AISSMS

INSTITUTE OF INFORMATION TECHNOLOGY

(I.O.I.T)

ADDING VALUE TO ENGINEERING

An Autonomous Institute Affiliated to Savitribai Phule Pune University

Approved by AICTE, New Delhi and Recognised by Govt. of Maharashtra

Accredited by NAAC with "A+" Grade | NBA - 5 UG Programmes

Department of Electrical Engineering

Curriculum Structure and Detailed Syllabus (PG Program)

First Year M.TECH

(Effective from A. Y.: 2023-24)

AISSMS INSTITUTE OF INFORMATIONTECHNOLOGY

Kennedy Road, Near RTO,

Pune – 411 001, Maharashtra State, India Email:

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Website: https://aissmsioit.org/

Institute Vision & Mission

Vision

To be recognized amongst top 10 private engineering colleges in Maharashtra by the year 2026 by rendering value added education through academic excellence, research, entrepreneurial attitude, and global exposure.

Mission

To enable placement of 150 plus students in the 7 lacs plus category & ensure 100% placement of all final year students

To connect with 10 plus international universities, professional bodies and organizations to provide global exposure to students

To create conducive environment for career growth, prosperity, and happiness of 100% staff.

To be amongst top 5 private colleges in Pune in terms of admission cut off.

Quality Policy

We commit ourselves to provide quality education & enhance our student's quality through continuous improvement in our teaching and learning processes.

Department Vision & Mission

VISION

To be known for imparting quality education in the field of electrical engineering and preparing competent professionals with high human values to serve the society.

MISSION

- To train the graduates with the latest technologies through industry institute interactions and experiential teaching learning practices to meet the emerging global challenges.
- To enhance engineering skills, employability skills, and research through professional activities.
- To develop globally competent electrical engineers with professional ethics and commitment to society.

PROGRAM EDUCATION OBJECTIVES

Graduates will

- Investigate problems in electrical engineering and provide effective solutions.
- Excel in the professional career, research, higher studies, and entrepreneurship.
- Engage in lifelong learning by adapting a professional, social, and ethical attitude for contributing to societal needs.

Program Outcomes (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. [Engineering knowledge]
2. Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. [Problem analysis]
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. [Design/development of solutions]
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. [Conduct investigations of complex problems]
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. [Modern tool usage]
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. [The engineer and society]
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. [Environment and sustainability]
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. [Ethics]
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. [Individual and teamwork]
10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. [Communication]
11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. [Project management and finance]
12. Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. [Life-long learning]

Program Specific Outcomes (PSOs)

1. The graduates will be able to proficiently employ the software tools used in the design and analysis of electrical systems.
2. The graduates will be able to acquire skills in electric mobility, power quality, and renewable energy.

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 2 Hours Practical (Lab)/week	0.5 credits 1 credit

B. Range of credits –

A range of credits from 150 to 160 for a student to be eligible to get Post Graduate degree in Engineering.

C. Credit for Post Graduate Degree in Electrical Engineering

Sr. No.	Year	Semester	Credits
1	First Year	I	20
2		II	20
3	Second Year	III	20
4		IV	20
	Total		**80**

D. Structure of Post Graduate Engineering program

Sr. No	Domains	Code	Total Credits	As per NEP Credits
1	Programme Core Courses	PCC	**29**	44-56
2	Programme Elective Courses	PEC	**06**	20
3	Vocational and Skill Enhancement Courses	VSE	**17**	08
4	Humanities Social Science and Management	HSM	**05**	14
5	Experiential Learning Courses	ELC	**23**	22
Total Credits			**80**	**80-88**

E. Domain wise Credits Distribution:

Sr. No.	Domains	Code	Credits				
			Semesters				Total Credits
			I	II	III	IV	
1	Programme core courses	PCC	13	16	--	--	**29**
2	Programme Elective courses	PEC	03	03	--	--	**06**
3	Vocational and Skill Enhancement Courses	VSE	--	--	13	04	**17**
4	Humanities Social Science and Management	HSM	01	01	03	--	**05**
5	Experiential Learning Courses	ELC	03	--	04	16	**23**
Total Credits			**20**	**20**	**20**	**20**	**80**
Total Marks			**625**	**625**	**300**	**300**	**1850**
Total Working Hours per week			**22**	**22**	**36**	**36**	**-**

F. Major Courses:

Sr. No.	Semester	Course Code	Course Title	Credits
1	Sem-I	PEPCC901	Applied Mathematics for Power Electronics Systems	**04**
2	Sem-I	PEPCC902	Modeling and Analysis of Electrical Machines	**04**
3	Sem-I	PEPCC903	Power Converters	**03**
4	Sem-I	PEPCC904	Lab Practice I	**02**
5	Sem-I	PEPEC905	Elective-I	**03**
6	Sem-II	PEPCC1001	AC and DC Drives	**03**
7	Sem-II	PEPCC1002	Analysis and Design of Inverters	**03**
8	Sem-II	PEPCC1003	Advanced Microcontroller Applications	**04**
9	Sem-II	PEPCC1004	Special Applications of Power Electronics	**04**
10	Sem-II	PEPCC1005	Lab Practice II	**02**
11	Sem-II	PEPEC1006	Elective-II	**03**
			Total Major Courses Credits	**35**

G. Vocational and Skill Enhancement Courses:

Sr. No.	Semester	Course Code	Course Title	Credits
1	Sem-III	PEVSE1101	Internship	**12**
2	Sem-III	PEVSE1103	Intellectual Property Rights	**01**
3	Sem-IV	PEVSE1201	Technical Paper Writing	**04**
			Total Credits	**17**

H. Humanities Social Science and Management Courses:

Sr. No.	Semester	Course Code	Course Title	Credits
1	Sem-I	PEHSM906	Audit Course-I (Introduction to Constitution/ Renewable Energy Studies)	**01**
2	Sem-II	PEHSM1007	Audit Course-II (Human Values in Ethics and Education/ Disaster Management	**01**
3	Sem-III	PEHSM1102	Project and Finance Management	**03**
			Total Credits	**05**

I. Experiential Learning Courses:

Sr. No.	Semester	Course Code	Course Title	Credits
1	Sem-I	PEELC907	Research Methodology	**03**
2	Sem-III	PEELC1104	Project Stage I	**04**
3	Sem-IV	PEELC1202	Project Stage II	**16**
			Total Credits	**23**

J. Exit Course

Sr. No.	Course Title	Offered for class	Course Credits
1	Internship @	First Year M. Tech	06

@ Six week Internship to be completed by the students from Drives and Automation Company along with certificate and report

SEMESTER WISE STRUCTURES

M. Tech. (Power Electronics and Drives) – First Year (Semester –I)											
Sr. No.	**Couse Code**	**Course Title**	**Hours per week**			**Credits**	**Examination scheme**				
			L	**T**	**P**		**ISE**	**ESE**	**TW**	**OR/ Presentation**	**Total**
1	PEPCC901	Applied Mathematics for Power Electronics Systems	4	--	--	**04**	40#	60*	--	--	**100**
2	PEPCC902	Modeling and Analysis of Electrical Machines	4	--	--	**04**	40#	60**	--	--	**100**
3	PEPCC903	Power Converters	3	--	--	**03**	40#	60**	--	--	**100**
4	PEPCC904	Lab Practice I	--	--	4	**02**	--	--	50	50	**100**
5	PEPEC905	Elective-I	3	--	--	**03**	40#	60*	--	--	**100**
6	PEHSM906	Audit Course I (Introduction to Constitution/ Renewable Energy Studies)	1	--	--	**01**	--	--	25	--	**25**
7	PEELC907	Research Methodology	3		--	**03**	40#	60*	--	--	**100**
Total			**18**		**04**	**20**	**200**	**300**	**75**	**50**	**625**

L- Lecture, T- Tutorial, P- Practical

Elective-I
A. Power Electronics for Renewable Energy Systems
B. Control Design Techniques for Power Electronic Systems
C. Power Electronics and FACTS Devices

* **End Semester Examination (ESE):** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In semester (ISE):**

1. **Subjective/ Multiple-Choice Question (MCQ)**.
2. **Activity based Evaluation** based on Presentation/ Group Discussion/ Laboratory Work/ Course Project/ Home Assignment/ Comprehensive Viva Voce/ Blog Writing/ Case Study/ Survey/ Subjective/ Multiple-Choice Question (MCQ) examination.

