OP JINDAL UNIVERSITY

Raigarh-Chhattisgarh

Scheme and Syllabus

of

M.Tech

(Power Electronics and Power System)

(01PG031)

Department of

Electrical Engineering

School of Engineering

2020-2022

Programme Outcome (PO)

Currently OP Jindal University is offering undergraduate programmes (3/4 Years), postgraduate and doctoral programmes in the field of engineering, management, and science. OPJU aims to bring high quality education to its students based on a world class industry-based curriculum, the latest teaching methodology, research, innovation, and entrepreneurship developed by committed faculty members. The outcome of each of the programme in detail is summarized below:

Program Outcomes for Engineering Post Graduate Program

1. **Disciplinary knowledge**: Accomplish vertical expertise in chosen discipline and enhance ability to function in multidisciplinary domains.
2. **Research aptitude**: Ability and aptitude to exercise research intelligence in investigations/ innovations and to communicate the findings in a clear, concise manner.
3. **Project management**: Develop and apply knowledge of engineering and management principles to manage a project in a multidisciplinary environment.
4. **Ethics**: Gain knowledge of ethical principles and commit to professional ethics
5. **Self-directed lifelong learning**: Ability to identify appropriate resources and learn independently for projects, research etc. using online resources.

M.TECH. POWER SYSTEMS & POWER ELECTRONICS

Graduates from the **Power Systems & Power Electronics** are expected to achieve the following after post-graduation:

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1	Design, Implement, Protect, Test, and Validate the Power Electronic system for the applications of Power Systems, Electric Drives, Hybrid Electric Vehicles, and Renewable Energy Applications
PSO2	Acquire research competence and leadership to enable personal and professional growth and to pursue a career in a broad area of power system engineering globally.
PSO3	Attain competence in using novel tools and Artificial Intelligence in analysis and design of grid connected renewable energy systems and drives control systems.

Electrical Engineering
(Detailed Syllabus of 1st Semester)

L: Lecture, T: Tutorial, P: Practical, C: Credit

Semester I

Sl. No	Subject Code	Subject	Periods per Week			Scheme of Examination Theory/ Practical			Total Marks	Credit L+(T+P)/2
			L	T	P	MID	TA	ESE		
1.	SOE-M-PEP101	Advanced Numerical Methods and Scientific Computing	3	1	0	30	20	50	100	4
2.	SOE-M-PEP102	Power Electronic Devices & Circuits	3	1	0	30	20	50	100	4
3.	SOE-M-PEP103	Advanced Power System Analysis	3	1	0	30	20	50	100	4
4.	SOE-M-PEP104	Modern control Theory	3	1	0	30	20	50	100	4
5.	SOE-M-PEP105	HVDC Power Transmission	3	1	0	30	20	50	100	4
6.	SOE-M-PEP106	Power Electronic Lab	0	0	4	20	20	50	100	2
7.	SOE-M-PEP107	Advance Power System Simulation Lab	0	0	4	30	20	50	100	2
8.	SOE-M-	Research Seminar-I	0	0	0	15	10	25	50	2

	PEP108									
Total			15	5	8	225	150	375	750	26

L: Lecture, T: Tutorial, P: Practical, ESE: End Semester Examination, T.A: Teacher's Assessment

Programme:	**M.Tech**	**Semester :**	**I**
Name of the Course:	**Advanced Numerical Methods and Scientific Computing**	**Course Code:**	SOE-M-PEP101
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

Mathematical models are used to understand, predict and optimise engineering systems. Many of these systems are deterministic and are modelled using differential equations. Others are random in nature and are analysed using probability theory and statistics. This course provides an introduction to differential equations and their solutions and to probability and statistics, and relates the theory to physical systems and simple real world applications. Topics covered are: Ordinary differential equations, including first and second order equations and series solutions; Fourier series; partial differential equations, including the heat equation, the wave equation, Laplace's equation and separation of variables; probability and statistical methods, including sampling and probability, descriptive statistics, random variables and probability distributions, mean and variance, linear combinations of random variables, statistical inference for means and proportions and linear regression.

Course Objectives:

1. To develop an ability to conceptualize, inquire, reason and communicate mathematically and to use the mathematical computational tools to formulate and solve the real life problems.

2. To make students proficient in transform techniques for solving the mathematical models involving partial differential equations and models in signal processing.

3. To develop an ability to apply and implement the finite difference methods to critically analyse, model and control the systems modelled using partial differential equations.

4. To make students familiar with the important tools of calculus of variations for analysing and describing the behaviour of the functional.

5. To make students conversant with concepts and steps of finite element analysis of mathematical models, particularly in heat transfer and fluid mechanics.

Syllabus:

UNIT-1

Fourier Integrals and Fourier Transforms, Elementary properties of Fourier Transforms, Fourier Sine, and Cosine Transforms, Finite Fourier Transforms, Applications of Fourier Transforms in the solution of heat conduction equations

UNIT-2

The system of Linear Equations, Direct and Iterative methods, Tri - Diagonal System of Equations, Classification of Partial Differential Equations, Finite Difference Approximations, Solution of Parabolic Equations in one and two dimensions by Finite Difference Approximations Methods

UNIT-3:

Solution of Elliptic and Hyperbolic Partial Differential Equations by Finite Difference Approximation Methods

UNIT- 4:

Calculus of Variations, Steps involved in the Finite Element Method, Rayleigh – Ritz and Galerkin's Finite Element Methods, Types of Elements, One Dimensional Bar element, Application of Finite Element Method in the solution of One Dimensional Heat flow and Fluid flow Equations

UNIT-5:

Piece-wise continuous trial functions, two and three dimensional finite elements, Application of Finite Element Method in the solution of simple Two Dimensional Heat flow and Fluid flow Equations.

Recommended Text books and Reference books:

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley, and Sons, New York.
2. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw Hill Publishing Company, New Delhi.
3. Numerical Methods for Engineers by Steven C. Chapra & Raymond P. Canale, McGraw Hill Education, New York.
4. An Introduction to Finite Element Method by J. N. Reddy, Tata McGraw Hill Publishing Company, New Delhi.
5. The Finite Element Method in Heat Transfer and Fluid Dynamics by J. N. Reddy & D. K. Gartling, CRC Press.
6. Textbook of Finite Element Analysis by P. Seshu, PHI Learning Pvt. Limited, New Delhi.
7. A First Course in the Finite Element Method by Daryl L. Logan, Cengage Learning, USA.

8. Finite Difference Schemes and Partial Differential Equations by John C. Strikwerda, SIAM, Philadelphia.

Online Resources:

1. http://mathworld.wolfram.com
2. https://openlab.citytech.cuny.edu
3. http://www.cdeep.iitb.ac.in
4. http://www.intmath.com
5. www.math.odu.edu
6. www.ima.umn.edu
7. www.math.utah.edu
8. www.mathworks.com/academia/student_center
9. https://math.dartmouth.edu
10. https://www.math.hmc.edu
11. http://www.ustudy.in
12. archives.math.utk.edu

Course Outcomes:

COs	Students will be able to:
CO1	Apply the transform methods for the solution of differential equations arising in the modelling of real world problems.
CO2	Implement the algorithms for the computation of inverse of Discrete Fourier and Wavelet Transforms
CO3	Solve the system of algebraic equations arising in the solution of PDEs by Finite Difference and Finite Element Methods, by matrix methods and by iterative methods.
CO4	Apply and analyze the finite difference schemes for the numerical solution of parabolic, hyperbolic and elliptic partial differential equations in one and two dimensions.
CO5	Implement the finite element technique for the solution of one and two dimensional equations, particularly arising in the study of heat transfer and fluid mechanics.

CO-PO & PSO Correlation:

Course Name : Advanced Numerical Methods and Scientific Computing Code:SOE-M-PEP101								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:		1			3			
CO2:	2		2			2	1	
CO3:		3		1				1
CO4:	3		1		1			2
CO5:		1		2		1	3	

Note: 1: Low 2: Moderate 3: High

Programme:	M.Tech	Semester :	I
Name of the Course:	Power Electronic Devices and Circuits	Course Code:	SOE-M-PEP102
Credits :	4	No of Hours :	4 hrs./week
Max Marks:	100		

Course Description:

The subject deals with the conversion, control and switching of electrical energy for power applications and playing a major role in revolutionizing the industrial processes. It provides the essential link between the micro level of electronic controllers and megawatt level of industrial power and processes requirements. It has applications within the whole field of the electrical energy system

Course Objectives:

1. To understand and develop the firing circuit requirement for different power semiconductor devices used as switches.
2. To understand the rating specification for design and development of the protection circuits for Semiconductor devices.
3. To analyze the effect of controlled and uncontrolled converters in Power system and their mitigation.
4. To design and develop the commutation circuits for semi controlled power semiconductor devices.
5. To understand the concepts of different types of AC-DC, DC-DC & DC-AC controlled converters for Industrial applications.

Syllabus:

UNIT-1:

Thyristor family & Switch Realization: Survey of power semiconductor devices, Silicon controlled rectifier (SCR), construction and principle of operation, two-transistor analogy, static and dynamic characteristics, gate characteristics, ratings, series and parallel operation of SCRs, over voltage and over current protections, protection against high di/dt and high dv/dt, Power diode, SCR, GTO, LASCR, RCT, SITH, BJT, MOSFET, IGBT etc., Switching losses, driver circuits, protection, cooling, application .

UNIT-2:

Controlled Rectifiers (Converters): Single Phase / Three Phase, Half wave / full wave, half controlled /fully controlled converters with R, RL and RLE loads, Continuous and discontinuous current operations- Evaluation of performance parameters. Effects of source inductance, Power factor improvement techniques, twelve pulse converters, Dual converters.

UNIT-3:

DC- DC Converters: Principle of operation of buck, boost, buck-boost, Cuk, fly back, forward, push-pull, half bridge, full bridge Converters with the continuous and discontinuous operation, Input & output filter design, multi-output boost converters, diode rectifier based boost converters. State space analysis of regulators.

UNIT- 4:

Design: Design considerations: Snubber circuit, a driver circuit, temperature control and heat sink, materials, windings. The design of converter and chopper circuits. Triggering circuits for converter and choppers. MMF equations, magnetic. The design of transformers and inductors.

UNIT-5:

Invertors: Classification of inverters, voltage source inverter, current source inverter, series resonant inverter, modified series resonant inverter, parallel inverter, bridge inverter, auxiliary commuted single-phase inverter, complementary commuted singe-phase inverter, and three-phase inverter, Cyclo-converters: the basic principle of operation, step-up and step down single-phase to single-phase Cyclo-converter.

Recommended Text books and Reference books:

1. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition, 1994.

2. "Power Electronics" by Dr. P. S. Bimbhra, Khanna Publishers, 5th Edition, 2012.

3. Bimal K Bose, “Modern Power Electronics and AC Drives” PHI

4. “A text book of power electronics”, S.N Singh, Dhanpat Rai.

5. Power electronics, Murthy, Oxford.

6. "Power electronics", P. C. Sen, TMH.

