protection, Over voltage in EHV system covered By switching operations, Power frequency voltage control and over voltage, Insulation Coordination, Design of EHV - AC lines

References:

1. R.D. Begamudre , “EHV AC transmission Engineering.” New Academic Science Ltd; 4 edition, 2011
2. S Rao, “EHV -AC & HVDC transmission system enginreering”, Khanna Publication,3rd edition

[PEPS(DE)-19013] Automotive Embedded Product Development

HELLA –COEP Automotive Electronics Program (Elective-1)

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs/week	T1 and T2: 20 Marks each
Complimentary lab sessions will be organized to ensure hands-on learning	End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Acquire automotive product development understanding
2. Learn Project Management concept
3. Apply processes, methods and tools to demonstrate learning

Syllabus Contents:

- **Automotive system overview & product development:** Major Automotive trends (e-mobility, Autonomous Driving, Comfort & Connected Cars), Vehicle EE architecture, product. Integration of Mechanical, Software, Hardware domains and their interdependences, Design for x Abilities (manufacturability, testability, serviceability, maintainability, Overview of Design guidelines.
- **Process, methods & tools:** Requirement Engineering and version control tools: DOORs, PTC, V model, Product Engineering Process, Automotive spice, TS 16949, Key Performance Indicators for development.
- **Product reliability, safety & quality:** DFMEA, PFMEA, Warranty, Design Validations, Process Validations, Customer Line Return, Non Quality Expenses, First Pass Yield, Statistical tools, ASIL levels, Safety Goals, Safety Measures, HARA, FMEDA,ISO 26262.
- **Project Management & Organization:** Matrix Organization, Line responsibilities, Functional responsibility, Team work, Leadership, Scope management, Scheduling, Cost, Monitoring & Tracking, Engineering Change Management, Milestones.

[ML-19011] Research Methodology & Intellectual Property Rights

Teaching Scheme:
Lectures: 2 Hrs/week

Examination Scheme:
Continuous evaluation
Assignments/Presentation/Quiz/Test

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Demonstrate research problem formulation and approaches of investigation of solutions for research problems
2. Learn ethical practices to be followed in research and apply research methodology in case studies and acquire skills required for presentation of research outcomes
3. Discover how IPR is regarded as a source of national wealth and mark of an economic leadership in context of global market scenario
4. Summarize that it is an incentive for further research work and investment in R & D, leading to creation of new and better products and generation of economic and social benefits

Syllabus Contents:

Unit 1: **[5Hrs]**
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations.

Unit 2: **[5Hrs]**
Effective literature studies approaches, analysis
Use Design of Experiments /Taguchi Method to plan a set of experiments or simulations or build prototype
Analyze your results and draw conclusions or Build Prototype, Test and Redesign

Unit 3: **[5Hrs]**
Plagiarism, Research ethics
Effective technical writing, how to write report, Paper.
Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4 : **[4Hrs]**
Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights, Objectives and Importance of understanding Intellectual Property Rights

Unit 5 : **[7Hrs]**

Understanding the types of Intellectual Property Rights: -Patents-Indian Patent Office and its Administration, Administration of Patent System – Patenting under Indian Patent Act , Patent Rights and its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non Provisional Patent Application and Specification, Plant Patenting, Idea Patenting,
Integrated Circuits, Industrial Designs, Trademarks (Registered and unregistered trademarks), Copyrights, Traditional Knowledge, Geographical Indications, Trade Secrets, Case Studies

Unit 6 : **[4Hrs]**

New Developments in IPR, Process of Patenting and Development: technological research, innovation, patenting, development,
International Scenario: WIPO, TRIPs, Patenting under PCT

References:

1. Aswani Kumar Bansal, "Law of Trademarks in India"
2. B L Wadehra, "Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications".
3. G.V.G Krishnamurthy, "The Law of Trademarks, Copyright, Patents and Design".
4. Satyawrat Ponkse, "The Management of Intellectual Property".
5. S K Roy Chaudhary & H K Saharay, "The Law of Trademarks, Copyright, Patents"
6. T. Ramappa, S. Chand, " Intellectual Property Rights under WTO".
7. Manual of Patent Office Practice and Procedure
8. WIPO : WIPO Guide To Using Patent Information
9. Halbert ,Taylor & Francis, "Resisting Intellectual Property".
10. Mayall , "Industrial Design", Mc Graw Hill
11. Niebel , "Product Design", Mc Graw Hill
12. Asimov, "Introduction to Design", Prentice Hall
13. Robert P. Merges, Peter S. Menell, Mark A. Lemley , "Intellectual Property in New Technological Age"

[ML-19012] Effective Technical Communication

Teaching Scheme:
Lectures: 1hr / week

Evaluation Scheme:
100M: 4 Assignments
(25M each)