M. Tech. (Power Electronics and Drives) – First Year (Semester –II)											
Sr. No.	Couse Code	Course Title	Hours per week			Credits	Examination scheme				
			L	T	P		ISE	ESE	TW	OR/ Presentation	Total
1	PEPCC1001	AC and DC Drives	3	--	--	**03**	40#	60*	--	--	**100**
2	PEPCC1002	Analysis and Design of Inverters	3	--	--	**03**	40#	60*	--	--	**100**
3	PEPCC1003	Advanced Microcontroller Applications	4	--	--	**04**	40#	60**	--	--	**100**
4	PEPCC1004	Special Applications of Power Electronics	4	--	--	**04**	40#	60**	--	--	**100**
5	PEPCC1005	Lab Practice II	--	--	4	**02**	--	--	50	50	**100**
6	PEPEC1006	Elective-II	3	--	--	**03**	40#	60*	--	--	**100**
7	PEHSM1007	Audit Course-II (Human Values in Ethics and Education/ Disaster Management	1	--	--	**01**	--	--	25	--	**25**
Total			**18**	**00**	**04**	**20**	**200**	**300**	**75**	**50**	**625**

L- Lecture, T- Tutorial, P- Practical

Elective-II
A. Emerging Trends in Power Conversion Technology
B. Distributed Generation and Micro Grid
C. Embedded Systems
D. Electric Vehicles and Power Management

* **End Semester Examination (ESE):** based on subjective questions.

** **Practical or Activity based Evaluation.**

\# **In semester (ISE):**

1. **Subjective/ Multiple-Choice Question (MCQ)**.
2. **Activity based Evaluation** based on Presentation/ Group Discussion/ Laboratory Work/ Course Project/ Home Assignment/ Comprehensive Viva Voce/ Blog Writing/ Case Study/ Survey/ Subjective/ Multiple-Choice Question (MCQ) examination.

M. Tech. (Power Electronics and Drives) – Second Year (Semester –III)											
Sr. No.	Couse Code	Course Title	Hours per week			Credits	Examination scheme				
			L	T	P		ISE	ESE	TW	OR/ Presentation	Total
1	PEVSE1101	Internship	--	--	24	**12**	--	--	100	--	**100**
2	PEHSM1102	Project and Finance Management	3	--	--	**03**	--	--	50	--	**50**
3	PEVSE1103	Intellectual Property Rights	1	--	--	**01**	--	--	50	--	**50**
3	PEELC1104	Project Stage I	--	--	08	**04**	--	--	50	50	**100**
Total			**04**	**00**	**32**	**20**	**00**	**00**	**250**	**50**	**300**

L- Lecture, T- Tutorial, P- Practical

M. Tech. (Power Electronics and Drives) – Second Year (Semester –IV)											
Sr. No.	Couse Code	Course Title	Hours per week			Credits	Examination scheme				
			L	T	P		ISE	ESE	TW	OR/ Presentation	Total
1	PEVSE1201	Technical Paper Writing	--	4	--	**04**	--	--	100	--	**100**
2	PEELC1202	Project Stage II	--	--	32	**16**	--	--	150	50	**200**
Total			**00**	**04**	**32**	**20**	**00**	**00**	**250**	**50**	**300**

L- Lecture, T- Tutorial, P- Practical

M. Tech. (Power Electronics and Drives) – First Year (Semester –I)

First Year M.Tech			
Applied Mathematics for Power Electronics Systems (PEPCC901)			
Course Code:	**PEPCC901**	**Credit**	**04**
Contact Hours:	4 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	Enable students to know matrix theory.
2	To give basic knowledge about probability and statistical concepts
3	To discuss various problems using various statistical techniques
4	To provide knowledge of tools of mathematics to problems in engineering.

Course Outcomes: Students will be able to	
1	Apply matrix theory in different problems of engineering.
2	Apply basic concepts of probability.
3	Organize, present and interpret statistical data.
4	Model and analyze measurement data using the appropriate distribution.
5	Apply knowledge of applied mathematics in analyzing real world problems of engineering.

Topics covered:

UNIT I:	**Numerical Analysis and Transform theory**	**(10 hrs.)**

Introduction, Interpolation Formulae, Difference equation, Roots of Equations, Solution for ordinary and partial differential equations. Special matrices, Eigen values and Eigen vectors, Diagonalization of matrices, Orthogonal symmetrical matrices, Skew matrices. Generalized Eigenvectors, Canonical basis, QR Factorization, Cholesky, Singular value decomposition. Fourier Series and Transform.

UNIT II:	**Probability and Random Variable**	**(8 hrs.)**

Probability, Axioms of probability, Conditional probability, Baye's theorem, Random variables, Probability function , Moments, Moment generating functions and their properties, Binomial, Poisson, Geometric, Uniform, Exponential, Beta, Gamma and Normal distributions, Function of a random variable, Covariance, Correlation and Regression Analysis.

UNIT III:	**Statistics**	**(8 hrs.)**

Types of measured quantity- discrete & continuous distributed, Histogram, Central tendency of data, Median and mean of data, Geometric and harmonic mean - computation - properties and uses, Measures of dispersion, Range, quartile , standard deviation and co-efficient of variation.

UNIT IV:	**Normal Distribution**	**(8 hrs.)**

Gaussian distribution and its properties, Area under normal distribution, Standardized normal distribution, Central limit theorem, Chi-square test.

UNIT V:	Graphical Data Analysis	(8 hrs.)
Equation of approximate curves, Determination of parameters in linear relationships: Graphical method, Method of sequential differences, Method of extended differences, Method of least squares.		
UNIT VI:	**Linear Programming**	**(6 hrs.)**
Formulation of Linear Programming (LP) Problems, Methods of solution LP Problem- Simplex, Big M, Graphical and Two phase. Transportation and Assignment Models.		

Reference Books:

1. Peter V. O'Neil, Cengage Learning, Canada , "Advanced Engineering Mathematics"
2. B.C. Nakra, K.K. Chaudhry, "Instrumentation, Measurement & Analysis", Tata McGraw Hill, 2004
3. Chi-T Song Chen, "Linear Systems Theory and Design", 3rd Edition, Oxford University Press
4. Andrews L.C. and Phillips R.L., "Mathematical Techniques for Engineers and Scientists", Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
5. Bronson, R. "Matrix Operation", Schaum's outline series, 2nd Edition, McGraw Hill, 2011
6. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
7. Veerarajan,T. "Probability, Statistics and Random Processes".3rd ed., Tata Mc Graw- Hill, 2008.
8. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015
9. Taha, H.A., "Operations Research, An Introduction", 9th Edition, Pearson education, New Delhi, 2016.
10. Vittal, P.R. & V.Malini."Statistical and Numerical Methods".Margham Publications

First Year M.Tech			
Modeling and Analysis of Electrical Machines (PEPCC902)			
Course Code:	**PEPCC902**	**Credit**	**04**
Contact Hours:	4 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To elaborate various linear and non-linear models for analysis of steady-state and dynamic machine performance estimation.
2	To explain concepts of representing transfer function model of different electrical machines.
3	To illustrate concept of 3-phase to 2-phase conversion.
4	To elaborate representation of 3-phase induction motor in various reference frames and Linearization of machine equations
5	To explain modelling of 3-phase synch. Motor in 2- axis representation and linearization of machine equations.

Course Outcomes: Students will be able to	
1	Apply the various linear and non-linear models for analysis of steady-state and dynamic machine performance estimation.
2	Have an appreciation of the simplifying assumptions associated with the various modelling techniques.
3	Determine the dynamic model of an induction machine and determination of torque.
4	Determine the torque developed in a salient pole synchronous machine using the Park's transformation and identify contribution of saliency torque-damping torque and excitation torque.
5	Apply the modelling techniques to novel or other machine technologies

Topics covered:		
UNIT I:	**Generalized Machine Theory**	**(8 hrs.)**
Elements of generalized circuit theory, basic electrical machine, conventions used, Kron's primitive machine, leakage flux in machines with more than two windings, voltage equations, matrix form, torque equations, power in AC circuits		
UNIT II:	**Linear Transformations in Machines**	**(8 hrs.)**
Linear Transformations in machines: Power invariance, transformations from displaced brush axis, transformations from 3-phase to 2-phase, transformation from rotating axes to stationary axes, Transformed impendence matrix.		
UNIT III:	**DC Machine**	**(8 hrs.)**
Separately excited DC motor-steady state and transient state analysis, sudden application of inertia load, transfer function of separately excited DC motor, mathematical model of dc series motor, shunt motor. Brushless DC motor.		