7. R W Erickson and D Makgimovic, "Fundamental of Power Electronics" Springer, 2nd Edition.

8. P. T. Krein, "Elements of Power Electronics", OUP

Online resources:

- http://nptel.ac.in/syllabus/syllabus.php?subjectId=108102006

Course outcome:

COs	Students will be able to:
CO1	To gain knowledge on basic DC-DC converters and their operation under continuous /discontinuous mode of conduction for RLE loads.
CO2	To identify and formulate the requirements for four quadrants operation of DC motor.
CO3	To differentiate and understand the significance of various commutation circuits and their consequence on device stress
CO4	To understand the principle of DC-AC conversion and the different topology for three phase to three phase and single phase to single phase DC-AC conversion

CO-PO & PSO Correlation:

Course Name : Power Electronics Devices and Circuits Code: SOE-M-PEP102								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3			1		3		
CO2:		2					1	
CO3:	2		2					1
CO4:		1		3	1	2		2

Note: 1: Low 2: Moderate 3: High

Programme:	**M.Tech**	**Semester :**	**I**
Name of the Course:	**Advanced Power System Analysis**	**Course Code:**	SOE-M-PEP103
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

Impart knowledge and skills for mathematical modelling as well as the techniques for steady-state and dynamic analysis of electric power transmission networks.

Course Objectives:

1. To introduce different techniques of dealing with the matrix for power systems analysis.
2. To impart in-depth knowledge on different methods of power flow solutions.
3. Load/generation balance: frequency regulation techniques in large power networks.
4. To perform optimal power flow solutions in detail.
5. To perform short circuit fault analysis and understand the consequence of the different type of faults.
6. Understanding of faults in large networks.
7. To illustrate different numerical integration methods and factors influencing transient stability.

Syllabus:

UNIT-1: Network Modelling

Single Line Diagram and Per Unit System, Transmission line Parameters and modelling, Single phase and three phase modelling of alternators, transformers, and transmission lines, Conditioning of Y Matrix – Incidence matrix method, Method of successive elimination, Triangular factorization.

UNIT-2: Power Flow Analysis

Load Flow - Network modelling, Power flow equation in real and polar forms; matrix-vector formulation Gauss-Seidel Iterative Solution, Newton-Raphson Method for Power Flow, Decoupled and Fast Decoupled Load Flow Solution Methods, Gauss elimination and Sparsity Techniques, Adjustment of P-V buses, Sensitivity factors for P-V bus adjustment.

UNIT-3: Fault Studies

Introduction to Short Circuit Analysis, Analysis of balanced and unbalanced three phase faults, Symmetrical Components, Sequence Networks, Short Circuit Calculations (L-G, L-L, L-L-G and 3-phase Faults), Bus Impedance Matrix Formulation, Short Circuit Calculation Using Bus Impedance Matrix, open circuit faults.

UNIT- 4: System Optimization

Strategy for two generator systems, generalized strategies, the effect of transmission losses, Sensitivity of the objective function, Formulation of optimal power flow-solution by Gradient method, Newton's method.

UNIT-5: **Transient Stability Analysis**

Introduction to Transient Stability Analysis, Numerical Integration Methods: Euler and Fourth Order Runge-Kutta methods, Swing Equation, Equal Area Criterion, Factors influencing transient stability, Numerical stability and implicit Integration methods.

Recommended Text books and Reference books:

1. Grainger, J.J. and Stevenson, W.D. "Power System Analysis", Tata McGraw hill, New Delhi, 2003.
2. Arrillaga, J and Arnold, C.P, "Computer analysis of power systems", John Wiley and Sons, New York, 1997.
3. Pai, M.A., "Computer Techniques in Power System Analysis", Tata McGraw hill, New Delhi, 2006.
4. A.J.Wood and B.F.Wollenberg, "Power Generation Operation and Control", John Wiley and sons, New York, 1996.
5. W.F.Tinney and W.S.Meyer, "Solution of Large Sparse System by Ordered Triangular Factorization" IEEE Trans. on Automatic Control, Vol: AC-18, pp:333-346, Aug 1973.

6. K.Zollenkopf, "Bi-Factorization: Basic Computational Algorithm and Programming Techniques ; pp:75-96 ; Book on "Large Sparse Set of Linear Systems" Editor: J.K.Rerd,Academic Press, 1971.

7. M.A.Pai, "Computer Techniques in Power System Analysis" ,Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.

8. G W Stagg , A.H El. Abiad, "Computer Methods in Power System Analysis", McGraw Hill, 1968.
9. P.Kundur, "Power System Stability and Control", McGraw Hill, 1994.

Online resources:

- http://nptel.ac.in/syllabus/syllabus.php?subjectId=108108032

Course outcome:

COs	**Students will be able to:**
CO1	Explain the Newton-Raphson technique in solving the power flow problem
CO2	Explain the need for a slack bus in solving the power flow problem and its practical implications
CO3	Appreciate the factors controlling the flow/generation of power within the power system
CO4	Explain the techniques used to control frequency in a power system
CO5	Appreciate the factors determining the magnitude of fault currents in power systems

CO-PO & PSO Correlation:

Course Name : Advanced Power System Analysis Code: SOE-M-PEP103								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**1**		**2**		**3**		**1**	
CO2:		**1**		**3**		3		**3**
CO3:	**2**		**1**		**1**		**2**	
CO4:		**2**						
CO5:	**3**			**2**				**2**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech**	**Semester :**	**I**
Name of the Course:	**Modern Control Theory**	**Course Code:**	SOE-M-PEP104
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

Impart knowledge and skills for mathematical modelling as well as the techniques for steady-state and dynamic analysis control systems.

Course learning objectives:

1. Identify the basic elements and structures of feedback control systems.
2. Apply final value theorem to determine the steady state response of stable control system.
3. Use root locus method for design of feedback control systems.
4. Construct and analysis Bode, Polar and Nyquist plots for rational transfer function.
5. Simulation and coding by using MATLAB.

Syllabus:

UNIT-1: Introduction to Control Systems

Open loop and closed loop control systems, Feedback characteristics of control systems, Mathematical representation of physical systems, electrical, mechanical, hydraulic, thermal systems, Block diagram, algebra and signal flow graphs, Mason's gain formula, simulation using MATLAB.

UNIT-2: Time Domain Analysis

Standard Text signals, Time response of first and second order system, steady state error and error constants, Effect of adding poles and zeroes to a system, Design specifications of second order system, stability concept, Routh- Hurwitz stability criteria relation stability analysis, Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity, and robustness. , Controllers- P, PI, PID, Feed-forward and multi-loop control configurations, applications of MATLAB on control mechanism.

UNIT-3: Frequency Domain Analysis

The relationship between time & frequency response, Polar plots, Bode plot, Performance specifications in frequency-domain. Frequency-domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Implementation of compensators using software applications (MATLAB), Tuning of process controllers.

UNIT– 4: **Stability Analysis**

Root loci's concepts, Construction for Root Loci, effects of adding poles and zero's, Bode Plots. All pass, minimum phase, and non-minimum phase systems Root locus technique (Concept and construction) Frequency Response Analysis Correlation between time and frequency response, Polar and inverse polar plots, Nyquist stability criterion, Bode plots, Time delay systems. Phase and gain margin.

UNIT- 5: State Variable Analysis and Design

Introduction, the concept of state, state variables and state model, state modelling of linear systems, linearization of state equations. State space representation using physical variables, phase variables & canonical variables Derivation of the transfer function from state model, digitalization, Eigen values, Eigen vectors, generalized Eigen vectors. A solution of state equation, state transition matrix and its properties, computation using Laplace transformation, power series method, Cayley-Hamilton method, the concept of controllability & observability, methods of determining the same.

Recommended Text books and Reference books:

1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.

2. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.

3. Ogata, K., "Modern Control Engineering", Prentice Hall, second edition, 1991.

4. Nagrath & Gopal, "Modern Control Engineering", New Ages International.

Online Resources:

http://nptel.ac.in/syllabus/syllabus.php?subjectId=108103007

Course outcome:

COs	Students will be able to:
CO1	Ability to acquire and apply fundamental principles of science and technology
CO2	Analyze continuous systems mathematically through the use of Laplace functions and state equations form
CO3	Apply classical design methods to improve the performance of continuous controlled system and describe the fundamental principles behind the methods of characterization
CO4	Represent any physical system in both transfer functions and state equations form

CO-PO & PSO Correlation:

Course Name :Modern Control Theory Code: SOE-M-PEP104								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	2		2		1	3		2
CO2:		2		3		3	1	
CO3:	3		1			1		
CO4:		1			3			3

Note: 1: Low 2: Moderate 3: High

Programme:	M.Tech	Semester :	I
Name of the Course:	HVDC Power Transmission	Course Code:	SOE-M-PEP105
Credits :	4	No of Hours :	4 hrs./week
Max Marks:	100		

Course Description:

To develop the skills in the area of modern trends in HVDC power transmission with the analysis of HVDC converters, Control, harmonics, the design of filters and physical phenomenon of HVDC Cables.

Course Objectives:

On completion of the course, the students would be skilled enough to work with the following points:-

1. To understand the concept, planning of DC power transmission and comparison with AC power transmission.
2. To analyze HVDC converters.
3. To study about basic controllers.
4. To analyze harmonics and design of filters.
5. To learn about HVDC cables.

Syllabus:

UNIT-1: Introduction

Introduction of HVDC transmission, Comparison of HVAC and HVDC transmission, Application of DC transmission, Description of DC transmission system, Planning for HVDC transmission, Modern trends in DC transmission, Types of HVDC links, monopolar, bipolar and homopolar links

UNIT-2: Analysis of HVDC Converters

Pulse number, choice of best topology for HVDC converters, Simplified analysis of Graetz circuit, Converter bridge characteristics, Characteristics of a twelve pulse converter, analysis with and without overlap

UNIT-3: Basic Controllers

Basic means of control, desired features of control, Constant Ignition Angle, Constant Current and Constant Extinction Advance angle control, power control, Converter faults - misfire, arc through, commutation failure. D.C. Reactor design - voltage and current oscillations

UNIT- 4: Harmonics and Filters

DC Circuit breakers, over voltage and over current protection, Generation of harmonics, Characteristic and uncharacteristic harmonics, troubles due to harmonics, harmonic filters, Design of AC filters and DC filters, Reactive power control of converters

UNIT-5: **HVDC Cables**

The introduction of DC cables, Basic physical phenomenon arising in DC insulation, Practical dielectrics, Dielectric stress consideration, Economics of DC cables compared with AC cables.

Recommended Text books and Reference books:

1. Padiyar, K. R., "HVDC power transmission system", Wiley Eastern Limited, New Delhi 1990. First edition.

2. Edward Wilson Kim bark, "Direct Current Transmission", Vol. I, Wiley inter science, New York, London, Sydney, 1971.

3. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.

4. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.

5. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.

Online resources:

- http://nptel.ac.in/courses/108104013/

Course outcome:

COs	Students will be able to:
CO1	Describe the various breakdown theories for gaseous, liquid and solid dielectric
CO2	Describe the generating methods for high DC, AC, and impulse
CO3	Describe the measuring methods for high DC, AC and impulse
CO4	Compute the breakdown strength of gas filled insulation systems with sphere gap.