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Produce effective dialogue for business related situations
2. Use listening, speaking, reading and writing skills for communication purposes and attempt tasks by using functional grammar and vocabulary effectively
3. Analyze critically different concepts / principles of communication skills
4. Demonstrate productive skills and have a knack for structured conversations
5. Appreciate, analyze, evaluate business reports and research papers

Syllabus Contents:

Unit 1: Fundamentals of Communication **[4 Hrs]**
7 Cs of communication, common errors in English, enriching vocabulary, styles and registers

Unit 2: Aural-Oral Communication **[4 Hrs]**
The art of listening, stress and intonation, group discussion, oral presentation skills

Unit 3: Reading and Writing **[4 Hrs]**
Types of reading, effective writing, business correspondence, interpretation of technical reports and research papers

References:

1. Raman Sharma, “Technical Communication”, Oxford University Press.
2. Raymond Murphy “Essential English Grammar” (Elementary & Intermediate) Cambridge University Press.
3. Mark Hancock “English Pronunciation in Use” Cambridge University Press.
4. Shirley Taylor, “Model Business Letters, Emails and Other Business Documents” (seventh edition), Prentise Hall
5. Thomas Huckin, Leslie Olsen “Technical writing and Professional Communications for Non-native speakers of English”, McGraw Hill.

[PEPS-19003] Advanced Control Theory

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course, the students will be able to,

1. Analyze linear control system using vector spaces.
2. Design linear control system using state space to achieve desired system performance
3. Design Linear quadratic regulator to achieve desired system performance
4. Analyze non- linear systems
5. Obtain discrete representation of LTI systems

Syllabus Contents:

Review of Linear Algebra : Vector space, linear combination, linear independence, bases of a vector space, representation of any vector on different basis, matrix representation of a linear operator, change of basis, rank, nullity, range space and null space of a matrix, Eigen value and Eigen vector of a matrix, similarity transform, Diagonalization.
Linear System analysis in state space: Controllability, Observability and Stability, Luapunov stability analysis of SISO and MIMO linear systems, Minimal realizations and co-prime fractions.
Control Design: State feedback controller by pole placement and design of observer for linear systems, Design of PI/PID controller
Optimal Control: Formulation of optimal control problem, linear quadratic regulator (LQR)
Non-linear Systems: Introduction to nonlinear systems, phase plane and describing function methods for analysis of linear systems and linearization,
Digital Control System: Discrete time systems, discretization, sampling, aliasing, choice of sampling frequency, ZOH equivalent

References:

1. Chi-Tsong Chen,"Linear System Theory and Design", Oxford University Press.
2. John S. Bay,"Linear System Theory".
3. Thomas Kailath," Linear System", Prentice Hall, 1990
4. Gillette,"Computer Oriented Operation Research", Mc-Graw Hill Publications.
5. K. Hoffman and R. Kunze,"Linear Algebra", Prentice-Hall (India), 1986.
6. G.H. Golub and C.F. Van Loan,"Matrix Computations", North Oxford Academic, 1983.
7. H. K. Khalil,"Nonlinear Systems", Prentice Hall, 2001.
8. K. Ogata,"Discrete Time Control Systems", Prentice hall, 1995.

[PEPS-19004] Advanced Power Electronics

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Compare the characteristics of switching devices and use them in practical systems.
2. Design and model different types of power converters.
3. Design controller and implement them in simulation.
4. Design power circuit and protection circuit of devices and converter.

Syllabus Contents:

Review of solid-State Devices such as MOSFET, IGBT, GTO, SIT, SITH, MCT; Heat sink design. DC-DC Converters: Power factor improvement techniques, Switch mode power converter, Buck, boost, buck-boost, Cuk, Fly-back, Forward Converters, operation, modeling, and design of DC-DC converters, Different control strategies of DC-DC converters. Voltage mode and current mode control methods. Inverters: Review of three-phase voltage source inverters, voltage and frequency control; Harmonic reduction techniques, PWM inverters, Space Vector Modulation; Multi-level inverters, Current source inverter, commutation circuits, transient voltage suppressing techniques, operation and control, AC-AC Converters: Three-phase ac regulators, cyclo-converters; Matrix converters, output voltage control techniques, commutation methods.

References:

1. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics: Converter, Applications and Design”, John Wiley and Sons, 1989.
2. M.H. Rashid, “Power Electronics”, Prentice Hall of India, 1994.
3. B. K .Bose, “Power Electronics and A.C. Drives”, Prentice Hall, 1986.
4. Christophe P. Basso, “Switch mode Power Supplies-Spice Simulations and Practical Designs”, Mc Graw Hill.
5. Erickson Robert W. Dragan Maksimović, “Fundamentals of Power Electronics”, Springer Publication.