UNIT IV:	Modelling of Three Phase Induction Machine	(8 hrs.)
Generalized model in arbitrary frame, Voltage, torque equations, Induction motor models-stator reference frame model, rotor reference frame model, synchronously rotating reference frame model, equations in flux linkages, per unit model, dynamic simulation.		
UNIT V:	**Modelling of Synchronous Machines**	**(8 hrs.)**
Construction and operation of synchronous motors. Model of a two-phase permanent-magnet synchronous motor. Static and dynamic characteristics. Open-loop control, stepping and microstepping. Closed-loop quadrature control. DQ transformation and DQ model. Closed-loop control in the DQ frame of reference. Torque optimization and field weakening. Hybrid stepper motors and reluctance motors.		
UNIT VI:	**Alternative forms of Machine Equations**	**(8 hrs.)**
Linearization of machine equations, Small displacement stability: Eigen values, Eigen values of typical induction machine and synchronous machine. Performance prediction of -Induction machine, synchronous machine with stator electric transients neglected Construction, modeling, and characteristics of Brushless DC motor		

Textbooks:

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis & Control", PHI LearningPrivate Ltd, 2009.
2. P. C. Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive Systems", IEEE Press ,John Wiley and Sons
3. P. S. Bimbra, "Generalized Theory of Electrical Machines", Khanna Publications
4. Mrittunjay Bhattacharyya, "Electrical Machines : Modelling and Analysis", PHI Publications
5. R. Ramanujam, "Modeling and Analysis of Electrical Machine", Dreamtech Press

Reference Books:

1. Chee-Mun Ong, "Dynamic Simulation of Electric Machinery using Matlab / Simulink", Prentice Hall, 1998.
2. Matrix Analysis of Electric Machines, N. N. Hancock, Pergamon Press.
3. Matrix Analysis of Electric Machines by Mukhopadhyay

First Year M.Tech			
Elective-I : Power Converters (PEPCC903)			
Course Code:	**PEPCC903**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective: To impart knowledge on	
1	The performance analysis and operation of various converters.
2	The dynamics of various converters.
3	The designing concepts of various converters

Course Outcomes: Students will be able to	
1	Illustrate the operating principle and construction of various types of converters.
2	Demonstrate knowledge of dynamics of various converters.
3	Design various converters.

Topics covered:		
UNIT I:	**Inverters**	**(6 hrs.)**
Single and three phase bridge inverters with R, RL and RLE loads, Voltage control, Harmonic reduction, square wave inverters, PWM inverters, modulation techniques, SPWM, Selective Harmonic Elimination PWM and delta modulation. blanking time. harmonic spectrum and comparison among different PWM techniques. Boost inverter. Current source inverters, Inverter Circuit Design.		
UNIT II:	**Resonant Pulse Converters**	**(6 hrs.)**
Series and parallel resonant inverters - zero current and Zero voltage switching resonant converters, frequency response. Two quadrant zero voltage switching resonant converters, Resonant dc link inverters, design and analysis, soft switching, load dependent problem.		
UNIT III:	**Cycloconverters**	**(6 hrs.)**
Single phase and three phase cycloconverters with R, RL and RLE loads – Voltage control , Harmonic analysis, operation waveforms designs.		
UNIT IV:	**AC Voltage Controllers**	**(6 hrs.)**
Single phase and three phase ac voltage controllers with R, RL and RLE loads, Voltage control, Harmonic analysis, operation waveforms PWM, Matrix converter, design.		
UNIT V:	**Dynamics of Converters**	**(6 hrs.)**
Modelling and control of inverters, resonant pulse converters, cyclo-converters, ac voltage controllers. Application of microcomputer.		
UNIT VI:	**Control Design**	**(6 hrs.)**
Method for control design: averaging method, small signal analysis, linearization, challenge. Geometric control: hysteresis control, boundary control. Triggering circuit. Design of inverters, resonant pulse converters, cycloconverters, ac voltage controllers circuits. PLL / Microcomputer based inverters, cycloconverters, and AC voltage controllers.		

	Reference Books:
1	Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995
2	Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, New Delhi, 1996
3	R. Bausiere & G. Seguier, Power Electronic Converters, Springer- Verlag, 1987.
4	D. M. Mitchell, DC-DC Switching Regulator Analysis McGraw Hill, 1987

First Year M.Tech			
Lab Practice I (PEPCC904)			
Course Code:	**PEPCC904**	**Credit**	**02**
Contact Hours:	4 Hrs./week (P)	**Type of Course:**	Lecture/Tutorial
Examination Scheme	Term-work 50 marks	Oral/Presentation 50 marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term-work	Internal	50
2.	Oral/Presentation	Internal	50

Course Objective:	
1	To develop thinking skills.
2	To develop data analysis skills.
3	To develop experimental skills.
4	To develop communication skills.

Course Outcomes: Students will be able to	
1	Design simulation of electrical machines.
2	Analyze harmonics of three phase Induction motor
3	Analyse THD in inverter output using Harmonic analyser.
4	Design simulation to analyse converters and inverters.

List of Experiments:

Minimum eight experiments should be performed under Lab Practice I from the following list

1	Modelling and simulation of three phase Induction machine and to study the dynamic behavior of the machine for change in load torque.
2	Modelling and simulation of separately excited DC motor and to study the dynamic behavior of the machine for change in load torque.
3	Modelling and simulation of separately stepper motor and to study the dynamic behavior.
4	Analysis of harmonics of three phase Induction motor.
5	Analyze THD in inverter output using Harmonic analyser.
6	To study the harmonic analysis of CFL, electronic fan regulator, electronic choke of tube, computer –UPS.
7	Simulation & analysis of three phase converters with RLE load.
8	Simulation & analysis of Buck/Boost converters with RLE load.
9	Simulation & analysis of three phase PWM inverter with RLE load.
10	FFT analysis of three phase converter.
11	Signature analysis of induction motor current.
12	Modelling and performance analysis of solar photovoltaic system.
13	Modelling and performance analysis of wind turbine.
14	Case study of harmonic analysis of typical installation.

	Reference Books:
1	Chee-Mun Ong, “Dynamic Simulation of Electric Machinery using Matlab / Simulink”, Prentice Hall, 1998.
2	Matrix Analysis of Electric Machines, N. N. Hancock, Pergamon Press.
3	Matrix Analysis of Electric Machines by Mukhopadhyay
4	Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995
5	Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, New Delhi, 1996
6	R. Bausiere & G. Seguier, Power Electronic Converters, Springer- Verlag, 1987.
7	D. M. Mitchell, DC-DC Switching Regulator Analysis McGraw Hill, 1987

First Year M.Tech			
Elective-I : A. Power Electronics for Renewable Energy Systems (PEPEC905A)			
Course Code:	**PEPEC905A**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To provide knowledge about the stand alone and grid connected renewable energy systems.
2	To equip with required skills to derive the criteria for the selection of power converters for renewable energy applications.

Course Outcomes: Students will be able to: able to	
1	Analyze the impacts of renewable energy generation on environment.
2	Explain the importance and qualitative analysis of solar and wind energy sources.
3	Select appropriate converter for PV & wind energy conversion and their performance characteristics.
4	Explain various converters for solar PV and wind energy systems.

Topics covered:		
UNIT I	**Introduction**	**(06 Hrs)**
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment -Qualitative study of different renewable energy resources:- ocean/tidal, Biomass, Hydrogen energy systems : operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems-control strategy, operating area.		
UNIT II	**Power converters**	**(06 Hrs)**
Line commutated inverters, matrix converter, buck, boost converters, PWM inverters, grid interactive inverters, back to back converters, Synchronized operation with grid supply - Harmonic problem - Grid connectors concepts - Wind farm and its accessories - Grid related problems - Generator control - Performance improvements - Different schemes - AC voltage controllers - Harmonics and PF improvement.		
UNIT III	**Wind Energy Systems**	**(06 Hrs)**
Basic Principle of wind Energy conversion - Nature of Wind - Wind survey in India - Power in the wind - Components of Wind Energy Conversion System (WECS)- Performance of Induction Generators (SCIG and DFIG) and PMSGs for WECS Three phase AC voltage controllers-AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, matrix converters- Standalone operation of fixed and variable speed wind energy conversion systems- Grid Connection Issues -Grid integrated PMSG and SCIG Based WECS.		
UNIT IV	**Solar photo voltaic system-**	**(06 Hrs)**
Working of solar photo voltaic system: Smart charge controller, line commutated converters (inversion-mode) - Boost and buck-boost converters-selection of inverter for PV plant, battery sizing, array sizing- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.		