CO-PO & PSO Correlation:

Course Name : HVDC Power Transmission Code: SOE-M-PEP105								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:		1		1	2	1	2	
CO2:	2		2					2
CO3:		3			1	3	1	
CO4:	3		1					1

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	I
Name of the Course:	Power Electronics Lab	**Course Code:**	SOE-M-PEP106
Credits :	**2**	**No of Hours :**	**2 hrs./week**
Max Marks:	**100**		

Objectives:

1. Introduce students to practical aspects in operating various classes of power electronics systems.

2. Develop hands-on experience of how power electronics systems operate how they are driven, controlled, and protected.

3. Develop in students the practical skills relevant to understand, analyze and operate power electronics systems.

Syllabus:

1. To study and plot the V-I characteristics of an SCR.

2. Study the characteristics of IGBT.

3. To study the single phase ac voltage control by using TRIAC for R and RL load.

4. To study half wave controlled bridge rectifier with R load.

5. To study full wave controlled bridge rectifier with R load.

6. Study of Step-up DC-DC converter power circuit.

7. To study of single phase series inverter with R and RL load.

8. To stuff single phase parallel inverter with R and RL load.

9. Simulation of full wave bridge rectifier with Close loop control.

10. Simulation of DC-DC Converter with Close loop control.

Equipment required:

1. Hardware kit of Power Electronics
2. Software: MATLAB / LABVIEW will be used
3. CRO/DSO
4. Function Generator
5. Power Supply
6. Multi-meter

Course outcome:

COs	**Students will be able to:**
CO1	Understand the characteristic of power electronics components
CO2	Understand the principles of DC-DC converters, rectifiers & inverters
CO3	Provide continuing professional development and self learning

CO-PO & PSO Correlation:

Course Name : Power Electronics Lab Code: SOE-M-PEP106											
	Program Outcomes								**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1**	**2**	**3**
CO1:	**3**	**2**							**1**		**2**
CO2:	**2**	**3**	**2**							**3**	
CO3:			**1**						**2**		**1**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech**	**Semester :**	**I**
Name of the Course:	**Advanced Power System Simulation Lab**	**Course Code:**	SOE-M-PEP107
Credits :	**2**	**No of Hours :**	**2 hrs./week**
Max Marks:	**100**		

Objectives:

1. To introduce the characteristics of different transmission line models, steady state analysis and transient analysis of power systems.
2. To develop students with an understanding load flow calculation, active power and reactive power control in power system.
3. To prepare the students to handle the un-symmetrical operations in power system.
4. To develop students with an understanding short circuit calculation.
5. To provide the basic concept on power system stability to students.
6. To provide the basic concept on power system protection to students.

Syllabus:

1. Develop a Single line diagram for a given Power system using Mi-Power.
2. Load Flow studies and Short Circuit Analysis.
3. Transient and stability Analysis using Mi Power Simulation.
4. Simulation of IGBT inverters and understand the performance.
5. Simulation of Thyristor converters and check the Performance.
6. Simulation of Facts controllers.
7. Power flow analysis by Newton-Raphson method and Fast decoupled method.

8. Transient stability analysis of single machine-infinite bus system using classical machine model.

9. Co-ordination of over-current and distance relays for radial line protection.

10. Develop MATLAB program for YBUS formation.

11. Develop MATLAB program for G-S Load Flow Analysis.

12.Develop MATLAB program for N-R Load Flow Analysis.

13.Develop MATLAB program for FDLF Load Flow Analysis.

Equipment required:

1. Software: MATLAB (Simulation).
2. Software: MiPower.

Course outcome:

COs	**Students will be able to:**
CO1	Ability to apply knowledge of mathematics, science and engineering
CO2	Ability to identify, formulate and solve engineering problems
CO3	Create techniques, skills and modern engineering tools
CO4	Conduct and analyse a problem from an industry

CO-PO & PSO Correlation:

Course Name : Advance Power System Simulation Lab Code: SOE-M-PEP107								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**1**	**1**						
CO2:		**3**					**2**	**2**
CO3:	**3**							**3**
CO4:		**1**					**1**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	I
Name of the Course:	Research Seminar -I	Course Code:	SOE-M-PEP108
Credits :	2	No of Hours :	2 hrs./week
Max Marks:	50		

Objectives:

1. Understanding the trends of developments in Electrical Engineering domain with the ability to adapt the new technologies in this rapidly growing field.

2. Developing the analytical skills in individual so that they can utilize the knowledge into practice of research in various domains of Electrical Engineering.

3. Able to operate as effective engineers or researcher in Electrical and Electronics industries, academics or related fields.

Syllabus:

- The student has to give a review presentation of comprehensive Design/Experimental project on a selected topic.

Requirements:

1. Understanding the fundamentals of the subjects.
2. Detailed industrial manufacturing process.
3. Articulate mind to find out new doors of research.
4. Plan to execute the problem area/areas.
5. Presentation skill.
6. Logical establishment of the selected topics.

Course outcome:

COs	Students will be able to:
CO1	Know how the basic principles of the advanced equipment.
CO2	Conduct and analyse a problem from an industry or Institute with an

	inspiration/problem.
CO3	Select and redesign the problem
CO4	Perform of the problem through experiments to reach the sustainable solution
CO5	Explain and demonstrate the solution developed

CO-PO & PSO Correlation:

Course Name : Research Seminar-I Code: SOE-M-PEP108								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:			**1**		**2**		**2**	
CO2:		**2**				**1**		**1**
CO3:					**3**	**2**	**1**	
CO4:	**1**	**1**	**2**		**1**		**1**	**2**
CO5:		**1**	**3**			**1**		**3**

Note: 1: Low 2.: Moderate 3: High

Semester II

Sl. No	Subject Code	Subject	Periods per Week			Scheme of Examination			Total Marks	Credit L+(T+P)/2
						Theory/ Practical				
			L	T	P	MID	TA	ESE		
1.	SOE-M-PEP201	Power Electronics Controlled Electric Drives	3	1	0	30	20	50	100	4
2.	SOE-M-PEP202	Power Systems Dynamics and Control	3	1	0	30	20	50	100	4
3.	SOE-M-PEP203	Microprocessor Applications in Power Electronics	3	1	0	30	20	50	100	4
4.	SOE-M-PEP204 (1-6)	Professional Elective- I	3	1	0	30	20	50	100	4
5.	SOE-M-PEP205	Electrical Drives Lab	0	0	4	30	20	50	100	2
6.	SOE-M-PEP206	MATLAB Simulation	0	0	4	30	20	50	100	2
7.	SOE-M-PEP207	Research Seminar-II	0	0	2	15	10	50	50	2
Total			12	4	10	195	130	325	650	22

L: Lecture, T: Tutorial, P: Practical, ESE: End Semester Examination, T.A: Teacher's Assessment.

The Semester also includes one professional elective subject which can be chosen by the students. List is attached in the following table.

Professional Elective -I (Annexure - I)

Sl. No	Subject Code	Name of the Courses
1.	SOE-M-PEP204 (1)	Flexible Alternating Current Transmission System (FACTS)
2.	SOE-M-PEP204 (2)	Power Electronic Applications in Renewable Energy
3.	SOE-M-PEP204 (3)	Circuit Simulation in Power Electronics
4.	SOE-M-PEP204 (4)	Energy Management system
5.	SOE-M-PEP204 (5)	Digital Simulations of Power Electronics Systems
6.	SOE-M-PEP204 (6)	Hybrid and Electric Vehicles

Programme:	M.Tech	Semester :	II
Name of the Course:	Power Electronics Controlled Electric Drives	Course Code:	SOE-M-PEP201
Credits :	4	No of Hours :	4 hrs./week
Max Marks:	100		

Course Description:

To develop the skills and critical fundamentals in the area of modern days Electrical Drives and to understand the importance of Power Electronics converters, Electrical machines and Control systems in the Drives applications point of view.

Course Objectives:

On completion of the course, the students would be skilled enough to work with the following points:

1. To understand various operating regions of the AC motor and DC motor drives.

2. To understand the speed control of induction motor drive from the rotor side.

3. To understand the field oriented control of electrical machines.

4. To understand the control of synchronous motor drives.

Syllabus:

UNIT-1: Review of Conventional Drives

Introduction of Electrical Drives-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.

UNIT-2: 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- 3: Design of DC Drives

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- 4: Inverter fed AC Drives

Analysis of different AC motor with single phase and three phase inverters Operations in different modes and configurations, Problems and strategies.

Cyclo-converter fed AC Drives

Analysis of different AC motor with single phase and three phase cycloconverters Operations in different modes and configurations, Problems and strategies.

AC Voltage controller fed AC Drives

Speed Control and braking, Analysis of different AC motor with single phase and three phase ac voltage controllers. Operations in different modes and configurations

UNIT-5: Control and estimation o AC drives

Induction motor: Small signal models, scalar control, FOC control, sensor less control, DTC, adaptive control. Synchronous motor: sin SPM, synchronous reluctance machines, sin IPM machines, trapezoidal SPM, wound fitted SM, sensor-less operation, switched reluctance machines, Dynamics and Modelling of AC Drives.

Recommended Text books:

1. Bimal.K. Bose, "Power Electronics and Variable frequency drives", Standard Publishers Distributors, New Delhi, 2000 Page of 13 18

2. Murphy J.M.D, Turnbull, F.G, "Thyristor control of AC motor, Pergamon press, Oxford, 1988.

3. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications", P.H.I Private Ltd. New Delhi, Second Edition, 1994

4. N. Mohan et.al. "Power Electronics- Converters, Applications and Design", John Wiley & Sons (Asia) Private Ltd., Singapore, 1996.

5. Bimal K Bose, "Modern Power Electronics and AC Drives" PHI 6. R. Krishnan, "Electric motor drives: modelling, analysis and control, Pearson.

Recommended Reference books:

1. Dubey G.K. "Power Semiconductor controlled drives", Prentice Hall inc, A division of Simon and Schester England cliffs, New Jersey 1989.

2. Dubey G.K. "Power Semiconductor controlled drives", Prentice Hall inc, A division of Simon and Schester England cliffs, New Jersey 1989.

3. Sen. P.C. "Thyristor DC Drives", John Wiley and sons, NewYork, 1981.

4. Subramanyam, V. "Electric Drives – Concepts and applications", Tata McGraw Hill Publishing Co., Ltd., New Delhi 2003.

Online Resources:

- http://nptel.ac.in/courses/108102046/
- http://nptel.ac.in/courses/108108077/

Course Outcome:

COs	Students will be able to:
CO1	Ability to acquire and apply knowledge of mathematics and converter/machine dynamics in Electrical engineering
CO2	Ability to formulate, design, simulate power supplies for generic load and for machine loads
CO3	Ability to perform experiments towards research

CO-PO & PSO Correlation:

Course Name : Power Electronics Controlled Electric Drive

Code: SOE-M-PEP201								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	2		1			3	1	1
CO2:	1	3					3	
CO3:	1		3	1		1		2

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	II
Name of the Course:	**Power Systems Dynamics and Control**	**Course Code:**	SOE-M-PEP202
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

The course describes about Stability of the power system, dynamic properties of electrical machines, networks, loads and interconnected systems. Models of power stations , load-and frequency control, power exchange between networks, model of the synchronous machine connected with the network, transient model, block diagram, behaviour of the machine in case of disturbances, transient stability, equal area criterion, model for small disturbances, voltage control.

Course Objectives:

Impart knowledge and skills for mathematical modelling as well as the techniques for steady-state and dynamic analysis of electric power transmission networks.

1. To have an overview of power system operation and control.
2. To model power - frequency dynamics and to design power-frequency controllers.
3. To model reactive power - voltage interaction and the control actions to be implemented for maintaining voltage profile against varying system load.
4. To illustrate different numerical integration methods and factors influencing transient stability.

Syllabus:

UNIT-1: Power System Stability& Dynamical Systems

Power System Operation and Control, Stability Problems faced by Power Systems, Impact on Power System operation and Control, Concept of Equilibria, Small and Large Disturbance Stability, Example: Single Machine Infinite Bus System, Modal Analysis of Linear Systems, Analysis using Numerical Integration Techniques, Issues in Modelling: Slow and Fast Transients, Stiff Systems.