[PEPS-19005] Power System Analysis

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Analyze power systems using basic concepts and principles.
2. Formulate and solve power flow problems, economic and environmental dispatch problems.
3. Compute the voltage stability indices, rank the contingencies and investigate the state of a power system of any size.
4. Analyze a practical system both under steady state and fault conditions and recommend sound solutions to practical power system problems
5. Develop algorithms as well as to use software tools to solve power system analysis and stability problems.

Syllabus Contents:

Algorithms for formation of bus admittance and impedance matrices, power flow solutions: Gauss Seidal, Newton-Raphson, Fast decoupled load flow, optimal power flow, sparsity exploitation in power system studies, Z - matrix for short circuit studies, concept security state and security analysis, contingency studies, unit commitment, state estimation, Weighted least squares state estimation, optimal hydro-thermal scheduling, voltage stability: Definition and classification, mechanism of voltage collapse, analytical concept of voltage stability for a two bus system, Artificial Intelligence applications to power system analysis., modeling of FACTs devices and renewable generation for power flow analysis.

References:

1. G. W. Stagg and A. H. El-Abiad, “Computer Methods in Power System Analysis”,
2. McGraw Hill 1968.
3. G. L. Kusic, “Computer Aided Power Systems Analysis”, Prentice Hall, 1986.
4. I. J. Nagrath and D. P. Kothari, “Modern Power Systems Analysis”, Tata McGraw Hill, 1980.
5. A J. Wood and B. F. Wollenberg, “Power Generation, Operation and Control”, John Wiley, 1984.

[PEPS-19006] Simulation Laboratory

Teaching Scheme:
Lectures: 4 Hrs/week

Examination Scheme:
Continuous Assessment- 50 Marks
Final Practical/Oral Exam – 50 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Model electrical power system under steady state and transient conditions.
2. Use MATLAB and ATP/PSCAD for power system studies.
3. Determine the reactive power requirement of lines and compute VAR compensation required from voltage profile along the line.
4. Compute the Y-bus matrix, perform load flow studies and interpret the results.
5. Use Maxwell software for analysis of electric machines.
6. Use PSIM, PSPICE for power electronic circuit simulation.
7. Use DigSILENT, ETAP for power system analysis.

Syllabus Contents:

This lab will cover simulation experiments/assignments on the platform like MATLAB, ATP/EMTP, PSCAD, MAXWELL, LABVIEW, PSIM, PSPICE, DigSILENT, etc. The problems will be related to the core subjects and electives.

References: Manuals of respective software.

[PEPS-19007] Embedded Systems Lab

Teaching Scheme:
Lectures: 4 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Explain microcontroller, microcomputer, embedded system.
2. Demonstrate interactions of different components of a micro-controller.
3. Become familiar with programming environment used to develop embedded systems
4. Demonstrate key concepts of embedded systems like I/O, timers, interrupts, interaction with peripheral devices
5. Apply debugging techniques for an embedded system

Syllabus Contents:

Experiments based on above objectives such as PID control, LED Interface, timers, Design of Energymeter etc.

References:

1. Steve Heath, "Embedded Systems Design", Publisher Butterworth-Heinemann.
2. Wyne Woff "Principles of Embedded computing system design", Morgan Koffman publication 2000
3. Rajkamal, "Embedded Systems- Architecture, Programming and Design", 2007- TMH.
4. Qing Li, "Real Time Concepts for Embedded Systems", Elsevier, 2011.
5. Shibu K.V, "Introduction to Embedded Systems", Mc Graw Hill.
6. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley.
7. Lyla "Embedded Systems", Pearson, 2013.
8. MSP 430 Guide

SEMESTER-II

[EE-19003] Engineering Optimization (Interdisciplinary Open Course)

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1, T2 – 20 marks each
End-Sem Exam: 60 Marks

Course Outcomes:
Upon successful completion of this course the students will be able to,

1. Explain and use the basic theoretical principles of optimization and various optimization techniques.
2. Develop and select appropriate models corresponding to problem descriptions in engineering and solve them correctly.
3. Solve and analyze complex optimization problems in various domains.
4. Implement various optimization software tools to solve real time problems and develop relevant algorithms.

Syllabus Contents:

Introduction to optimization, Classical Optimization: Single variable optimization, Multivariable optimization with no constraints, Multivariable optimization with equality constraints, Multivariable optimization with inequality constraints. Linear Programming: Simplex Method, Duality, Transportation problems. Nonlinear Programming: One dimensional minimization methods, unconstrained and constrained optimization. Dynamic Programming: Development of dynamic programming, Principle of optimality.

Practical Aspects of Optimization: Reduced basic techniques, Sensitivity of optimum solution to problem parameters, advanced optimization techniques, applications of optimization techniques to real time problems.