UNIT V	Interfacing in Renewable Energy Systems	(06 Hrs)
Control methods, stability, diagnostics and interfacing of energy storage in renewable energy systems, Hybrid renewable energy storage Voltage and frequency control of grids with high penetration of renewable distributed generation.		
UNIT VI	**Stability of Grid-tied Renewable Energy Sources**	**(06 Hrs)**
Challenges of performance and stability of multivariable grid tied 3 phase inverter system of renewable sources, Case Studies & applications		

Reference Books:

1. S. N. Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009.
2. Rashid M. H. "Power Electronics Hand book", Academic press, 2001.
3. Rai G.D, "Non conventional Energy Sources", Khanna publishes, 1993.
4. Rai G.D," Solar Energy Utilization", Khanna publishes, 1993.
5. Gray, L. Johnson, "Wind Energy System", Prentice Hall linc, 1995.
6. B. H. Khan, " Non-conventional Energy Sources", Tata McGraw-hill Publishing Company.
7. P. S. Bimbhra, "Power Electronics", Khanna Publishers, 3rd Edition,2003.
8. Fang Lin Luo Hong Ye, "Renewable Energy systems", Taylor & Francis Group,2013.
9. R. Seyezhai and R. Ramaprabha, "Power Electronics for Renewable Energy Systems", Scitech Publications, 2015.

First Year M.Tech			
Elective-I : B. Control Design Techniques for Power Electronic Systems (PEPEC905B)			
Course Code:	**PEPEC905B**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To explore conceptual bridges between the fields of Control Systems and Power Electronics
2	To explain various advanced control techniques relevant to the design of controllers in Power Electronics

Course Outcomes: Students will be able to:	
1	Apply modern linear and nonlinear control strategies for power electronics devices
2	Design appropriate controllers for modern power electronics devices
3	Apply different stability concepts in the context of linear and nonlinear systems

Topics covered:		
UNIT I:	**Classical and Modern Control Concept**	**(06 Hrs)**
Proportional Integral and Derivative (PID) control, State space method, analysis and design of control system in state space,		
UNIT II:	**Approximate Linearization Methods**	**(06 Hrs)**
Pole placement by state feedback, state observer, design of control system with Luenberger observer. Reduced Order Observer		
UNIT III:	**Optimal Control**	**(06 Hrs)**
Performance Indices, Linear Quadratic Regulator, Dynamic Programming, Pontryagin's Minimum Principle.		
UNIT IV:	**Sliding Mode Control**	**(06 Hrs)**
Sliding Mode Control: Introduction, chattering, chattering attenuation, concept of equivalent control, sliding mode equation, sliding surface design, Gao's reaching laws, regular form.		
UNIT V:	**Nonlinear Control Methods**	**(06 Hrs)**
Nonlinear Systems and Equilibrium Points , Concepts of Stability, Linearization, Stability analysis of nonlinear systems, Feedback Linearization, Input-output linearization, Input-State Linearization.		
UNIT VI:	**Stability**	**(06 Hrs)**
Introduction to Stability, Basic definitions of Stability, Stability of Linear Systems, Stability of Nonlinear Systems, Lyapunov's Indirect Method.		

Reference Books:

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall India, 5th Edition, 2010.
2. Jean-Jacques E. Slotine,"Applied Non Linear Control", Prentice Hall Englewood Cliffs, New Jersey.
3. Sarah K. Spurgeon, " Sliding-mode Control: Theory and applications" , Taylor & Francis, 1998
4. Stanislaw H Zak, "Systems and Control" , Oxford University Press, 2003.

First Year M.Tech			
Elective-I : C. Power Electronics and FACTS Devices (PEPEC905C)			
Course Code:	**PEPEC905C**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	**Course assessment methods/tools**	**External/ Internal**	**Marks**
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To emphasize the need for FACTS controllers.
2	To learn the characteristics, applications and modelling of series and shunt FACTS controllers.
3	To analyze the interaction of different FACTS controller and perform control coordination

Course Outcomes: Students will be able to:	
1	Understand the operation of the compensator and its applications in power system.
2	Understand the various emerging Facts controllers.
3	Know about the genetic algorithm used in Facts controller coordination.

Topics covered:		
UNIT I:	**Introduction**	**(6 hrs.)**
Need for FACTS controllers, types of FACTS controllers, Brief Description and Definitions of FACTS Controllers, Benefits from FACTS Technology.		
UNIT II:	**Static VAR Compensator (SVC)**	**(6 hrs.)**
Tyristor Controlled Reactor (TCR) - Thyristor Switched Reactor (TSR) - Thyristor Switched Capacitor (TSC) - Fixed Capacitor - Thyristor Controlled Reactor (FC-TCR) - Thyristor Switched Capacitor - Thyristor Controlled Reactor (TSC -TCR) – V-I Characteristics of Static Var Compensator (SVC) - Advantages of slope in dynamic Characteristic – Voltage control by SVC – Design of SCV voltage regulator		
UNIT III:	**Thyristor And GTO Thyristor Controlled Series Capacitors (TCSC and GCSC)**	**(6 hrs.)**
Concepts of Controlled Series Compensation – Operation of TCSC and GCSC- Analysis of TCSC-GCSC – Modelling of TCSC and GCSC for load flow studies- modeling TCSC and GCSC for stability studied- Applications of TCSC and GCSC.		
UNIT IV:	**Voltage Source Converter Based Facts Controllers**	**(6 hrs.)**
Principle of Operation of STATCOM, A Simplified Analysis of a Three Phase Six Pulse STATCOM, Analysis of a Six Pulse VSC Using Switching Function, Multi-pulse Converters, Control of Type 2 Converters, Control of Type 1 Converter, Multilevel Voltage Source Converters, Harmonic Transfer and Resonance in VSC, Applications of STATCOM		
UNIT V:	**Controllers And Their Coordination**	**(6 hrs.)**
FACTS Controller interactions – SVC–SVC interaction - co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination.		

UNIT VI:	Dynamic Voltage Restorer And Unified Power Quality Conditioner	(6 hrs.)
Introduction, Dynamic Voltage Restoration, Series Active Filtering, A Case Study on DVR, Unified Power Quality Conditioner, A Case Study on UPQC		

Reference Books:

1. A.T.John, "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. NarainG.Hingorani, Laszio. Gyugyl, "Understanding FACTS Concepts and Technology of Flexible AC Transmission System", Standard Publishers, Delhi 2001.
3. V. K.Sood, "HVDC and FACTS controllers- Applications of Static Converters in Power System", 2004, Kluwer Academic Publishers
4. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc.
5. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Ltd., Publishers New Delhi, Reprint 2008,

First Year M.Tech			
Audit Course-I: Introduction to Constitution (PEHSM906)			
Course Code:	**PEHSM906**	**Credit**	**01**
Contact Hours:	1 Hrs./week (L)	**Type of Course:**	Lecture/Tutorial
Examination Scheme	Term-work 25 marks		

Course Objective:	
1	To realise the significance of constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution.
2	To identify the importance of fundamental rights as well as fundamental duties.
3	To understand the functioning of Union, State and Local Governments in Indian federal system.
4	To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.

Course Outcomes: Students will be able to	
1	Understand the philosophy of Constitution of India.
2	Understand their freedoms and responsibilities.