UNIT -2: Modelling of a Synchronous Machine

Physical Characteristics, Rotor Position Dependent model, D-Q Transformation, Model with Standard Parameters, Steady State Analysis of Synchronous Machine, Short Circuit Transient Analysis of a Synchronous Machine, Synchronous Machine Connected to Infinite Bus.

UNIT-3: Modeling of Excitation, Prime Mover Systems, Transmission Lines and Loads

Physical Characteristics and Models, Control system components, Excitation System Controllers, Prime Mover, control Systems, Transmission Line Physical Characteristics, Transmission Line Modelling, Load Models - induction machine model, Other Subsystems - HVDC, protection systems.

UNIT- 4: Stability Issues in Interconnected Power Systems

Single Machine Infinite Bus System, Multi-machine Systems, Stability of Relative Motion, Frequency Stability: Centre of Inertia Motion, Concept of Load Sharing: Governors, Single Machine Load Bus System: Voltage stability, Torsional Oscillations.

UNIT – 5: Power System Stability Analysis Tools for Enhancing System Stability

Transient Stability Program, Small Signal Analysis Program, EMTP Programs, Real-Time Simulators, Planning Measures, Stabilizing Controllers (Power System Stabilizers),Operational Measures- Preventive Control, Emergency Control.

References Books:

1. K.R.Padiyar, Power System Dynamics, Stability & Control, 2nd Edition, B.S. Publications, Hyderabad, 2002.

2. P.Kundur, Power System Stability and Control, McGraw Hill Inc, New York, 1995.

3. 3. P.Sauer & M.A.Pai, Power System Dynamics & Stability, Prentice Hall, 1997.

Online Resource: NPTEL http://nptel.ac.in

Course Outcome:

Students will be able to know:

COs	Students will be able to:
CO1	Power System Stability
CO2	Analysis and Modelling of Dynamical Systems
CO3	Modelling of Synchronous Machines
CO4	Modelling of Excitation and Prime Mover Systems
CO5	Modelling of Transmission Lines and Loads

CO-PO & PSO Correlation:

Course Name : Power Systems Dynamics and Control Code: SOE-M-PEP202								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:		1			1	2		
CO2:	2		3				3	
CO3:		2		1				2
CO4:	1				3	1	1	
CO5:					1			

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	II
Name of the Course:	Microprocessor Application in Power Electronics	Course Code:	SOE-M-PEP203
Credits :	4	No of Hours :	4 hrs./week
Max Marks:	100		

Course Description:

The course will have both theoretical and experimental components for digital control application by using different processors. Stress would be given on Intel 8051 microcontroller, though selected examples of other popular controllers (e.g. Motorola's MC68HC11, PIC Microcontroller etc.) and introduction to DSP control in power electronics will also be included.

Typical applications to power electronic systems are included and emphasis will be given on practical implementation of the systems (both software and hardware aspects).

Course Objectives:

1. Ability to design and analyse various power electronic circuits.

2. A foundation in the fundamentals of PIC 18F4580 controller based system design for power electronics systems.

3. Design and develop various power converter circuits using embedded system.

4. Introduction to the advanced TMS320F2407 DSP controller for developing power electronics control embedded system.

Syllabus:

UNIT-1:

Review of microcontrollers (Intel 8051, PIC, Motorola MC68HC11) and digital signal processors: architecture, peripheral Modules. Memory organization, CPU details, addressing modes.

UNIT-2:

Interrupt structure, hardware multiplier, pipelining. Fixed- and floating-point data representations. Assemblers, linkers and loaders. Binary file formats for processor executable files. Typical structure of timer-interrupt driven programs. Processor Programming in assembly and C language.

UNIT-3:

Implementing digital processor based control systems for power electronics: Reference frame transformations, PLL implementations, machine models, harmonic and reactive power compensation, space vector PWM, Gate firing control of converters.

UNIT- 4:

Numerical integration methods for power electronics systems simulation, Multitasking concepts for power electronics implementations: The need for multitasking, various multitasking methods.

UNIT-5:

Active power filters, Soft Computing Techniques for the Control of an Active Power Filter, digital control for power converters, Digital Current Mode Control, Multi-Sampled Current Controllers.

Text/References:

1. Digital Control in Power Electronics, 2nd Edition, by Simone Buso ; Paolo Mattavelli.

2. K Ogata, "Discrete-Time Control Systems", second edition, Pearson Education Asia.

3. Muhammad Ali Mazidi, Rolind D. Mckinlay, Danny Causey. " PIC microcontroller and Embedded Systems – using assembly and C for PIC18" 13th impression, Pearson, 2013.

4. Han Way Huang, "PIC Microcontroller, An introduction to software and hardware interfacing", Delmar – 2007.

5. George Terzakis, Introduction to C Programming With the TMS320LF2407A DSP Controller, Create Space Independent Publishing Platform, February 2011.

6. Microprocessors and Interfacing by D.V. Hall.

Course Outcome:

COs	**Students will be able to:**
CO1	Will have the ability to develop embedded controllers for power electronic based systems
CO2	Will have an ability to analyze critical digital control systems for power electronics equipment
CO3	Will have an ability to program the system for desired output response

CO-PO & PSO Correlation:

Course Name : Microprocessor Application in Power Electronics Code: SOE-M-PEP203								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**3**				**2**	**3**	**1**	
CO2:		**1**	**1**	**2**			**3**	**1**
CO3:	**1**	**2**			**1**	**2**		**2**

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	II
Name of the Course:	Flexible Alternating Current Transmission System	Course Code:	SOE-M-PEP204(1)
Credits :	4	No of Hours :	4 hrs./week
Max Marks:	100		

Course Description:

To impart advanced knowledge about the FACTS – systems involving their applications in long Bulk power Transmission line, in distribution systems, in custom Power and improving stability & voltage profile in power system. This is a new technology which has found acceptance in Power Industry. At the end of the course the student should be able to design power and distribution system using various FACT devices.

Course Objectives:

On completion of the course, the students would be skilled enough to work with the following points:

1. To impart the knowledge.
2. To tackle the problem of regulatory constraints on the expansion of power.
3. To familiarize students with the transmission challenges of modern electrical power systems.
4. To focus on concepts and applications various configurations of FACTs controllers.

Syllabus:

UNIT-1:

Introduction of Basic FACTS devices: Semiconductor devices, Steady state and dynamic problems in AC systems, Power flow. Flexible AC transmission systems (FACTS) : Basic realities & roles, Types of facts controller, Principles of series and shunt compensation., Description of static var compensators (SVC), Thyristor Controlled series compensators (TCSC), Static phase shifters (SPS), Static condenser (STATCON), Static synchronous series compensator (SSSC) and Unified power flow controller (UPFC).

UNIT-2:

Fundamentals of ac power transmission: Transmission problems and needs - Emergence of FACTS - FACTS control considerations - FACTS controllers. Angle stability, voltage stability, power flow control and sub-synchronous resonance (SSR), Variable Impedance type & switching converter type - Static Synchronous Compensator (STATCOM) configuration - Characteristics and control.

UNIT-3:

Modelling and Analysis of FACTS controllers: Control strategies to improve system stability. Power Quality problems in distribution systems. Harmonics, harmonics creating loads, modelling, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, filters, passive filters. Active filters, shunt, series hybrid filters, voltage sags and swells, voltage flicker.

UNIT- 4:

Basic Issues Involved in Bulk Power Transmission & distribution: Angle stability, voltage stability, power flow control and sub-synchronous resonance (SSR), Harmonics, load unbalance, poor power factor and voltage interruptions.

UNIT-5

UPFC: Principles of operation and characteristics - Independent active and reactive power flow control - Comparison of UPFC with the controlled series compensators and phase shifters.

Name of Text Books:

1. R.c. dugan, M.F. Mc Granaghan and H.W. Beaty, “Electric Power Systems Quality”, Mc Graw Hill, 1996.
2. K.R. Padiyar, “FACTS controllers in Power Transmission and Distribution”, New Age, New Delhi, 2007.
3. N.G. Hingorani, “Understanding of FACTs”, IEE press. 2. T.E.Acha, “Power Electronics Control in Electrical Systems” , New NES (Elsevier) Publication, 2006.

Name of Reference Books:

1. Padiyar K.R., ‘FACTS controllers for Transmission and Distribution systems’, New Age International Publishers, 1st Edition, 2007.

2. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho, 'FACTS – Modeling and simulation in Power Networks', John Wiley & Sons, 2002.

3. T.J.E. Miller, "Static Reactive Power Compensation", John Wiley & Sons, New York, 1982.

4. Yong Hua Song, "Flexible AC transmission system (FACTS)".

Online Resources:

http://nptel.ac.in/courses/108104052/26

Course Outcome:

COs	**Students will be able to:**
CO1	Ability to identify the conditions in conventional power system where the installation of FACTS controllers or Devices becomes vital
CO2	Ability to illustrate the modes of operation of thyristor based and voltage source converter based FACTS controllers and explains the capabilities and modelling aspects
CO3	Ability to analyze different series, shunt or combined series-shunt FACTS controllers and compute the performance when installed in a given transmission system
CO4	Ability to compare the characteristics of different FACTS controllers and defend the choice of a particular controller to suit the given system/ scenario.

CO-PO & PSO Correlation:

Course Name : Flexible Alternating Current Transmission System
Code: SOE-M-PEP204 (1)

	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**1**	**2**	**1**			**2**		
CO2:				**2**				**3**
CO3:	**1**	**3**			**3**	**1**		**1**
CO4:	**2**		**1**					**1**

Note: 1: Low 2.: Moderate 3: Hig

Programme:	M.Tech	Semester :	II
Name of the Course:	**Power Electronics Application in Renewable Energy**	**Course Code:**	SOE-M-PEP204(2)
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

The subject deals with the renewable energy generation, conversion, control for power applications and playing a major role in revolutionizing the industrial processes for coming generation. It provides the essential link between the AC power generation and DC power generation and the conversions of power as per the need by using the Power electronics converters

Course Objectives:

On completion of the course, the students would be skilled enough to work with the following points:

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 design of power converters for renewable energy applications.

3. To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.

4. To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.

5. To develop maximum power point tracking algorithms.

Syllabus:

UNIT-1: Introduction

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) – Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT-2: Electrical Machines for Renewable Energy Conversion

Reference theory fundamentals-principle of operation and analysis: permanent magnet synchronous generator (PMSG), squirrel cage induction generators (SCIG) and doubly fed induction generators (DFIG).

UNIT-3: Power Converters

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) – Boost and buck-boost converters-selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT- 4: Analysis of Wind and PV Systems

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

UNIT-5: **Hybrid Renewable Energy Systems**

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

Name of Text Books:

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.

2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi, 2009.

Name of Reference Books:

1. Rashid .M. H "power electronics Hand book", Academic press, 2001.

2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
3. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
5. Andrzej M. Trzynnadlowski, ‘Introduction to Modern Power Electronics’, Second edition, wiley India Pvt. Ltd, 2012.