References:

1. R. Fletcher, “Practical Optimization”, Second edition, John Wiley and Sons, New York, 1987.
2. S. S. Rao, “Engineering Optimization-Theory and practice”, fourth edition, Wiley Easter Publications, January 2009.
3. K. V. Mital and C. Mohan, “Optimization Methods in Operations Research and System Analysis”, New age International Publishers, Third edition, 1996.
4. Bazaraa M. S., Sherali H.D. and Shetty C. “Nonlinear Programming Theory and Algorithms”, John Wiley and Sons, New York 1993.
5. Bertsekas D. P., “Constrained Optimization and Lagrange Multiplier Methods”, Academic Press, New York, 1982.Durga Das Basu, “Introduction to the Constitution of India” Prentice Hall EEE, 19th/20th Edn., 2001. (Students Edn.)

[PEPS(DE)-19004] Power System Transients

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Define, classify, interpret and model the transient phenomena in power system.
2. Simulate the transients using PSCAD, EMTP/ATP software.
3. Analyze transient phenomena and develop the strategies to mitigate associated problems.
4. Evaluate the transient process due to lightning.

Syllabus Contents:

Sources of electrical transients, basic concepts, definitions, causes, effects, basic mathematical concepts for transient analysis, Laplace transform and differential equations, representation of transient wave shapes, modelling power apparatus for transient analysis, capacitor switching, reactor switching, magnetizing inrush and ferroresonance, transmission lines, the wave equation, and line terminations, travelling wave attenuation and distortion, transients due to faults, electromagnetic induction, magnetic flux, and currents, transient electromagnetic phenomena, lightning induced transients, computation of lightning events, lightning protection using shielding and surge arresters, transient voltages and grounding practices, numerical simulation of electrical transients, simulation tools, international standards.

References:

1. Pritindra Chaudhari, “Electromagnetic transients in Power System”, PHI.
2. J.C. Das, “Transients in Electrical Systems”, McGraw-Hill, 2010.
3. A. Greenwood, “Electrical Transients in Power Systems”, Wiley-Interscience, 1991.
4. L. van der Sluis, “Transients in Power Systems”, Wiley, 2001.
5. J.A. Martinez-Velasco, “Power System Transients: Parameter Determination”, CRC Press, 2009.
6. L.V. Bewley, “Traveling Waves on Transmission Systems”.
7. H. W. Dommell, EMTP Theory Book.
8. Alternate Transients Program Rule Book.

[PEPS(DE)-19005] Machine Learning

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Explain the basic concepts of machine learning
2. Demonstrate fundamental issues and challenges of machine learning algorithms
3. Compare various popular Machine Learning approaches.
4. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms.
5. Design and Apply machine learning algorithms to real world problems

Syllabus Contents:

Introduction to Machine Learning: Basic definitions, types of learning, designing a learning system, perspectives and issues, hypothesis space and inductive bias, evaluation, cross- validation. Linear regression, Decision trees, Splitting Criteria, Issues in decision tree learning, over-fitting and evaluation, nearest neighbor methods. Neural network: Perceptron, multilayer network, back propagation, introduction to deep neural network. Dimensionality Reduction: Feature reduction, Principal Component Analysis, Fischer's Discriminant Analysis. Probability and Bayes learning, Naive Bayes Model, Logistic Regression, Reinforcement learning. Support Vector Machine, Kernel function and Kernel SVM, Clustering: partitioning, k-means clustering, hierarchical clustering, and Case studies

References:

1. Ethem Alpaydin, “Introduction to Machine Learning”, Second Edition, The MIT Press, 2010.
2. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997.
3. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, CRC Press, 2009.
4. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

[PEPS(DE)-19006] Electrical Power Distribution Systems

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Demonstrate load forecasting and planning of new distribution systems or it's extension.
2. Design primary and secondary distribution systems.
3. Model and analyze unbalanced distribution systems and explain impact of integration of DGs.
4. Address the protection and reliability issues in distribution systems.
5. Design active network management.

Syllabus Contents:

Overview of power distribution systems, objectives and goals, physical layout, standards and requirements, Distribution network planning, distribution transformers, grounding and protection, Medium and long term load forecasting, three phase network modelling, analysis of unbalance networks, Distribution load flow, Distribution state estimation, Distribution losses, Reliability considerations and bench marking, Distributed generation (DG), distribution planning in presence of DGs, grid integration of DG, protection issues with DG, Electric vehicles, impact on forecasts, planning for charging networks, Battery storage systems sizing and location, Design of active networks, economic considerations of power distribution, microgrid and hybrid systems

References:

1. W. H. Kersting, "Distribution Systems Modeling and Analysis", CRC Press, Fourth Edition, 2017
2. Turan Gönen, " Electric Power Distribution System Engineering" (Second Edition)
3. NPTEL course on 'Electrical Distribution Systems' by Prof. Kumbhar

[PEPS(DE)-19007] Restructured Power Systems

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Describe various types of regulations in power systems.
2. Identify the need of regulation and deregulation.
3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4. Identify and give examples of existing electricity markets.
5. Classify different market mechanisms and to summarize the role of various entities in the market.
6. Define and describe various pricing mechanisms in the Generation, Transmission and Distribution sector.