Topics covered:

UNIT I:	**Philosophy of the Indian Constitution**	**(3 hrs.)**

a) Constitutional History of India
b) Role of Dr. B. R. Ambedkar in Constituent Assembly
c) Preamble - Source and Objects
d) Sovereign and Republic
e) Socialist and Secular
f) Democratic - Social and Economic Democracy
g) Justice - Social, Economic and Political
h) Liberty - Thought, Expression, Belief, Faith and Worship
i) Equality - Status and Opportunity
j) Fraternity, Human Dignity, Unity and Integrity of the Nation

UNIT II:	**Fundamental Rights**	**(4 hrs.)**

a) Right to equality
b) Right to freedoms
c) Right against exploitation
d) Right to freedom of religion
e) Cultural and educational rights
f) Right to property
g) Right to constitutional remedies

UNIT III:	**Directive Principles of State Policy**	**(4 hrs.)**

a) Equal Justice and free legal aid
b) Right to work and provisions for just and humane conditions of work
c) Provision for early childhood, Right to education and SC,ST, weaker section
d) Uniform Civil Code
e) Standard of Living, nutrition and public health
f) Protection and improvement of environment
g) Separation of Judiciary from executive
h) Promotion of International peace and security

UNIT IV:	Fundamental Duties	(3 hrs.)

a) Duty to abide by the Constitution
b) Duty to cherish and follow the noble ideals
c) Duty to defend the country and render national service
d) Duty to value and preserve the rich heritage of our composite culture
e) Duty to develop scientific temper, humanism, the spirit of inquiry & reform
f) Duty to safeguard public prope1ty and abjure violence
g) Duty to strive towards excellence

Reference Books:

1. D. D. Basu, Introduction to the Constitution of India, LexisNexis.
2. Granville Austin, The Constitution of India: Cornerstone of a Nation, Oxford University Press
3. Subhash Kashyap, Our Constitution, National Book Trust
4. M. P. Jain, Indian Constitutional Law, LexisNexis
5. V. N. Slmkla, Constitution of lndia, Eastern Book Company
6. P. M. Bakshi, The Constitution of India , Universal Law Publishing
7. M. V. Pylee, Constitutional Government in India , S. Chand
8. V. S. Khare, Dr. B. R. Ambedkar and India's National Security

First Year M.Tech			
Research Methodology (PEELC907)			
Course Code:	**PEELC907**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To develop understanding of the basic framework of research and identify various sources of information for literature review.
2	To identify various sources of data collection and analyze the same.
3	An ability to prepare technical document using LATEX.
4	To develop an understanding of the ethical issues related to research.
5	To enable students to differentiate between different types of technical papers.
6	To develop this skill of report writing and preparing a research proposal.

Course Outcomes: Students will be able to:	
1	Understand some basic concepts of research and its methodologies
2	Select and define appropriate research problem and its parameters
3	Demonstrate knowledge and understanding of data analysis
4	Prepare research proposal and write a research thesis using LATEX follow research ethics

Topics covered:		
UNIT I:	**Basics of Research**	**(5 hrs.)**
Definition, Research Characteristics, Research Need, Objectives and types of research: Motivation and objectives – Research methods vs Methodology, Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.		
UNIT II:	**Research Formulation**	**(8 hrs.)**
Defining and formulating the research problem, Selecting the problem Necessity of defining the problem, Importance of literature review in defining a problem. Using web for literature review, Types of literature: books, papers, reviews, treatise, monographs, patents, process of identifying gap areas from literature review Development of working hypothesis. Different tools for literature survey.		
UNIT III:	**Data Collection and Analysis**	**(7 hrs.)**
Data Collection and analysis:- Observation and Collection of primary and secondary data - Methods of data collection, processing operations, types of analysis, statistics in research, measures of central tendency, measures of dispersion, measures of asymmetry, measures of relationships, simple regression analysis, multiple correlation and regression, partial correlation.		

UNIT IV:	Assessment of Research Output	(6 hrs.)
Assessment of research output: Measure for quality of research, citation index Researcher metrics (i10-index, H-index etc.), Article metrics, Journal Metrics. Ethical practices in research such as plagiarism, acknowledgment etc. Commercialization of research, Copy right, royalty, Intellectual property rights and patent law, Trade related aspects of Intellectual Property Rights, patent search, drafting and filing patent, legal procedure in granting patent.		
UNIT V:	**Technical Writing**	**(6 hrs.)**
Structure and components of scientific reports, Types of report – Technical reports and thesis, Significance, Different steps in the preparation, Layout, structure and Language of typical reports. Writing papers: types of technical papers, Journal papers, Conference papers, Survey papers, Poster papers, Comparison, Structure of a survey, conference and journal paper. Writing Research Proposal: Importance of research funding in research, standard formats for different research schemes of AICTE, DST. Preparation for research proposal, how to write a research proposal		
UNIT VI:	**LATEX**	**(6 hrs.)**
Report/Thesis preparation using LATEX Important parts of reports like abstract, results, conclusion. Supplementary parts like list of symbols, list of tables, annexure, references etc. Making title page, writing mathematical equations, including graphics, making tables and writing references using LaTex/ MiKTeX.		

Reference Books:

1. Kothari, C.R., Research Methodology: Methods and Techniques. New Age International
2. Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners, 2nd Edition, APH Publishing Corporation
3. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., An introduction to Research Methodology, RBSA Publishers
4. Suresh Sinha, Anil K Dhiman, Research Methodology, ESS Publications,Volumes 2
5. Day R.A., How to Write and Publish a Scientific Paper, Cambridge University Press
6. Wadehra, B.L. Law relating to patents, Trade Marks, copyright designs and geographical indications. Universal Law Publishing.
7. Leslie Lamport, ' Latex: A document preparation system' Addison Wesley, Reading, Massachusetts, second edition, 1994, ISBN 0-201-52983-1

M. Tech. (Power Electronics and Drives) – First Year (Semester –II)

First Year M. Tech			
AC and DC Drives (PEPCC1001)			
Course Code:	**PEPCC1001**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	**Course assessment methods/tools**	**External/ Internal**	**Marks**
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To understand the stable steady-state operation and transient dynamics of a motor-load system.
2	To study and analyse the operation of the converter, chopper fed dc drive.
3	To study and understand the operation of both classical and modern induction motor drives.
4	To study and analyse the operation of Reluctance Motor, PMSM and BLDC drives.

Course Outcomes: Students will be able to:	
1	Analyse the operation of the converter, chopper fed dc drive.
2	Analyse the operation of both classical and modern induction motor drives.
3	Demonstrate knowledge of controls of Synchronous motor drives
4	Demonstrate knowledge of Operation of Reluctance Motor, PMSM and BLDC drives.

Topics covered:		
UNIT I:	**Review of Conventional Drives**	**(6 hrs.)**
Speed –torque relation, Steady state stability, methods of speed control, braking for DC motor – Multi quadrant operation, Speed torque relation of AC motors, Methods of speed control and braking for Induction motor, Synchronous motor. Criteria for selection of motor for drives.		
UNIT II:	**Control of DC Drives**	**(6 hrs.)**
Converter Control of DC Drives: Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configurations. **Chopper Control of DC Drives:** Analysis of series and separately excited DC motors fed from different choppers for both time ratio control and current limit control, four quadrant control.		
UNIT III:	**Design of DC Drives**	**(6 hrs.)**
Single quadrant variable speed chopper fed DC drives, Four quadrant variable speed chopper fed DC Drives, Single phase/ three phase converter, Dual converter fed DC Drive, current loop control, Armature current reversal, Field current control, Different controllers and firing circuits, simulation.		
UNIT IV:	**Control of Induction Motor Drive**	**(6 hrs.)**
Slip power recovery drives – Static Kramer Drive – Phasor diagram – Torque expression – speed control of Kramer Drive – Static Scherbius 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 V:	Control of Synchronous Motor Drives	(6 hrs.)
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 VI:	**Variable Reluctance and Brushless DC Motor Drives**	**(6 hrs.)**
Variable Reluctance motor drive – Torque production in the variable reluctance motor Drive characteristics and control principles – Current control variable reluctance motor service drive. Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor- current controlled Brushless dc motor Servo drive.		

Reference Books:

1. Electric Motor Drives Pearson Modelling, 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, 1st edition
4. Power Electronics and Variable frequency drives – BK Bose – IEEE Press – Standard publications - 1st edition – 2002.
5. Fundamentals of Electrical Drives – G.K. Dubey – Narora publications – 1995

First Year M. Tech			
Analysis and Design of Inverters (PEPCC1002)			
Course Code:	**PEPCC1002**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To provide the electrical circuit concepts behind the different working modes of inverters so as to enable deep understanding of their operation.
2	To equip with required skills to derive the criteria for the design of inverters for UPS, drives etc.
3	To analyse and comprehend the various operating modes of different configurations of inverters
4	To design different single phase and three phase inverters.
5	To impart knowledge on multilevel inverters and modulation techniques.

Course Outcomes: Students will be able to:	
1	Explain basic principles of inverters and models of operation of different types of inverters
2	Select appropriate topologies for inverters
3	Design the power stage with controllers for various applications.
4	Apply advanced modulation techniques for analyzing and designing inverters.