Online Resources:

- http://nptel.ac.in/courses/108103009/34

Course Outcome:

COs	**Students will be able to:**
CO1	Ability to understand and analyse power system operation, stability, control and protection
CO2	Ability to handle the engineering aspects of electrical energy generation and utilization

CO-PO & PSO Correlation:

Course Name : Power Electronics Applications in Renewable Energy Code: SOE-M-PEP204 (2)								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**3**	**1**		**2**		**2**		
CO2:	**2**	**1**	**2**			**1**	**1**	**2**

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	II
Name of the Course:	Circuit Simulation in Power Electronics	Course Code:	SOE-M-PEP204(3)
Credits :	4	No of Hours :	4 hrs./week
Max Marks:	100		

Course Description:

This course familiarizes the students with basic power switch technology and associated electronic circuits. In this course power electronic circuits and switching devices such as power transistors, MOSFETs, SCRs, GTOs, IGBTs and UJTs are studied. Their applications in AC/DC, DC/DC, DC/AC and AC/AC converters as well as switching power supplies are studied. Simulation and lab experiments emphasizing the power electronic circuit analysis, design and control will also be covered.

Course Objectives:

To provide knowledge on modelling and simulation of power simulation circuits and systems.

1. To learn the characteristics of power electronics devices.
2. To understand the control methods of rectifiers and choppers.
3. To learn different gating circuits for thyristor turn-on.
4. To learn the operation of ac voltage controllers and inverters.
5. To learn the simulation of power electronics circuits 6. To understand the concepts of different loads.

Syllabus:

UNIT- 1: Review of numerical methods

Application of numerical methods to solve transients in D.C. - Switched R, L, R-L, R-C and R-L-C circuits - Extension to AC circuits.

UNIT- 2: Modelling of diode in simulation

Diode with R, R-L, R-C and R-L-C load with AC supply - Modelling of SCR, TRIAC, IGBT and Power Transistors in simulation - Application of numerical methods to R, L, C circuits with power electronic switches - Simulation of gate/base drive circuits, simulation of snubber circuits.

UNIT- 3: Modelling of Power Electronic Converters

Modelling of semiconductor devices; Switch realization– single quadrant and two quadrant switches; switching losses. Review of DC-DC converters, Steady-state analysis of converter in continuous and discontinuous modes (CCM & DCM) and estimation of converter efficiency. Development of circuit model for simulating dynamic operating conditions in CCM & DCM.

UNIT- 4: Feedback control for converters

Controller design Dynamic Modelling of Electrical Machines: Modelling of DC machines, Modelling of three phase Induction machine: Reference frame theory – ARF, RRF, SYRF, SRF; equations of transformation, voltage equations, torque equations, analysis of steady-state operation, acceleration characteristics, effect of loading and operation with non-sinusoidal voltages

UNIT–5: Simulation of single phase and three phase

Uncontrolled and controlled (SCR) rectifiers, converters with self commutated devices - simulation of power factor correction schemes, simulation of converter fed dc motor drives, simulation of thyristor choppers with voltage, current and load commutation schemes, simulation of chopper fed dc motor.

Text Books:

1. Robert W. Erickson, Dragan Maksimovic; Fundamentals of Power Electronics (2 e), Springer, 2005.

2. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff;. Analysis of Electrical Machinery & Derive Systems (2 e), Wiley Student Edition, 2002.

Reference Books:

1. Simulink Reference Manual, Math works, USA.

2. Robert Ericson, 'Fundamentals of Power Electronics', Chapman & Hall, 1997.

3. Issa Batarseh, 'Power Electronic Circuits', John Wiley, 2004.

Online Recourse:

http://nptel.ac.in/courses/108101038/

Course Outcome:
Upon completion of the course, the students will be able to:

COs	**Students will be able to:**
CO1	Develop algorithm and software models for power electronics and drives applications
CO2	Analyse the transient and steady performance of the designed models
CO3	Choose suitable devices or models for appropriate applications

CO-PO & PSO Correlation:

Course Name : Circuit Simulation in Power Electronics Code: SOE-M-PEP204(3)								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**3**		**2**		**2**	**2**	**1**	
CO2:		**1**		**3**		**1**		**2**
CO3:	**1**	**2**			**1**		**3**	

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	II
Name of the Course:	Energy Management System	Course Code:	SOE-M-PEP204(4)
Credits :	4	No of Hours :	4 hrs./week
Max Marks:	100		

Course Description:

This Course enable the students to understand practical methods of Energy Auditing. Prepare the students for a successful career in energy management in electrical systems. Enable the students to evaluate energy losses and devise methods to save energy and save our energy resources.

Course Objectives:

On completion of the course, the students would be skilled enough to work with the following points:

1. To emphasize the energy management on various electrical equipments and metering.
2. To illustrate the energy management in lighting systems and cogeneration.
3. To study the concepts behind the economic analysis and load management

Syllabus:

UNIT-1: Introduction

Trends in energy consumption-world energy scenario, energy resources and their availability, conventional and renewable sources, need to development new energy technologies

UNIT-2: Energy system Modeling

Levels of analysis, steps in model development, examples of models. Quantitative Techniques: Interpolation-polynomial, Lagrangian. Curve-fitting, regression analysis, solution of transcendental equations. Systems Simulation-information flow diagram, solution of set of nonlinear algebraic equations, successive substitution, Newton Raphson.

UNIT-3: Energy Scenario

Energy Resources - Energy Sector Reforms & Restructuring - Energy Security - Energy Conservation Act and its features - Energy Conservation.

UNIT- 4: Energy auditing

Methodology, analysis of past trends (plant data), closing the energy balance, laws of thermodynamics, measurements, portable and on line instruments. Steam Systems: Boiler -efficiency testing, excess air control, Steam distribution & use- steam traps, condensate recovery, flash steam utilization

UNIT-5: **Cogeneration**

Concept, options (steam/gas turbines/diesel engine based), selection criteria, control strategy. Heat exchanger networking - concept of pinch, target setting, problem table approach, composite curves. Demand side management.

Text Books:

1. L.C.Witte, P.S.Schmidt, D.R.Brown, Industrial Energy Management and Utilisation, Hemisphere Publ, Washington,1988.

2. Paul W. O'Callaghan, "Energy Management – A comprehensive guide to reducing costs by efficient energy use", McGraw Hill, England, 1993.

3. W.R. Murphy and G. McKay, "Energy management", Butterworth & Co Publishers, Oxford, UK, 2001.

Reference Books:

1. Barney L. Capehart, Wayne C. Turner, and William J.Kennedy, 'Guide to Energy Management', 5th Edition, The Fairmont Press, Inc., 2006.

2. P. Meier Energy Systems Analysis for Developing Countries, Springer Verlag, 1984

3. Amit K. Tyagi, 'Handbook on Energy Audits and Management', The Energy and Resources Institute, 2003.

4. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.

5. Handbook on Energy Audit and Environment Management, Y P Abbi and Shashank Jain, TERI, 2006

Online Resource:
http://nptel.ac.in/courses/10810602

Course Outcome:

COs	**Students will be able to:**
CO1	Understand the basics of Energy auditing and Energy management
CO2	Employ energy management strategies for electric machines and cogeneration
CO3	Employ energy management strategies in lighting systems
CO4	Devise energy management strategies for metering and instrumentation
CO5	Analyze and justify the economics of different energy management strategies

CO-PO & PSO Correlation:

Course Name : Energy Management System Code: SOE-M-PEP204 (4)								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:		**2**					**2**	
CO2:	**1**		**3**		**2**			**1**
CO3:		**2**				**3**	**2**	
CO4:				**3**	**1**			**3**
CO5:	**2**		**1**			**1**		

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	II
Name of the Course:	Digital Simulation of Power Electronics System	Course Code:	SOE-M-PEP204(5)
Credits :	4	No of Hours :	4 hrs./week
Max Marks:	100		

Course Description:

This course will make students conversant with the modelling and simulations of various power electronic devices and converters using simulation software like PSICE and MATLAB simulink. At the end of the course the students will be able to simulate power electronic converters and analyze their performance on computer, which will help in selecting the specifications of various components for fabricating the actual systems.

Course Objectives:

On completion of the course, the students would be skilled enough to work with the following points:

1. To provide an in depth knowledge about modelling of Power Electronic Circuits and to analyze the behaviour and performance of Power Electronic circuits.

2. To model Power Electronic Circuits.

3. To analyze the behaviour of Power Electronic Circuits

Syllabus:

UNIT-1:

Computer Simulation of Power Electronic Converters and Systems: Challenges in computer simulation, simulation process, Types of analysis, mechanics of simulation, circuit-oriented simulators, equation solvers, comparison of circuit oriented simulators and equation solvers

UNIT-2:

Converter Dynamics / simulations: Feedback control for converters: regulation and control problem, control principles, model for feedback, P and PI control. Non linear dynamic modelling, Control and analysis of choppers, voltage mode and current mode control. Simulation: process, mechanics, techniques, PSPICE simulator

UNIT-3:

Simulation of power electronics circuits: Simulation and design of converters, Choppers, A.C. Voltage Controllers, Inverters and Cyclo-converters.

Simulation tools: General overview and understanding of SPICE/PSPICE and MATLAB SIMULINK software.

UNIT- 4:

Modelling of power electronics devices: Criteria for switch selection, modelling of Diode, SCR, Power transistor MOSFET AND IGBT for ac and dc circuit using SPICE /PSPICE and MATLAB SIMULINK software, simulation of driver and snubber circuits.

UNIT- 5:

Application of numerical methods to solve transients in D.C, Extension to AC circuits, Modelling of Power semiconductor switches using simulation, Introduction to electrical machine modelling, Simulation of basic electric drives, stability aspects.

Text Books:

1. The Mathworks Inc., “MAT LAB the Language of Technical Computing”, version 6.

2. The Mathworks Inc., “SIMULINK Dynamic System Simulation”

Reference:

1. Simulink Reference Manual, Math works, USA.

2. Robert Ericson, ‘Fundamentals of Power Electronics’, Chapman & Hall, 1997.

3. Issa Batarseh, ‘Power Electronic Circuits’, John Wiley, 2004.

4. Bimal K Bose, “Modern Power Electronics and AC Drives” PHI.

Online Resources:

nptelvideos.in/2012/11/industrial-drives-power-electronics.htML

Course Outcome:

COs	Students will be able to:
CO1	Develop algorithm and software models for power electronics and drives applications
CO2	Analyse the transient and steady performance of the designed models
CO3	Choose suitable devices or models for appropriate applications

CO-PO & PSO Correlation:

Course Name: Digital Simulations of Power Electronics System Code: SOE-M-PEP204 (5)								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1	2		2		2		1
CO2:			1		3		1	
CO3:	2	3				3		2

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech**	**Semester :**	**II**
Name of the Course:	**Hybrid and Electric Vehicle**	**Course Code:**	SOE-M-PEP204(6)
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

The subject deals with the Electric Hybrid vehicle fundamentals, operation, conversion, control for power applications and playing a major role in revolutionizing the industrial processes for coming generation. It provides the essential combination link of electrical and mechanical components for vehicle industries.

Course Objectives:

On completion of the course, the students would be skilled enough to work with the following points:

1. To provide knowledge about the Hybrid Electric vehicle systems.
2. To equip with required skills to derive the criteria for the design of power converters for such applications.
3. To analyse and comprehend the various operating modes of Electric Hybrid Vehicle (EHV).
4. To design different power converters namely Direct current to Direct current (DC to DC) and Direct current to alternating current (DC to AC) converters with battery power management system.
5. To develop and design the Control System for Electric and Electric Hybrid Vehicles.

Syllabus:

UNIT-1: Introduction

Historical Journey of Hybrids and Electric Vehicle, Economic and Environmental Impact of Electric Hybrid Vehicle, Dynamics of Electric and Hybrid vehicles, Vehicle Power Plant and Transmission Characteristics, Power Flow in HEVs, Torque Coupling.