Syllabus Contents:

Fundamentals of restructured system, market architecture, load elasticity, social welfare maximization, OPF: role in vertically integrated systems and in restructured markets, congestion management, optimal bidding, risk assessment and hedging, transmission pricing and tracing of power, ancillary services, standard market design, distributed generation in restructured markets, developments in India, IT applications in restructured markets, working of restructured power systems : PJM.

References:

1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub.,1998.• Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
2. Kankar Bhattacharya, Jaap E. Daadler, Math H. J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
3. Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

[PEPS(DE)-19011] Automotive Electronics: Hardware Development

HELLA –COEP Automotive Electronics Program (Elective-2)

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs/week	T1 and T2: 20 Marks each
Complimentary lab sessions will be organized to ensure hands-on learning	End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Acquire automotive specific hardware design skills.
2. Apply concept such as DFM, DFT, EMC, DFMEA.
3. Apply processes, methods and tools to demonstrate learning

Syllabus Contents:

- **Low Power Domain:** 16/32 bit controllers, Hardware-Software Interfaces, communication interfaces- CAN, LIN, SPI, wireless interfaces- Bluetooth ,ISM band applications, I/O interfaces –digital, analog signal conditioning, switches, relays, high side, low side drivers, Introduction to design tools (Microcap, Cadence Concept HDL and Allegro).
- **High Power Domain**: Selection of power switching devices- MOSFETs/IGBTs/SiC/ GaNFETs, Gate driver design, power loss calculations, thermal management, Design consideration For High Voltage applications.
- **Electromagnetic Compatibility**: Introduction to various regulatory requirements and International electrical and EMC standards, Understanding origin of pulses, disturbances, circuit and PCB layout design techniques to meet EMC.
- **Design for Manufacturability and Testability:** PCB layout consideration, manufacturing interfaces and process flow, ICT, AOI and EOL testing.

[PEPS(DE)-19008] Energy Storage Systems

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Identify the emerging needs of Electrical Energy Storage Systems.
2. Discuss the scientific principles underpinning the operation of energy storage systems
3. Model various electrical energy storage systems and analyze their performance.
4. Assess the global markets for the Electrical Energy Storage Systems.

Syllabus Contents:

The Role of Electrical Energy Storage Technologies in Electricity use, emerging needs of Electrical Energy Storage (EES), roles of EES, Types of Electrical Energy Storage Systems, Classification of EES systems, Performance characteristics of energy storage systems, Types of load curves, energy shift, Ragone plot. Importance of energy density and power density. Mechanical, Electrochemical, Chemical, Electrical, Thermal Energy Storage systems, Standards and Safety involved, Areas of applications of EES, Markets and forecast for EES.

References:

1. IEC White paper on Electrical Energy Systems: www.iec.ch/whitepaper/pdf/iecWP
2. Energy Storage Systems, Volume I and II, EOLSS, www. eolssunesco@gmail.com
3. A. G. Ter-Gazarian, ”Energy Storage for Power Systems”, Institution of Engineering and Technology, 2011.
4. James M. Eyer, Joseph J. Iannucci and Garth P. Corey, “Energy Storage Benefits and Market Analysis”, Sandia National Laboratories, 2004.

[PEPS(DE)-19009] Power Quality Issues and Mitigation

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Assess power quality of the power system
2. Suggest mitigating equipment for power quality issues
3. Demonstrate different power quality improvement techniques.
4. Select and use power quality monitoring meters
5. Design harmonic filter

Syllabus Contents:

Terms and definitions, voltage sags and interruptions: sources of sags and interruptions, end user issues, transient over voltages: sources of transient overvoltages, devices for overvoltage protection, load switching transient problems, harmonics: harmonic distortion, total harmonic distortion, triplen harmonics, effects of harmonic distortion, locating sources of harmonics, modelling harmonic sources, computer tools for harmonic analysis, long duration voltage variations: devices for voltage regulation, capacitors for voltage regulations, regulating utility voltages with dispersed sources, monitoring and measurement of power quality. Mitigation equipment, filter design.

References:

1. Roger Dugan, H. Wayne, "Electrical power systems quality". McGraw Hill, 2002
2. Alexander Kusko and Marc T. Thompson, "Power quality in electrical systems".
3. Arindam Ghosh, Gerard Ledwich, "Power Quality Enhancement using Custom Power Devices".
4. Math H. J. Bolen, "Understanding Power Quality Problems", IEEE power series on Power Engineering.
5. Wakileh, George J.," Power system harmonics, Fundamentals, Analysis and Filter Design", Springer

[PEPS(DE)-19010] Smart Grid Technologies

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Differentiate conventional and smart grid
2. Identify the need of smart grid, micro grid, smart metering, smart storage, hybrid vehicles, home automation, smart communication
3. Express the need and specify the components of smart grid and smart communication.