Topics covered:		
UNIT I:	**Single Phase Inverters**	**(6 hrs.)**
Principle of operation of half and full bridge inverters – Performance parameters – Voltagecontrol of single phase inverters using various PWM techniques – various harmonic elimination techniques – forced commutated thyristor inverters.		
UNIT II:	**Three Phase Voltage Source Inverters**	**(6 hrs.)**
180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques – Application to drive system.		
UNIT III:	**Current Source Inverters**	**(6 hrs.)**
Operation of six-step thyristor inverter – inverter operation modes – load – commutated inverters – Auto sequential current source inverter (ASCI) – current pulsations – comparison of current source inverter and voltage source inverters – PWM techniques for current source inverters.		
UNIT IV:	**Multilevel & Boost Inverters**	**(6 hrs.)**
Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters – PWM techniques for MLI – Single phase & Three phase Impedance source inverters.		

UNIT V:	Resonant Inverters And Power Conditioners	(6 hrs.)
Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – resonant DC - link inverters.-power line disturbances-power conditioners-UPS: offline UPS, online UPS.		
UNIT VI:	**Modern Inverters and Gating Circuits**	**(6 hrs.)**
Resonant inverters - Series and parallel - Class E series inverter - ZCS and ZVS concepts - Resonant DC link inverters - Gating circuit for single phase complementary commutated inverter - Logic circuit for three phase current source inverter.		

Reference Books:

1. Rashid M. H., “Power Electronics Circuits, Devices and Applications ", PrenticeHall India, Third Edition, New Delhi, 2004.
2. Jai P. Agrawal, “Power Electronics Systems”, Pearson Education, Second Edition, 2002
3. Bimal K. Bose “Modern Power Electronics and AC Drives”, Pearson Education, Second Edition, 2003
4. M. H. Rashid, “Power Electronics: Circuits, Devices and Application”, Pearson, Education of India,2011
5. P. S. Bimbhra, “Power Electronics”, Khanna Publishers, Delhi, 4th Edition, 2006.

First Year M. Tech			
Advanced Microcontroller Applications (PEPCC1003)			
Course Code:	**PEPCC1003**	**Credit**	**04**
Contact Hours:	4 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To explain the architecture of PIC 18F458 microcontroller.
2	To demonstrate programming of PIC18f458 microcontroller in C language programs.
3	To interface various devices with PIC18F458.

Course Outcomes: Students will be able to:	
1	Describe architecture of PIC microcontroller.
2	Develop a program PIC microcontroller for various applications.
3	Interface I/O devices with PIC microcontroller and develop programs to control different types of motors.

Topics covered:		
UNIT I:	**PIC Architecture**	**(8 hrs.)**
CISC and RISC architectures, Architecture of PIC 18F458 microcontroller. Embedded C concepts. Port Programming.		
UNIT II:	**Timer and Interrupt Programming of PIC18F458 Microcontroller**	**(8 hrs.)**
Timers in PIC microcontroller programing of timers in C for generation of delay. Interrupt Structure of PIC microcontroller and Programming External interrupts.		
UNIT III:	**Special Hardware Features and Programming of PIC18F458 Microcontroller**	**(8 hrs.)**
Serial Port Structure and its programming, CCP module in PIC 18F458 microcontroller, Applications of CCP mode.		
UNIT IV:	**PIC Microcontroller Based Data Acquisition and Control**	**(8 hrs.)**
PIC ADC Programming ADC. Interfacing of sensors using PIC microcontroller. Interfacing DAC.		
UNIT V:	**Interfacing of Motors and Output Devices with PIC Microcontroller**	**(8 hrs.)**
DC motor control, Stepper Motor Interfacing, Servo motor interfacing, Interfacing of LCD and Keyboard, Relay and Opt isolator.		
UNIT VI:	**Microcontroller Based Application Development**	**(8 hrs.)**
Induction Motor control (VSI and CSI fed) , UPS Applications , Special Machine control (PMBLDC). Design of a closed loop temperature monitoring system using PIC microcontroller.		

	Reference Books:
1	PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. McKinley, Danny Causey, Pearson Education.
2	Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC by Ramesh Gaonkar, Thomson and Delmar learning, First Edition.
3	Programming And Customizing the PIC Microcontroller by Myke Predko, TATA McGraw-Hill.
4	PIC microcontroller: An introduction to software and Hardware interfacing by HanWay-Huang Thomson Delmar Learning.
5	MICROCHIP Technical Reference Manual of 18F4520 Embedded Design with PIC 18F452 Microcontroller by John B. Peatman, Prentice Hall.
6	PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. McKinley, Danny Causey, Pearson Education.

First Year M. Tech			
Special Applications of Power Electronics (PEPCC1004)			
Course Code:	**PEPCC1004**	**Credit**	**04**
Contact Hours:	4 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To enable the students to understand the use of power electronics in utility applications.
2	To learn the fundamentals of the smart grid, its purpose and objectives, architectures.
3	To gain the knowledge of, issues and challenges that remain to be solved and understand the various aspects of the smart grid, including communication and measurement technologies.
4	To understand role of Internet of Things in smart grid.
5	To introduce objectives, communication technologies and automotive applications of smart cities.
6	To understand the different compensation techniques using FACTS.

Course Outcomes: Students will be able to:	
1	Specify the need and describe the components of smart grid and smart communication.
2	Comprehend the implementation of power electronics in utility applications.
3	Describe concept, definitions, functions and architectures of smart grid, micro grid and distributed energy generation.
4	Explain issues and challenges of interconnection along with various measurement and communication technology.
5	Explain Internet of Things and devices, its applications for smart grid and smart power transmission.
6	Describe concept, objectives of smart cities and communication networks.

Topics covered:		
UNIT I:	**MTDC System and HVDC Light**	**(8 hrs.)**
Introduction to MTDC system and HVDC light, Concept of Multi terminal HVDC systems and HVDC light, Configuration and types. Introduction to VSC transmission, Power transfer characteristics, Structure of VSC link, HVDC light technology.		
UNIT II:	**Reactive Power Compensation**	**(8 hrs.)**
Basic concepts of Reactive Power Compensation, Improvement in voltage profile and power factor, Modeling and control of Thyristorised controlled series compensators, Static VAR Compensation – Basic concepts, Thyristor controlled reactor (TCR), Thyristor switched reactor (TSR), Thyristor switched capacitor.		
UNIT III:	**IoT Based Applications in Power Electronics**	**(8 hrs.)**
Introduction to IoT (Internet of Things) Technology, Role of IoT in smart grid, Sensors and actuators used for signal acquisition and control e.g. Smart Metering, Power electronics in signal conditioning required for Inter facing sensors to open source hardware, Applications in Data Acquisition and Substation Automation.		

UNIT IV:	Communication Infrastructures for Smart City	(8 hrs.)
Concept of communication protocol, IP addressing and layers of communication, Role of power electronics in client server communication, Concept and Objectives of smart city, Two-way Digital Communications Paradigm, Infrastructures Modern communication networks like Zigbee, Bluetooth, HAN, WLAN , WIMaxetc, Automotive Applications, Smart home, Smart building, Concept of Cyber security and Cloud computing.		
UNIT V:	**Applications in Smart Grid**	**(8 hrs.)**
Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Micro Grids, Distributed Energy Resources and their interconnection with a hosting grid, Integration and interconnection issues and challenges. Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU), Application of PMU for Wide Area Monitoring Protection and Control (WAMPAC).		
UNIT VI:	**Applications in Industries**	**(8 hrs.)**
Switched Mode Power Supplies, UPS and Battery charging system, Applications of Power Electronics in Heating & Welding, Illumination application, Electronic Ballast, AC-DC electric locomotives systems, Hybrid vehicle systems.		

Reference Books:

1. Clark Gellings, The Smart Grid: Enabling energy efficiency and demand response, CRC Press.
2. Arun G. Phadke, J. S. Thorp, Synchronized Phasor Measurements and their Applications, Springer Publications.
3. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Willy Publications.
4. Padiyar K. R, HVDC Transmission Systems, Wiley Eastern Limited, New Delhi.
5. Rashid M. H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, New Delhi.