UNIT-2: Power Converters

DC-DC Converter: DC-DC Converters for EV and HEV Applications, Boost and Buck-Boost Converters, Multi Quadrant DC-DC Converters.

DC-AC Converter: DC-AC Inverter for Electric Vehicle (EV) and Electric Hybrid Vehicle (EHV) Applications, Three Phase DC-AC Inverters, Voltage Control of DC-AC Inverters Using Pulse width modulation (PWM).

UNIT-3: Electrical Machines for Hybrid and Electric Vehicles

Induction motors, their configurations and optimization for HEV/EVs, Permanent Magnet Motors, Steady State Characteristics of Permanent Magnet Motors, Dynamic Model of Permanent Magnet (PM) Machines, Control of PM machines, Flux Weakening Control of PM machines, Design Principles of HEVs.

UNIT- 4: Energy Storage

Batteries, Classifications and characteristics of Batteries, Mathematical Modelling for Lead acid battery, Alternative and Novel Energy Sources, Fuel Cell, operation and application in EHV.

UNIT-5: **Control System for Electric and Hybrid Electric Vehicles**

Control Systems for the EHV and EVs, Rule and optimization, Fundamentals of Regenerative Braking, Brake System of EVs and HEVs, Design of Hybrid Electric vehicles, Design of Series EHV, Design of Parallel EHV.

Name of Text Books:

1. M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005.

2. D. C. Hanselman, Brushless Permanent Magnet Motor Design, Magna Physics Pub, 2006.

3. M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005.

4. M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005.

Name of Reference Books:

1. Rashid .M. H "power electronics Hand book", Academic press, 2001.

2. I. Husain, Electric and Hybrid Electric Vehicles , CRC Press, 2003.

3. A. E. Fuhs, Hybrid Vehicles and the Future of Personal Transportation, CRC Press, 2009.

4. A. E. Fuhs, Hybrid Vehicles and the Future of Personal Transportation, CRC Press, 2009.

Online Resources:

- http://nptel.ac.in/courses/108103009/1

Course Outcome:

COs	Students will be able to:
CO1	Ability to understand and analyse power system operation, stability, control and protection
CO2	Ability to handle the engineering aspects of electrical energy generation and utilization

CO-PO & PSO Correlation:

Course Name : Hybrid and Electric Vehicles Code: SOE-M-PEP204 (6)								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	2		1			2	2	1
CO2:	2	2			2	1	1	3

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	II
Name of the Course:	Electrical Drives Lab	Course Code:	SOE-M-PEP205
Credits :	2	No of Hours :	2 hrs./week
Max Marks:	100		

Objectives:

1. To prepare the students to handle the industrial operations related to motor control operations.

2. Introduce students to practical aspects in operating various kinds of Electrical drives operations.

3. Develop hands-on experience of electrical drive systems such as operation, controlled, and protected.

4. Develop in students the practical skills relevant to understand, analyze and operate Electrical Drive systems.

Syllabus:

1. Operation of 3-phase fully controlled Converter with R & R-L load.

2. Performance & Operation of Chopper fed D.C. Drive.

3. Performance & Operation of a 3-phase A.C. Voltage controller on motor load.

4. Operation of 3-phase IGBT based PWM Inverter on R & R-L load.

5. Performance & speed control of 3 phase slip ring Induction motor by Static Rotor Resistance Controller.

6. Speed control of BLDC motor with spring-balance.

7. Speed control of Switched Reluctance motor with eddy current load.

8. Study of Variable frequency Drive.

Equipment Required:

1. Software: MATLAB (Simulation)

Course Outcome:

COs	**Students will be able to:**
CO1	Ability to apply knowledge of electrical machines and power electronic
CO2	Ability to identify, formulate and solve engineering problems
CO3	Create techniques, skills and modern engineering tools related to drives
CO4	Conduct and analyse a problem from an industry

CO-PO & PSO Correlation:

Course Name : Electrical Drives Lab Code:SOE-M-PEP205								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**3**	**1**	**1**			**3**		**1**
CO2:	**1**	**3**					**3**	
CO3:		**3**	**1**	**1**	**1**	**1**		**3**
CO4:	**1**	**2**		**1**			**2**	**1**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech**	**Semester :**	**II**
Name of the Course:	**MATLAB Simulation LAB**	**Course Code:**	SOE-M-PEP206
Credits :	**2**	**No of Hours :**	**2 hrs./week**
Max Marks:	**100**		

Objectives:

1. To prepare the students for the modeling issues and analysis methods for the power electronics devices operation, machine operation, required to be carried out for the power systems operations.

2. Different types of power electronics devices have been observed which need to be critically analyzed.

3. Develop in students the practical skills relevant to understand, analyze and operate Electrical and power electronics devices.

Syllabus:

1. Study Power GUI Block & its Parameters.
2. Study and simulation of an on-off controller
3. Illustrates the Ideal Switching device solution method of the Power GUI block.
4. Simulation of different types of controllers (PID, PI, PLL)
5. Simulation of the performance of a full wave bridge rectifier for RL and RLC load
6. Illustrate the effect of current chopping in an inductive circuit
7. Illustrate the use of the MOSFET in a Zero-Current Quasi-Resonant Switch converter
8. Illustrate the use of the Universal Bridge and Discrete PWM Pulse Generator blocks
9. To study Permanent Magnet DC Motor
10. Simulation of chopper controlled DC motor
11. Simulation and modeling of synchronous machine

12.Illustrate steady-state and transient performance of a simple 500 MW (250 kV-2kA) HVDC transmission system
13. Simulation of Buck converter.
14. Simulation of Boost converter.
15. Simulation of cycloconverter.

Equipment Required:

- Software: MATLAB (Simulation)

Course Outcome:

COs	Students will be able to:
CO1	Ability to apply knowledge of electrical machines and power electronics devices
CO2	Ability to identify, formulate and solve engineering problems
CO3	Create techniques, skills and modern engineering tools related to power electronics
CO4	Develop computer based tools for specific applications in power system analysis, design and operation

CO-PO & PSO Correlation:

Course Name : MATLAB Simulation LAB Code: SOE-M-PEP206								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1				1	2		2
CO2:		2					1	
CO3:	2		2		3			
CO4:		3		3		1	1	3

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	II
Name of the Course:	Research Seminar-II	Course Code:	SOE-M-PEP207
Credits :	2	No of Hours :	2 hrs./week
Max Marks:	50		

Objectives:

1. Understanding the trends of developments in Electrical Engineering domain with the ability to adapt the new technologies in this rapidly growing field.

2. Developing the analytical skills in individual so that they can utilize the knowledge into practice of research in various domains of Electrical Engineering.

3. Able to operate as effective engineers or researcher in Electrical and Electronics industries, academics or related fields.

Syllabus:

➢ The student has to give a review presentation of comprehensive Design/Experimental project on a selected topic.

Requirements:

1. Understanding the fundamentals of the subjects.
2. Detailed industrial manufacturing process.
3. Articulate mind to find out new doors of research.
4. Plan to execute the problem area/areas.
5. Presentation skill.
6. Logical establishment of the selected topics.

Course Outcome:

COs	Students will be able to:
CO1	Knowhow the basic principles of the advanced equipment
CO2	Conduct and analyze a problem from an industry or Institute with an inspiration/problem
CO3	Select and redesign the problem
CO4	Perform of the problem through experiments to reach the sustainable solution

CO5	Explain and demonstrate the solution developed

CO-PO & PSO Correlation:

Course Name : Research Seminar-II SOE-M-PEP207								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:		**2**		**1**	**2**		**2**	
CO2:			**2**	**2**			**1**	**3**
CO3:	**3**			**2**	**1**	**2**		**3**
CO4:		**2**		**1**		**1**	**3**	
CO5:	**1**	**1**	**2**		**2**	**1**		**2**

Note: 1: Low 2.: Moderate 3: High

Semester III (Stage-I)

Sl. No	Subject Code	Subject	Periods per Week			Scheme of Examination Theory / Practical		Total Marks	Credit L+(T+P)/2
			L	T	P	ESE	TA		
1.	SOE-M-PEP301	Industrial Training	0	0	0	100	100	200	2
2.	SOE-M-PEP302	Research Seminar- III	0	0	0	25	25	50	2
Total						**125**	**125**	**250**	**4**

L: Lecture, **T:** Tutorial, **P:** Practical, **ESE:** End Semester Examination, **T.A:** Teacher's Assessment.

Semester III (Stage-II)

Sl. No	Subject Code	Subject	Periods per Week			Scheme of Examination Theory / Practical			Total Marks	Credit L+(T+P)/2
			L	T	P	MID	TA	ESE		
1.	SOE-M-PEP303 (1-5)	Elective-II	3	1	0	30	20	50	100	4
2.	SOE-M-PEP304	Dissertation-I	0	0	28	0	125	125	250	10
Total			**3**	**1**	**28**	**30**	**145**	**175**	**350**	**14**

L: Lecture, **T:** Tutorial, **P:** Practical, **ESE:** End Semester Examination, **T.A:** Teacher's Assessment.

The Semester also includes one professional elective subject which can be chosen by the students. List is attached in the following table.

Professional Elective -II (Annexure - II)

Sl. No	Subject Code	Name of the Courses
1.	SOE-M-PEP303 (1)	Applications of Power Electronics to Power Systems
2.	SOE-M-PEP303 (2)	Modelling and Analysis of Electrical Machines
3.	SOE-M-PEP303 (3)	Robotics and Automation
4.	SOE-M-PEP303 (4)	Computer Application of Power Systems
5.	SOE-M-PEP303 (5)	Digital Signal Processing & Its Application

Programme:	M.Tech	Semester :	III
Name of the Course:	**Industrial Training**	**Course Code:**	SOE-M-PEP301
Credits :	**2**	**No of Hours :**	**2 hrs./week**
Max Marks:	**200**		

Industrial visit has its own importance in a career of a student who is pursuing a professional degree. It is considered as a part of college curriculum, mainly seen in engineering courses.

Objectives of industrial visit are to provide students an insight regarding internal working of companies. We know, theoretical knowledge is not enough for making a good professional career. With an aim to go beyond academics, industrial visit provides student a practical perspective on the world of work.

It provides students with an opportunity to learn practically through interaction, working methods and employment practices.

1. It gives them exposure to current work practices as opposed to possibly theoretical knowledge being taught at college.

2. Industrial visits provide an excellent opportunity to interact with industries and know more about industrial environment. Industrial visits are arranged by colleges to students with an objective of providing students functional opportunity in different sectors.

3. Industrial visit helps to combine theoretical knowledge with industrial knowledge. Industrial realities are opened to the students through industrial visits.

Course Outcomes:

COs	Students will be able to:
C01	Understand the practical aspects in the industry/laboratories as trainees;
C02	Understand the industrial ethics and professionalism.

CO-PO & PSO Correlation:

Course Name: Industrial Training Code: SOE-M-PEP301								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:		3		1	3	2		1
CO2:	2		1		1			

1. **Note:** 1.: Low 2: Moderate 3.: High

Programme:	**M.Tech**	**Semester :**	**III**
Name of the Course:	**Research Seminar III**	**Course Code:**	SOE-M-PEP302
Credits :	**2**	**No of Hours :**	**2 hrs./week**
Max Marks:	**50**		

Objectives:

1. Understanding the trends of developments in Electrical Engineering domain with the ability to adapt the new technologies in this rapidly growing field.
2. Developing the analytical skills in individual so that they can utilize the knowledge into practice of research in various domains of Electrical Engineering.
3. Able to operate as effective engineers or researcher in Electrical and Electronics industries, academics or related fields.