Syllabus Contents:

Introduction to smart grid, smart grid vision and road map in India, Concept of Resilient and self Healing Grid, Present international developments, smart cities, RTU, IED, PMU, smart substations, feeder automation, PHEV, V2G, G2V, CAES, real time prizing, AMR, OMS, smart sensors, Home and building automation, GIS, Concept of microgrid, architecture, DC micro grid, issues, integration of renewable energy sources, cyber controlled smart grid, Power quality and EMC in micro grid, web based PQ monitoring, smart grid communication architecture, WAMS, HAN, NAN, WAN, Bluetooth, ZigBee, GPS, i-Fi Max based communication, wireless network, cloud computing, cyber security, BPL, IP based protocols.

References:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, "Integration of green and renuable energy in electric power systems, John Weily.
2. Clark W. Gellings, 'Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Stuart Borlase, "Smart Grids-Infrastructures, Technology and Soluations", CRC Press, Taylor and Francis group.
4. Janaka Ekanayake, Kithsiri Liyanage, J. Wu and Akihiko Yokoyama, 'Smart Grid- Technology and Applications, John Wily.

[PEPS(DE)-19012] Automotive Electronics: Software Development

HELLA –COEP Automotive Electronics Program (Elective-3)

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs/week	T1 and T2: 20 Marks each
Complimentary lab sessions will be organized to ensure hands-on learning	End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Acquire automotive specific software design skills.
2. Apply concepts such as AUTOSAR, MATLAB and Communication Protocol.
3. Apply processes, methods and tools to demonstrate design skills.

Syllabus Contents:

- **Software Architecture:** Classical architecture, Layered architecture (AUTOSAR), All layer information (e.g. RTE, BSW, Application) Tool: Davind developer, configurator, Raphsody.
- **Communication Protocols:** Communication Protocol, CAN, LIN, Automotive Ethernet, RF, Bluetooth, Wi-Fi, Diagnostic Protocol: UDS, Tools: CANoe, Vehicle spy, CAPEL ,TAE scripting.
- **Model Based Development:** Model Based Development: Algorithm/application development using Simulink, stateflow, code generator.
- **Embedded C:**Concepts of C (structure, union, pointer, bitwise operator), Logic building according to requirement, MISRA C guidelines.
- **Software Testing:** Unit testing, Model in loop(MIL) testing, module testing, integration testing, software in loop(SIL) testing, Hardware in Loop (HIL) testing,. Tools: Tessy, PolySpace, TPT, Winidea, QAC, HIL Test Setup.

[LL-19001] Liberal Learning Course

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Survey new topics from various disciplines and Select various sources and avenues to harvest/gather information.
2. Explain qualitative attributes of a good learner.
3. Demonstrate quantitative measurements of learning approaches and learning styles.
4. Appreciate openness to diversity.

Syllabus Contents:

Topic selected by the student from areas displayed by the institute. The sample list is below.

Agriculture (Landscaping, Farming, etc.), Business (Management, Entrepreneurship, etc.), Defense (Study about functioning of Armed Forces), Education (Education system, Policies, Importance, etc.), FineArts (Painting, Sculpting, Sketching, etc.), Linguistics, Medicine and Health (Diseases, Remedies, Nutrition, Dietetics, etc.), Performing Arts (Music, Dance, Instruments, Drama,etc.), Philosophy, Social Sciences (History, PoliticalSc., Archeology, Geography, Civics, Economics, etc.)

References:

1. Expert(s), Books, Texts, Newspaper, Magazines, Research Papers, Journal, Discussion with peers or faculty.

[PEPS-19008] Power Systems Dynamics and Stability

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Comprehend concepts in the dynamic phenomena and stability of power systems
2. Model power system components, such as synchronous machines, excitation systems and governors
3. Analyze dynamic and oscillatory behavior of power systems and to alleviate the same.
4. Interpret results of system stability studies.

Syllabus Contents:

Basic concepts of dynamical systems and stability, modelling of power system components for stability studies: generators, transmission lines, excitation and prime mover controllers, analysis of single machine and multi-machine systems, small signal angle instability (low frequency oscillations): damping and synchronizing torque analysis, Eigen value analysis, mitigation using power system stabilizers, PSS design for multi-machine systems, small signal angle instability (sub-synchronous frequency oscillations): analysis and counter-measures, transient instability: analysis using digital simulation and energy function method, transient stability controllers.

References:

1. K. R. Padiyar, “Power System Dynamics, Stability and Control”, Interline Publishers, Bangalore, 1996.
2. P. Kundur, “Power System Stability and Control”, McGraw Hill Inc, New York, 1995.
3. P. Sauer and M. A. Pai, “Power System Dynamics and Stability”, Prentice Hall, 1997.
4. E.W. Kimbark, “Power systems Stability”, Vol. I and III.