First Year M. Tech			
Lab Practice II (PEPCC1005)			
Course Code:	**PEPCC1005**	**Credit**	**02**
Contact Hours:	4 Hrs./week (P)	**Type of Course:**	Lecture/Tutorial
Examination Scheme	Term-work 50 marks	Oral/Presentation 50 marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	Term-work	Internal	50
2.	Oral/Presentation	Internal	50

Course Objective:	
1	To develop thinking skills.
2	To develop data analysis skills.
3	To develop experimental skills.
4	To develop communication skills.

Course Outcomes: Students will be able to	
1	Design simulation of electrical drives.
2	Analyze power quality analysis of UPS loads / drives used in industry.
3	Design and analysis of snubber circuit.
4	Design and simulation of sliding mode control for double integrating system.

List of Experiments:

Minimum eight experiments should be performed under Lab Practice II from the following list

1	Modeling and simulation of Chopper fed DC drive.
2	Study of the performance characteristics of vector controlled three phase Induction motor.
3	Study of performance characteristics of BLDC motor drive.
4	Power Quality Analysis of UPS loads / Drives used in industry.
5	Power Quality audit and Report on effect of renewables on power quality parameters in an electrical network grid
6	To study the performance characteristics of Switched Reluctance motor.
7	Simulation of three phase voltage regulator.
8	Design and analysis of snubber circuit.
9	Design of heat sink.
10	Design of Luenberger observer for DC motor drive.
11	Design and simulation of finite time Linear Quadratic Regulator (LQR).
12	Design and simulation of sliding mode control for double integrating system.
13	Analysis of closed loop control of converter based system.
14	Study of Power Quality Analyser -Class A- Fluke 435 (II)/430 (II), Elspec.

	Reference Books:
1	Chee-Mun Ong, “Dynamic Simulation of Electric Machinery using Matlab / Simulink”, Prentice Hall, 1998.
2	Matrix Analysis of Electric Machines, N. N. Hancock, Pergamon Press.
3	Matrix Analysis of Electric Machines by Mukhopadhyay
4	Joseph Vithayathil, "Power Electronics - Principles and Applications", McGraw Hill Inc., New York, 1995
5	Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, New Delhi, 1996
6	R. Bausiere & G. Seguier, Power Electronic Converters, Springer- Verlag, 1987.
7	D. M. Mitchell, DC-DC Switching Regulator Analysis McGraw Hill, 1987

First Year M. Tech			
Elective-II: A. Emerging Trends in Power Conversion Technology (PEPEC1006A)			
Course Code:	**PEPEC1006A**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	**Course assessment methods/tools**	**External/ Internal**	**Marks**
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective: The student will be able to understand	
1	Different Inverter control techniques
2	Advance converters like Resonant Converters, multilevel inverters
3	Concept of SMPS and its detailed analysis
4	Different Protections required in power converters

Course Outcomes: Students will be able to:	
1	Use different converters in given application
2	Use different control techniques for power converters
3	Develop a good insight about the practical issues in power electronics circuit design.
4	Gain skills to understand operational issues and limitations of practical converters

Topics covered:		
UNIT I:	**PWM Inverters**	**(6 hrs.)**
Voltage Control of single phase and three phase Inverter: Sinusoidal Pulse Width Modulation, Modified SPWM, Phase displacement control, Space Vector PWM, Comparison of PWM Techniques.		
UNIT II:	**Multilevel Inverters**	**(6 hrs.)**
Introduction, Concept of Multilevel, Types of Multilevel inverter: Diode Clamped, Cascaded, Flying Capacitor. Application of Multilevel inverter.		
UNIT III:	**Resonant Converters**	**(6 hrs.)**
Concept of basic resonant circuit, Classification and Analysis of ZVS and ZCS, Advantages, Applications.		
UNIT IV:	**Switch Mode Power Supply**	**(6 hrs.)**
Introduction, Linear power supplies, Overview of Switching power supplies, DC-DC, Converters with electrical isolation, Control of Switch mode power supplies, Power supply protection. Design of SMPS.		
UNIT V:	**Thermal Design**	**(6 hrs.)**
Thermal modelling of power switching devices, Electrical equivalent thermal model, Heat sink design, Selection of Heat Sink.		
UNIT VI:	**Magnetic Design and Snubber Circuit**	**(6 hrs.)**
A) **Magnetic design:** Specific inductor design and procedure B) **Snubber circuit:** Need of Snubber circuit, Types of Snubber circuits: Turn-ON snubber, Turn-OFF snubber and over voltage Snubber.		

	Reference Books:
1	Ned Mohan, Undeland, Robbins, “Power Electronics: Converters, Design and Applications”, WILEY India Edition
2	Rashid M.H ,"Power Electronics Circuits, Devices and Applications ", Prentice Hall India,
3	B.W.Williams, “Power Electronics: Devices, Drivers, Applications and Passive components”, McGraw-Hill.
4	Robert W.Erickson, Dragan Maksimovic, “Fundamentals of Power Electronics”, Springer,2nd Edition
5	Keith Billings, “Switch mode Power Supply Handbook” , Taylor Morey McGraw-Hill

First Year M. Tech			
Elective-II : B. Distributed Generation and Micro Grid (PEPEC1006B)			
Course Code:	**PEPEC1006B**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	**Course assessment methods/tools**	**External/ Internal**	**Marks**
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To illustrate the concept of distributed generation.
2	To analyze the impact of grid integration.
3	To study concept of Microgrid and its configuration.

Course Outcomes: Students will be able to:	
1	Explain the various schemes of conventional andnonconventional power generation.
2	Explain the topologies and energy sources of distributed generation.
3	Describe the requirements for grid interconnection and its impact.
4	Explain the fundamental concept of Microgrid.

Topics covered:

UNIT I:	**Introduction**	**(6 hrs.)**

Conventional power generation: benefits & limitations, Energy crises, Non- conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II:	**Distributed Generations**	**(6 hrs.)**

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants.

UNIT III:	**Impact of Grid Integration**	**(6 hrs.)**

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Voltage control techniques, Reactive power control, Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV:	**Microgrid Architecture**	**(6 hrs.)**

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, components & architecture of micro grid, Power Electronics interfaces in DC and AC microgrids.
Renewable sources in distributed generation – Current scenario in distributed generation – Planning of DGs – location and sizing of DGs – Optimal placement of DG sources in distribution systems.

UNIT V:	Microgrid Operating Modes & Economics	(6 hrs.)
Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.		
UNIT VI:	**Metering & Interfacing**	**(6 hrs.)**
Challenges: economic issues and constraints, environmental impact. Market facts, issues with DGs – smart meters - metering infrastructures for micro grid - metering equipment - communication of metering equipment - communication protocols - Metering Data Management Systems (MDMS) - Application of DGMGs - Interconnections issues between MGs. Micro-grids with power electronic interfacing units – Transients in micro-grids – Protection of micro-grids – Case studies.		

Reference Books:

1. N. Hatziargyriou, Microgrids: Architectures and Control, Wiley-IEEE Press, 1st Edition, 2014
2. J. N. Twidell &A. D. Weir, Renewable Energy Sources, University press ,Cambridge, 2001
3. J. F. Manwell , J. G. McGowan, A. L. Rogers , Wind Energy Explained, John Weily & Sons Ltd 2009
4. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
5. D. D. Hall and R. P. Grover, "Biomass Regenerable Energy", John Wiley, New York, 1987.
6. John Twidell and Tony Weir, "Renewable Energy Resources" Tyalor and Francis Publications, Second edition 2006.

First Year M. Tech			
Elective-II : C. Embedded Systems (PEPEC1006C)			
Course Code:	**PEPEC1006C**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	**Course assessment methods/tools**	**External/ Internal**	**Marks**
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	Explain basics of embedded systems and networking protocols.
2	Explain basics of Real time operating systems.
3	Explain architecture of ARM 9 processor.
4	Explain basics of Embedded Linux and Scripting language.

Course Outcomes: Students will be able to:	
1	Describe concept of embedded system.
2	Use various networking protocols.
3	Describe concept of Real time systems.
4	Describe architecture of ARM 9 processor.
5	Use Embedded LINUX for embedded programming.
6	Use Python Scripting language for programming embedded system.