Syllabus:

- The student has to give a review presentation of comprehensive Design/Experimental project on a selected topic.

Requirements:

1. Understanding the fundamentals of the subjects.
2. Detailed industrial manufacturing process.
3. Articulate mind to find out new doors of research.
4. Plan to execute the problem area/areas.
5. Presentation skill.
6. Logical establishment of the selected topics.

Course Outcome:

COs	**Students will be able to:**
CO1	Knowhow the basic principles of the advanced equipment

CO2	Conduct and analyse a problem from an industry or Institute with an inspiration/problem
CO3	Select and redesign the problem
CO4	Perform of the problem through experiments to reach the sustainable solution
CO5	Explain and demonstrate the solution developed

CO-PO & PSO Correlation:

Course Name : Research Seminar-III Code: SOE-M-PEP302								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:		**1**	**2**	**2**	**3**		**2**	**1**
CO2:				**1**	**2**		**2**	
CO3:		**2**		**1**		**1**		**1**
CO4:			**2**		**3**	**2**	**1**	
CO5:	**1**	**1**	**2**		**1**		**1**	**2**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech**	**Semester :**	**III**
Name of the Course:	**Application of Power Electronics in Power System**	**Course Code:**	SOE-M-PEP303(1)
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

The course will embed the knowledge to understand, analyse, design, and realize the applications of power electronics in power system. The course will emphasize on different FACTs devices, power quality issues and its mitigation by using the design of different types of filters through various techniques.

Course Objectives:

The subject aims to provide the student with: -

1. Understanding the concepts of FACTs devices and its principle of operations.
2. Acquiring the knowledge of various FACTs controller.
3. Acquiring the knowledge of power quality issues and its IEEE standards'.
4. Basic compensation by power electronic conditioner.
5. Designing of different type of filters.

Syllabus:

UNIT-1: Steady State and Dynamic Problems in AC Systems

Flexible AC transmission systems (FACTS), Principles of series and shunt compensation, Description of static var compensators (SVC), Thyristor Controlled series compensators (TCSC), Static phase shifters (SPS), Static condenser (STATCON), Static synchronous series compensator (SSSC) and Unified power flow controller (UPFC).

UNIT-2: Modelling and Analysis of FACTS Controllers

Control strategies to improve system stability, Power Quality problems in distribution systems.

UNIT-3: Harmonics and Power Quality Issues

Harmonics and other power quality issues, Voltage sags & swells, Voltage flicker, Harmonic creating loads, Modelling, Harmonic propagation, Series and parallel resonances, Harmonic power flow. Standards of power quality issues.

UNIT-4: Mitigation of Harmonics

Filters, Passive filters, Active filters, Shunt and series hybrid filters, Mitigation of power quality problems using power electronic conditioners, IEEE standards, HVDC Converters and their characteristics, Control of the converters (CC and CEA), Parallel and series operation of converters.

UNIT-5: Active Power Filter

Introduction, types of Filter, Development of active power filter and hybrid active power filter, HAPF Topology 1- series APF and shunt APF, HAPF Topology 2- shunt APF and shunt PPF, HAPF Topology 3-APF in series with shunt PPF, circuit configuration of a three-phase four wire centre-split HAPF. Conventional and proposed compensating current generation method for active power filter.

Text Books:

1. N.G.Hingorani & Laszlo Gyugyi, Understanding FACTS, IEEE press, 2000

2. E.F. Fuchs and Mohammad A. S. Masoum, Power quality in power systems and electrical machines, Elsevier academic press, 2008.

Reference Books:

1. K. R. Padiyar, FACTs controllers in power transmission and distribution, New age international publishers, New Delhi, 2007.

2. K. R. Padiyar, HVDC power transmission system, New age international publishers, New Delhi, 1999.

Course Outcome:

COs	Students will be able to:
CO1	Understand the application and working principle of FACTs devices
CO2	Obtain the basic knowledge of FACTs controller and its design
CO3	Understand different power quality issues and its standard
CO4	Understand the application of harmonic mitigating devices
CO5	Understand the basic working principle and design procedure of active power filters

CO-PO & PSO Correlation:

Course Name : Application of Power Electronics in Power System Code: SOE-M-PEP303(1)								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:		1		2		3		
CO2:	2		2			2	1	
CO3:		3		1				1
CO4:	3		1		1			2
CO5:		1				2		

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech**	**Semester :**	**III**
Name of the Course:	**Modeling and Analysis of Electrical Machines**	**Course Code:**	SOE-M-PEP303(2)
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

This course deals with the development of mathematical models for electrical machines, suitable for transient analysis of machine performance. It deals with electro-mechanical energy converters in all relevant aspects, and also to acquaint oneself of a single treatment for all types of machines for modelling and analysis purpose.

Course Objectives:

The subject aim to provide the students with: -

1. Understanding the fundamentals and representation of various electrical components of machines.
2. The basics of reference frame theory as well as mathematical modelling of various DC machines.
3. The basic understanding of dynamic modelling of three phase induction motor.
4. To introduces the student to the fundamentals of modelling of synchronous machine.
5. To introduce the student to the analysis of synchronous machine.

Syllabus:

UNIT-1: Basic Concepts of Modelling

Basic two pole machine representation of commutator machines, 3- phase synchronous machine with and without damper bar and 3-phase induction machine, Kron's primitive machine-voltage, current and torque equations.

UNIT-2: DC Machine Modelling and Reference Frame Theory

Mathematical model of separately excited DC motor-steady state and transient state analysis, sudden application of inertia load, transfer function of separately

excited DC motor, mathematical model of dc series motor, shunt motor, linearization techniques for small perturbations.
Real time model of a two phase induction machine, transformation to obtain constant matrices, three phase to two phase transformation, power equivalence.

UNIT-3: Dynamic Modelling and analysis of Three Phase Induction Machine:

Generalized model in arbitrary frame, electromagnetic torque, deviation of commonly used induction motor models-stator reference frames model, rotor reference frames model, synchronously rotating reference frames model, equations in flux linkages, per unit model, dynamic simulation.
Derivation of small signal equations of induction machine, space phasor model, DQ flux linkages model derivation, control principle of the induction motor.

UNIT-4: Modelling of Synchronous Machines:

Introduction, voltage equations and torque equation in machine variables, stator voltage equations in arbitrary and rotor reference frame variables, Park's equations, torque equations in substitute variables, rotor angle and angle between rotors, per unit system, analysis of steady state operation.

UNIT-5: Dynamic Analysis of Synchronous Machines:

Dynamic performance during sudden change in input torque and during a 3-phase fault at the machine terminals, approximate transient torque versus rotor angle characteristics, comparison of actual and approximate transient torque-angle characteristics during a sudden change in input torque; first swing transient stability limit, comparison of actual and approximate transient torque-angle characteristics during a 3-phase fault at the machine terminals, critical clearing time, equal area criterion, computer simulation.

Text Books:

1. Scott D. Sudhoff, Paul C. Krause and Oleg Wasynczuk, "Analysis of Electric Machinery and Drive Systems", Wiley, 2nd ed. 2010

2. M. Bhattacharyya, "Electrical Machines Modelling And Analysis", PHI Learning Pvt. Ltd.,2016

Reference Books:

1. A. E. Fitzgerald and Jr. C. Kingsley, Electric Machinery, McGraw-Hill, 2003

2. Denis O'Kelly, S. Simmons, Introduction to Generalized Machine Theory, McGraw-Hill, 1968

3. N. N. Hancock, Pergamon, Matrix Analysis of Electric Machinery, 2nd edition, 2016

4. R. Ramanujam, Modeling and Analysis of Electrical Machines, Deamtech press, 2019

Course Outcomes:

COs	**Students will be able to:**
CO1	Know the fundamental principle behind the electro-mechanical energy conversion in electrical machine
CO2	Employ various reference frame theory in modelling of various machine and can model different kind of DC machines
CO3	Carry out dynamic modelling and analysis of three phase induction motor
CO4	Implement steady state as well as dynamic modelling of three phase synchronous machine
CO5	Accomplish analysis of three phase synchronous machine with different operational constraints

CO-PO & PSO Correlation:

Course Name : Modelling and Analysis of Electrical Machines Code: SOE-M-PEP 303(2)								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**3**		**2**					
CO2:		**1**		**3**		**2**	**1**	
CO3:	**2**		**1**					**1**
CO4:		**2**			**2**	**3**		
CO5:	**1**			**1**	**1**			**3**

Note: 1: Low 2: Moderate 3: High

Programme:	M.Tech	Semester :	III
Name of the Course:	Robotics and Automation	Course Code:	SOE-M-PEP303(3)
Credits :	4	No of Hours :	4 hrs./week
Max Marks:	100		

Course Description:

This course describes the application of robotics and industrial automation in industrial processes to study the components of a robot, their technical properties as well as their specifications. Methods and systems for controlling robots are described. This course also emphasises on robotics vision technology in detail. In process automation, it includes the knowledge of PLCs and SCADA systems.

Course Objectives:

Students will be able:

1. To understand the Design and program of robotic systems.
2. To select application specific Transducers, sensors, actuators and controllers employed commonly in robotics and industrial automation systems.
3. To Learn how to design and program monitoring interfaces and automated control processes.
4. To Acquire the basic knowledge of industrial communications.
5. To Learn to develop and manage projects in robotics and industrial automation.

Syllabus:

UNIT – I: Fundamental Concepts of Robotics

History, present status & future Trends-Robotics & Automation-Laws of Robotics-Robot Definitions Robotics systems & robot Anatomy-Specification of Robots-resolution, Repeatability & accuracy of a manipulator. Robot drive mechanisms, hydraulic-electric-pneumatic drives, mechanical transmission Method-Rotary-to /Rotary motion conversion, Rotary –to linear motion Conversion-End Effectors-Types- in piping Problem-Remote cantered compliance devices-control of actuators.

UNIT – II: Symbolic Modelling of Robots

Direct Kinematic Model Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modelling of the Manipulator, Denavit – Hartenberg

Notation, Kinematic Relationship between Adjacent Links, Manipulator Transformation Matrix. Introduction to Inverse Kinematic model

UNIT – III: Robotic Sensing and Vision

Robotics sensors, imaging model – imaging components, picture coding – basic relationship between pixels - Camera-Computer interfaces. Image representation, Filtering – edge detection, segmentation and recognition. Camera Calibration - Stereo Imaging - Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking.

UNIT – IV: Factory & Process Automation

Control elements of Industrial Automation- IEC/ ISA Standards for Control Elements and Selection criteria, Relay Ladder logic, PLC modules, PLC Configuration, Scan cycle, PLC software, Wiring and Installation, PLC programming – Bit Instructions -Timers and counters– PLC arithmetic functions PTO / PWM generation, Stepper Motor Control. SCADA, DCS, Real time systems, Supervisory control.

UNIT – V: HMI Systems

Types of HMI – Configuration of HMI, Screen development and navigation, Configuration of HMI elements / objects and Interfacing with PLC.PLC Networking- Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet - CAN Open.

Text Books:

1. K.S.Fu, R.C.Gonzalez, CSG. Lee, "Robotics Control, Sensing, Vision And Intelligence", McGraw Hill Education Pvt. Ltd., 2013.
2. Richard D. Klafter, Thomas A. Chmielewski Michael Negin, "Robotics Engg-An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P.Ltd.1989.
3. W. Bolton, "Programmable Logic Controllers", Elsevier Ltd, 2015.