[PEPS-19009] HVDC and FACTS

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Classify and explain the functioning of FACTS devices.
2. Model FACTS devices to improve steady and dynamic performance of power system.
3. Identify the need for HVDC systems.
4. Identify converters for HVDC application and implant their control characteristics.
5. Appreciate the use of filters for HVDC systems

Syllabus Contents:

The concept of flexible AC transmission – reactive power control in electrical power transmission lines, uncompensated transmission line, Introduction to FACTS devices and its importance in transmission Network, Introduction to basic types of FACTS controllers, Shunt Compensation: Methods of Var generation: Thyristor controlled reactor (TCR), Thyristor switched capacitor (TSC), Fixed capacitor-Thyristor controlled reactor (FC-TCR), STATCOM; Series Compensation : Thyristor Switched Series Capacitor (TSSC), Thyristor Controlled Series Capacitor (TCSC). Static Synchronous Series Compensator (SSSC), modes of operation, Voltage regulator and Phase Angle Regulator (PAR), Multi functional FACTS controller: The Unified Power Flow Compensator (UPFC); circuit and steady-state characteristic; effect on transmission line compensation; Interline Power Flow Controller (IPFC); circuit and steady-state characteristic; HVDC: Introduction, various possible HVDC configurations, components of HVDC system, operation of 6-pulse and 12-pulse converter, Effect of source inductance, Generation of Harmonics, Design of AC filters and DC filters, HVDC light and HVDC PLUS Series and Parallel operation of converters, Introduction to distribution FACTs devices.

References:

1. K. R. Padiyar , " HVDC Power Transmission System", Wiley Eastern Limited, New Delhi , First Edition 1990.
2. T.J.E. Miller , " Reactive Power Control in Electrical System", John Wiley and Sons, New York , 1982.
3. N.G.Hingorani, "Understanding FACTS :Concepts and Technology of FACTS Systems", IEEE Press, 2000.
4. K.R.Padiyar "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
5. J.Arrillaga, " High Voltage Direct Current Transmission", Peter Pregnnus, London 1983.

[PEPS-19010] Digital Protection

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Select and model various components (like CT, CVT, and numerical relay) for protection purpose.
2. Use and implement least squares, DFT, FFT phasor estimation algorithms for numerical protection.
3. Design and simulate over current, distance and differential protection schemes for power systems.
4. Develop the advanced schemes for power system protection using new technologies such as synchronized measurements, PMUs, GPS, fiber optics.

Syllabus Contents:

Review of principles of power system protection: over current, directional, differential and distance protection, review of sequence networks and short circuit analysis, relay coordination: over current and distance relay coordination, Current transformer and potential transformer, standards, effect on relaying philosophy, introduction to computer aided relaying, motivation, basic hardware, digital signal processing aspects, sampling, aliasing, anti-aliasing filter, Fourier and discrete Fourier transform recursive DFT, half cycle and full cycle algorithm, estimation of phasors and frequency, algorithms for transmission line protection, out-of-step relaying, introduction to adaptive relaying and wide area measurements(WAM), transformer, generator and bus bar protection

References:

1. Prof. S. A. Soman, “A Web Course on Digital protection of power system”, IIT Bombay.
2. A. G. Phadke, J. S. Thorp, “Computer relaying for power systems”, research studies press ltd. England, John Wiley and sons inc., New York.
3. Blackburn, ”Protection of power systems”.
4. Y. G. Paithankar, S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall, India.

[PEPS-19011] DSP Application Lab

Teaching Scheme:
Lectures: 1 Hrs/week
Practicals: 2 Hrs/week

Examination Scheme:
Continuous Evaluation: 50 Marks
End-SemExam–50marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Analyze and describe the functionality of a real world DSP system.
2. Write low level device drivers/Chip Support Libraries for standard peripherals such as UART/PWM/TimersCreate/debuganddevelopapplicationsinCforembeddedenvironment.
3. Develop various DSP Algorithms using MATLAB Software package.
4. Develop an embedded controller for power electronics and drive applications

Syllabus Contents:

Experiments on the DSP/Micro-controllers, Interfacing peripherals to DSP/micro-controller, Assembly language programming, Real-time voltage/current, speed sensing signal and processing, PWM strategies realization through DSP and controlling power electronic converters and Drive Systems.

References:

1. TI User Manuals TMS320C2x, TMS28335.
2. Website: www.ti.comandwww.DSPguide.com.
3. Marven,C., Ewers, G.A simple approach to DSP TexasInstr.1993.
4. MSP430 Technical Reference Manual

[PEPS-19012] HIL Lab

Teaching Scheme:
Lectures: 2 Hrs/week

Examination Scheme:
Continuous Evaluation: 50 Marks
End-Sem Exam: 50 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Mathematically formalize requirements based on design objectives.
2. Perform analysis and design in the discrete domain using ADC and DAC.
3. Gain knowledge and hands on experience with sensor and actuator calibration, signal amplification, sampling, DAC and ADC, uncertainties and noise, continuous and discrete filters, safety measures for HIL implementations, *etc*.
4. Independently setup HIL experiments using Simulink and dSpace virtual HIL software packages.