Topics covered:		
UNIT I:	**Introduction to Embedded Systems**	**(6 hrs.)**
Introduction to Embedded Systems –Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.		
UNIT II:	**Embedded Networking**	**(6 hrs.)**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS42 – RS 485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C).		
UNIT III:	**Real Time Systems Concepts**	**(6 hrs.)**
Foreground/ Background systems, Critical section of code, Resource, Shared resource, multitasking, Task, Context switch, Kernel, Scheduler, Non-Preemptive Kernel , Preemptive Kernel, Reentrancy, Round robin scheduling, Task Priorities, Static & Dynamic Priority, Priority Inversion, Assigning task priorities, Mutual Exclusion, Deadlock, Clock Tick, Memory requirements, Advantages & disadvantages of real time kernels.		
UNIT IV:	**ARM-9 Architecture**	**(6 hrs.)**
ARM-9-TDMI Processor core, ARM architectural support for high level language, ARM architectural support for system development, ARM architectural support for operating System, Memory subsystem architecture, Designing a cache system, Memory allocation, Communication protocols.		

UNIT V:	Embedded Linux	(6 hrs.)
System architecture, BIOS versus boot-loader, Booting the kernel, Kernel initialization, Space initialization, Boot loaders, Storage considerations Linux kernel construction: Kernel build system, Obtaining a custom Linux kernel, File systems, Device drivers, Kernel configuration.		
UNIT VI:	**Scripting Languages**	**(6 hrs.)**
Scripting Languages for Embedded Systems Shell scripting, Programming basics of Python, Comparison of scripting languages.		

Reference Books:

1. Steve Furber, "ARM System-on-Chip Architecture", Second Edition, Pearson Education Publication.
2. Tammy Noergaard, "Embedded Systems Architecture", Elsevier Publication.
3. Christopher Hallinan, "Embedded Linux Primer: A Practical Real-World Approach", Second Edition, Pearson Education Publication.
4. Craig Hollabaugh, "Embedded Linux, Hardware, Software and Interfacing", Pearson Education Publication.
5. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition, McGraw Hill.
6. Programming Microcontrollers with Python: Experience the Power of Embedded Python by Armstrong Subero Apress.

First Year M. Tech			
Elective-II : D. Electric Vehicles and Power Management (PEPEC1006D)			
Course Code:	**PEPEC1006D**	**Credit**	**03**
Contact Hours:	3 Hrs./week (L)	**Type of Course:**	Lecture
Examination Scheme	In-sem. Evaluation 40 Marks	End-sem. Examination 60 Marks	

Sr. No.	Course assessment methods/tools	External/ Internal	Marks
1.	In-sem. Evaluation	Internal	**40**
2.	End-sem. Examination	External	**60**

Course Objective:	
1	To familiarize with the basic electric components configuration for the Electric Propulsion unit.
2	To expose utilization of different Energy storage system and Hybridization.
3	To inculcate the knowledge while resolving issue of Energy management system.

Course Outcomes: Students will be able to:	
1	Understand the Electric components in detail.
2	Apply controls of different motors for drive system efficiency.
3	Understand various Energy storage devices including the Hybridization.
4	Apply Energy management system strategies to solve problems.

Topics covered:		
UNIT I:	**Introduction**	**(4 hrs.)**
Conventional Vehicle: Vehicle Fundamentals. History of Electric and Hybrid Vehicles, Components of Electric and Hybrid Vehicles .Comparison with internal combustion Engine, advantages and Disadvantages.		
UNIT II:	**Electric and Hybrid Vehicle**	**(7 hrs.)**
Electric vehicles: - Components, configuration, performance, tractive efforts in normal driving, Advantages and challenges in EV design. Hybrid Electric vehicles: - Concept and architecture of HEV drive train (Series, parallel and series-parallel).Energy consumption of EV and HEV.		
UNIT III:	**Drives**	**(7 hrs.)**
DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor based vector control operation – Switched reluctance motor (SRM) drives Drives: - Application of BLDC drives and Switched reluctance motor drive for HEV and EV, performance characteristics of drives.		
UNIT IV:	**Energy Storage**	**(7 hrs.)**
Introduction to energy storage requirements in Hybrid and Electric vehicles, battery-based energy storage and its analysis, Fuel cell based energy storage and its analysis, Ultra capacitor based energy storage and its analysis, flywheel based energy storage and its analysis.		

UNIT V:	Charging Station	(7 hrs.)
Types of Charging station. Selection and sizing of charging station. Components of charging station. Single line diagram of charging station. Battery management system representation: - battery module, measurement unit block, battery equalization balancing unit, MCU estimation unit, display unit, fault warning block. SoC and SoH, estimation of SoC, battery balancing, Thermal monitoring of Battery unit.		
UNIT VI:	**Indian and Global Scenario**	**(4 hrs.)**
Indian and Global Scenario. Market Scenario. Policies and Regulations. Policies in India. Overview of Tesla car and Toyota prius.		

Reference Books:

1. Mehrdad Ehsani, Yimin Gao and Ali Emadi, "Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and design", CRC Press, 2009.
2. James Larminie and John Lowry, "Electrical Vehicle", John Wiley and Sons, 2012.
3. Ronald K. Jurgen, "Electric and Hybrid-Electric Vehicles", SAE International Publisher.
4. K T Chau, "Energy Systems for Electric and Hybrid Vehicles", The institution of Engineering and Technology Publication.
5. D.A.J Rand, R Woods, R M Dell, "Batteries for Electric Vehicles", Research studies press Ltd, New York, John Willey and Sons.

First Year M. Tech			
Audit Course-II: Human Values in Ethics and Education (PEHSM1007)			
Course Code:	**PEHSM1007**	**Credit**	**01**
Contact Hours:	1 Hrs./week (L)	**Type of Course:**	Lecture/Tutorial
Examination Scheme	Term-work 25 marks		

Course Objective:	
1	To create an awareness on Engineering Ethics and Human Values.
2	To instill Moral and Social Values and Loyalty.
3	To appreciate the rights of others.
4	To create awareness on assessment of safety and risk.

Course Outcomes: Students will be able to	
1	Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field.
2	Identify the multiple ethical interests at stake in a real-world situation or practice.
3	Articulate what makes a particular course of action ethically defensible.
4	Assess their own ethical values and the social context of problems.
5	Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects.
6	Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research.

Topics covered:		
UNIT I:	**Human Values**	**(3 hrs.)**
Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully –Caring –Sharing –Honesty -Courage-Cooperation– Commitment – Empathy –Self Confidence Character –Spirituality-Case Study.		
UNIT II:	**Engineering Ethics**	**(3 hrs.)**
Senses of 'Engineering Ethics-Variety of moral issued –Types of inquiry –Moral dilemmas – Moral autonomy –Kohlberg's theory-Gilligan's theory-Consensus and controversy –Models of professional roles-Theories about right action-Self interest -Customs and religion –Uses of Ethical theories – Valuing time –Co operation –Commitment-Case Study.		
UNIT III:	**Engineering as Social Experimentation**	**(3 hrs.)**
Engineering As Social Experimentation –Framing the problem –Determining the facts – Codes of Ethics –Clarifying Concepts –Application issues –Common Ground -General Principles –Utilitarian thinking respect for persons-Case study.		
UNIT IV:	**Engineers Responsibility for Safety and Risk**	**(3 hrs.)**
Safety and risk –Assessment of safety and risk –Risk benefit analysis and reducing risk- Safety and the Engineer-Designing for the safety-Intellectual Property rights (IPR).		
UNIT V:	**Global Issues**	**(3 hrs.)**
Globalization –Cross culture issues-Environmental Ethics –Computer Ethics –Computers as the instrument of Unethical behavior –Computers as the object of Unethical acts – Autonomous Computers-Computer codes of Ethics –Weapons Development -Ethics and Research –Analyzing Ethical Problems in research- Case Study.		

	Reference Books:
1	M. Govindarajan, S. Natarajananad, V. S. Senthil Kumar "Engineering Ethics includes Human Values" - PHI Learning Pvt. Ltd-2009.
2	Harris, Pritchard and Rabins "Engineering Ethics", CENGAGE Learning, India Edition, 2009.
3	Mike W. Martin and Roland Schinzinger "Ethics in Engineering" Tata McGraw- Hill–2003.
4	Prof. A. R. Aryasri, Dharanikota Suyodhana "Professional Ethics and Morals" Maruthi Publications.
5	A. Alavudeen, R. Kalil Rahman and M. Jayakumaran "Professional Ethics and Human Values" –Laxmi Publications.
6	Prof. D. R. Kiran "Professional Ethics and Human Values".
7	PSR Murthy "Indian Culture, Values and Professional Ethics" BS Publication