Reference Books:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering", Eastern Economy Edition, Prentice Hall of India P.Ltd.1989.
2. Frank D Petruzella, "Programmable Logic Controllers", McGraw-Hill, 2011
3. "SIMATIC Programming with STEP 7", SIEMENS Manual, 2014.
4. John R Hackworth and Fredrick D Hackworth Jr., "Programmable Logic Controllers: Programming Methods and Applications", Pearson Education, 2006

Course Outcome:

COs	Students will be able to:
CO1	Interface various Servo and hardware components with Controller based projects
CO2	Identify parameters required to be controlled in a Robot
CO3	Develop small automatic / autotrophic applications with the help of Robotics
CO4	Design and interface PLC and SCADA based systems

CO-PO & PSO Correlation:

Course Name : Robotics and Automation Code: SOE-M-PEP 303(3)								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	3	1				3		
CO2:			2				1	
CO3:	2	3		3				1
CO4:		2			1		2	

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	III
Name of the Course:	**Computer Application of Power Systems**	**Course Code:**	SOE-M-PEP303(4)
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

This course deals with the development of computer systems for advanced planning, operation, and control of electric power systems. It deals with a complete overview of interconnected power system operation which helps to develop appropriate models for an interconnected power system and to know how to perform various power system operations using computer programs.

Course Objectives:

The course is designed to meet with the objectives of:

1. Introduction to the modelling of power equipment, power flow equations and formation of Y-bus matrix,
2. Study of various power flow solution algorithms and their use in AC/DC Power System analysis.
3. Study of symmetrical and asymmetrical faults.
4. Stability analysis and use of digital computers in power system solutions.

Syllabus:

UNIT-1: General Introduction

Modern Power Systems Operation and Control, Different types of Power System Analysis. Overview of Graph theory-tree, Co-tree and Incidence Matrix, Development of Network Matrices from Graph Theoretic Approach, Review of Solution of Linear System of Equations by Gauss Jordan Method, Gauss Elimination, LDU factorization.

UNIT-2: AC Power Flow Analysis

Introduction, Modelling of Power System Components, Power Flow Equations, Formation of Y-bus Matrix, Power Flow Solution Algorithms: Gauss – Siedel Load Flow Method, Newton Raphson Load Flow Method, Fast Decoupled Load Flow Method and DC Load Flow Method, AC-DC System Power Flow Analysis Sequential and Simultaneous Solution Algorithms.

UNIT-3: Optimal Power Flow Analysis:

Sparse Matrices, Sparsity directed Optimal Ordering Schemes, Solution Algorithms-LU Factorization, Bi-factorization and Iterative Methods.
Optimal Power Flow Concepts, Active/Reactive Power Objectives (Economic Dispatch, MW and MVAR loss Minimization) – Applications- Security Constrained Optimal Power Flow.

UNIT-4: Contingency Analysis and State Estimation:

Contingency Analysis in Power systems, Contingency Calculations using ZBUS and YBUS Table of Factors.
State Estimation–Least Square and Weighted Least Square Estimation Methods for Linear Systems.

UNIT-5: Analysis of Faulted Power System

Symmetrical and Asymmetrical Faults, Z-bus Formulation, Short Circuit Analysis of Large Power Systems using Z-bus, Analysis of Open Circuit Faults. Stability Analysis: Classification of Power System Stability, Swing Equation and its solution, Classical Model of Synchronous Machines and Excitation System, Transient Stability Analysis of Multi-Machine Systems, Equal Area Criterion, Eigen Analysis of Dynamical Systems, Small Signal Stability Analysis using Classical Model. Basic Concepts of Voltage Stability Analysis –Causes of Voltage Instability, Analysis of Static Voltage Stability, Sub Synchronous Resonance in Power System.

Text Books:

1. R. Bergen, V. Vittal, "Power Systems Analysis", 2nd Ed., Pearson Higher Education
2. G.L.Kusic, "Computer Aided Power System Analysis", PHI, 1989
3. John J. Grainger, William D. Stevenson, Jr., "Power System Analysis", Tata McGraw-Hill Series in Electrical and Computer Engineering.
4. M. A. Pai, "Computer Techniques in Power Systems Analysis", Tata McGraw-Hill, 2nd Ed. 2005.

Reference Books:

1. I. J. Nagrath and D. P. Kothari, "Modern Power System Analysis", Tata McGraw Hill, 1980
2. J. Arriliga and N.R. Watson, "Computer Modelling Of Electrical Power Systems", 2/e, John Wiley, 2001
3. L. P. Singh, "Advanced Power System Analysis and Dynamics", 3/e, New Age Intl, 1996.
4. Stagg and E. L. Abiad, "Computer Methods In Power System Analysis", McGraw Hill, 1968.

Course Outcomes:

Students successfully completing this module will be able to:

COs	**Students will be able to:**
CO1	The students will gain the ability to critically analyse the solution methods used in power system studies
CO2	Students will be adequately trained to work with for modelling of power flow problems
CO3	Students will be skilled to work as power system engineers and to do fault analysis of the system with help of software like SIMULINK/MATLAB, PSSE, ETAP, etc
CO4	Students will be substantially prepared to take up relevant research works.

CO-PO & PSO Correlation:

Course Name : Computer Application of Power Systems Code: SOE-M-PEP 303(4)								
	Program Outcomes					**PSOs**		
Course Outcomes	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1:	**1**		**1**			**2**		**1**
CO2:		**2**		**3**			**1**	
CO3:	**2**				**2**	**2**		
CO4:	**3**	**1**	**1**					**3**

Note: 1: Low 2.: Moderate 3: High

Programme:	**M.Tech**	**Semester :**	**III**
Name of the Course:	**Digital Signal Processing & its Application**	**Course Code:**	SOE-M-PEP303(5)
Credits :	**4**	**No of Hours :**	**4 hrs./week**
Max Marks:	**100**		

Course Description:

The course will embed the knowledge to understand, analyse, design, and realize the discrete-time systems for digital signal processing applications. The course will emphasize on realization of discrete-time systems, design of IIR and FIR filters through various techniques, multirate digital signal processing and brief introduction of different applications of digital signal processing in industries.

Course Objectives:

The subject aims to provide the student with

1. Understanding the concepts of Fourier and Z transform associated with discrete time systems.
2. Acquiring the knowledge of various linear time invariant systems.
3. Designing of IIR and FIR filters.
4. Understanding the applications of DSP in industrial fields.

Syllabus:

UNIT-1: Discrete-Time Systems and Its Realizations

Discrete-time systems: Introduction, Classifications, Properties Linear time invariant systems, linear constant difference equations, Fourier and z–transform domain representation of LTI systems, Realization of systems: Basic building blocks, IIR structures: Direct, cascade, parallel, ladder and state space from, FIR structure: direct, Linear phase FIR system form.

UNIT-2: IIR Filter Design

Basics of infinite impulse response (IIR) systems, Linear constant difference equations, Mapping from analog to digital domain systems, Designing by impulse invariant and Bi-linear transformation methods, Design of Butterworth IIR filter, Analog & Digital Frequency transformation.

UNIT-3: FIR Filter Design
Basics of finite impulse response (FIR) systems, Linear constant difference equations, Frequency response of linear phase filters, Fourier series method of designing, Designing of FIR filters using windowing techniques: Rectangular, Triangular, Hamming, Blackman & Kaiser.
UNIT-4: Multirate Digital Signal Processing

Introduction, Sampling, Sampling rate conversion: decimation and interpolation, Cascading of sampling rate converters, Polyphase filter structure: Polyphase decomposition, Multistage Decimator and Interpolators
UNIT-5: Applications of Digital Signal Processing:

Introduction, Applications of DSP: Digital Sinusoidal Oscillators, Modern RADAR systems, Applications of DSP in Image Processing, Applications of DSP in speech processing, Digital and binary images, Spatial image Processing and noise removal, Computer vision fundamentals, Edge detection and processing.

Text Books:

1. Vallavaraj, Salivahanan, Gnanapriya, “Digital Signal Processing”, PHI Publisher, TMH
2. Proakis, Manolakis & Sharma, “Digital Signal Processing”, Pearson Education.

Reference Books:

1. P. Ramesh Babu, “Digital Signal Processing”, Scitech Publication, India
2. Oppenheim & Schafer, “Discrete Time Signal Processing”, Pearson - PHI

Course Outcome:
Electrical Engineering Graduates will be able to:

CO1	Understand the application of Fourier and Z transform with respect to Digital signal processing.
CO2	Obtain the basic knowledge of FIR and IIR filters and its design
CO3	Evaluate and design multirate digital signal processing systems for different applications.
CO4	Apply the concepts of digital signal processing for different applications.

CO-PO & PSO Correlation:

Course Name : Digital Signal Processing & its Application Code: SOE-M-PEP303(5)								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1				2			
CO2:			2			2	1	
CO3:		1		3				1
CO4:	2				1		2	

Note: 1: Low 2.: Moderate 3: High

Programme:	M.Tech	Semester :	III
Name of the Course:	Dissertation-I	Course Code:	SOE-M-PEP304
Credits :	10	No of Hours :	10 hrs./week
Max Marks:	250		

Dissertation-I:

Dissertation-I has its own importance in a career of a student who is pursuing a professional degree. It is considered as a part of PG curriculum and related to research practicality.

Objectives:

1. To set out the chosen research methods, including their theoretical basis, and the literature supporting.
2. The method is more experimental, and what kind of reliance could place on the results and reaches a discussion section.
3. Aim to test the research methods, to see if the work is in certain circumstances or not.

Course Outcome:

COs	Students will be able to:
CO1	Understanding to summarize the research methods and its approach, and the key challenges that will face in the research.

CO-PO & PSO Correlation:

Course Name : Dissertation-I Code: SOE-M-PEP304								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1		3		2		3	1

Note: 1: Low 2.: Moderate 3: High

Semester-IV

Sl. No	Subject Code	Subject	Periods per Week			Scheme of Examination Theory / Practical		Total Marks	Credit L+(T+P)/2
			L	T	P	ESE	TA		
1.	SOE-M-PEP401	Dissertation-II	0	0	28	200	200	400	14
Total			**0**	**0**	**28**	**200**	**200**	**400**	**14**

Scheme of Marks Allotment

Semester	Total Marks	Grand Total
I	750	**2400**
II	650	
III (Stage-I)	250	
III (Stage-II)	350	
IV	400	

L- Lecture
P- Practical
ESE- End Semester Exam
T.A- Teacher's Assessment

Programme:	M.Tech	Semester :	IV
Name of the Course:	Dissertation-II	Course Code:	SOE-M-PEP401
Credits :	14	No of Hours :	28 hrs./week
Max Marks:	400		

Dissertation-II:

Dissertation-II has its own importance in a career of a student who is pursuing a professional degree. It is considered as a part of PG curriculum and related to research practicality.

Objectives:

1. To set out the chosen research methods, including their theoretical basis, and the literature supporting.
2. The method is more experimental, and what kind of reliance could place on the results and reaches a discussion section.
3. Aim to test the research methods, to see if the work is in certain circumstances or not.

Course Outcome:

COs	Students will be able to:
CO1	Understanding to summarize the research methods and its approach, and the key challenges that will face in the research

CO-PO & PSO Correlation:

Course Name : Dissertation-II Code: SOE-M-PEP401								
	Program Outcomes					PSOs		
Course Outcomes	1	2	3	4	5	1	2	3
CO1:	1		2		2		3	1

Note: 1: Low 2.: Moderate 3: High