Syllabus Contents:

Experiments on Development and debugging the model/controller in MATLAB/SIMULINK, Design MIL tests in order to verify and validate the model/controller according to predefined requirements, Generate and debug production code, and performing SIL tests, hands on experience of V&V tools in MATLAB/SIMULINK, Learning to work with dSPACE software packages, setting up VHIL, and recording data using data acquisition tools in dSPACE, Designing and implementing DOE tests on the VHIL platform.

References: Manuals of relevant devices and software.

SEMESTER-III

[PEPS-20001] Dissertation Phase – I

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Identify key research and development topics in the field of chosen dissertation area (Power Systems, Power electronics, Electrical machines, Energy systems and any interdisciplinary area).
2. Identify, summarize and critically evaluate relevant literature and write a literature review on the relevant topic.
3. Manage time effectively whilst working on independent research and prepare action plan.
4. Show evidence of clarity of argument, understanding of the chosen topic area, and presentation of technical information.
5. Use and develop written and oral presentation skills.

Syllabus Contents:

The M. Tech. project is aimed at training the students to analyze independently any problem in the field of Electrical Engineering or interdisciplinary. The project may be analytical, computational, experimental or a combination of three. The project report is expected to show clarity of thoughts and expression, critical appreciation of the existing literature and analytical, experimental, computational aptitude.
The student progress of the dissertation work will be evaluated in stage I by the departmental evaluation committee

References:

1. Various books, research papers, patents and IPRs on the topic selected for the dissertation.

[PEPS-20002] Project and Finance Management

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Demonstrate project management skills.
2. Analyze risk and manage it.
3. Illustrate project financial evaluation
4. Utilize specialized economic evaluation techniques to determine and evaluate project feasibility.

Syllabus Contents:

Project organization and contracts, Construction finance, Public-private partnerships in financing of infrastructure, Private finance initiative, Project finance, How to get involved in private finance, Risk analysis, Risk management, Project financial evaluation, Capital program management, Project control, Project management engineering, procurement and construction, Identifying and covering risks—current trends, Project uncertainty management. Term project presentation

References:

1. Online MOOC course material available in the selected area
2. Shtub, Bard and Globerson, “Project Management: Engineering, Technology, and Implementation”, PH Inc.
3. Khan, M.Y & Jain, P.K.: Financial Management; Tata McGraw Hill, New Delhi, 2008
4. Keown, Martin, Petty and Scott (Jr), “Financial Management; Principles and Applications”, Prentice Hall of India, New Delhi, 2002.

SEM-IV

[PEPS-20003] Dissertation Phase – II

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Manage time and other resources effectively whilst working on independent research.
2. Identify, analyses and interpret suitable data to enable the research question to be answered.
3. Model, Simulate/ develop innovative hardware/ develop new algorithms/ emulate/ HIL/ develop prototype for the selected topic.
4. Describe the process of carrying out independent research in written format and report your results and conclusions with reference to existing literature and Analyze and synthesize research findings.
5. Use and develop written and oral presentation skills and Prepare good technical project reports for publication in journals and conferences.
6. Take up challenging issues in industry and provide solutions.

Work Contents:

The M. Tech. project is aimed at training the students to analyze independently any problem in the field of Electrical Engineering or interdisciplinary. The project may be analytical, computational, experimental or a combination of three. The project report is expected to show clarity of thoughts and expression, critical appreciation of the existing literature and analytical, experimental, computational aptitude.
The student progress of the dissertation work will be evaluated in stage II by the departmental evaluation committee and final viva voce will be conducted by the external examiner.

References:

1. Various books, research papers, patents and IPRs on the topic selected for the dissertation.

[PEPS-20004] Design of Internet of Things

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 Marks

Course Outcomes:

Upon successful completion of this course the students will be able to,

1. Illustrate the application areas of IOT ·
2. Realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks ·
3. Demonstrate building blocks of Internet of Things and characteristics.

Syllabus Contents:

Introduction to IoT, Sensing, Actuation, Basics of Networking, Basics of Networking, Communication Protocols, Communication Protocols, Sensor Networks, Sensor Networks, Machine-to-Machine Communications, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Python programming, Introduction to Raspberry, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT, Data Handling and Analytics, Cloud Computing, Cloud Computing, Sensor-Cloud, Fog Computing, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring.

References:

1. Adrian McEwen Hakim Cassimally, “Designing the Internet of Things”, Publisher: JOHN WILEY & SONS INC
2. NPTEL Course on “Design of Internet OF Things” by Prof. T V Prabhakar from IISC Bangalore.