

**SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY: PUTTUR  
(AUTONOMOUS)**

**Power Electronics (M .Tech):**

**Department of Electrical and Electronics Engineering (EEE)**

**I Year I Semester**

S. No.	Subject Code	Name of the Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	Lab/ Practice	
1	20HS0823	Research Methodology and IPR	2	-	-	2
2	20EE2101	Electric Drives Systems	3	-	-	3
3	20EE2102	Modelling and Analysis of Electrical Machines	3	-	-	3
<b>Programme Elective (PE)-I</b>						
4	20EE2103 20EE2104 20EE2105	Advanced Power Electronic Circuits Optimal and Adaptive Control Power Quality	3	-	-	3
<b>Programme Elective (PE)-II</b>						
5	20EE2107 20EE2108 20EE2109	Static VAR Controllers and Harmonic Filtering PWM Converters and Applications Energy Auditing, Conservation & Management	3	-	-	3
6	20EE2110	Power Electronics Simulation Lab	-	-	4	2
7	20EE2111	Industrial Automation Lab (Virtual Lab)	-	-	4	2
<b>Audit Course- I</b>						
8	20HS0818	English for Research Paper Writing	2	-	-	-
<b>Contact Periods/Week</b>			16	-	8	18
			<b>Total 24/Week</b>			

## I Year II Semester

S. No.	Subject Code	Name of the Course / Laboratory	No. of Periods per week			No. of Credits
			L	T	Lab/ Practice	
1	20EE2112	Power Electronic Converters	3	-	-	3
2	20EE2113	Digital Control of Power Electronic and Drive Systems	3	-	-	3
<b>Programme Elective (PE)-III</b>						
3	20EE2114	Switched Mode and Resonant Converters	3	-	-	3
	20EE2115	Industrial Load Modeling and Control				
	20EE2116	Advanced Digital Signal Processing				
<b>Programme Elective (PE)-IV</b>						
4	20EE2117	Advanced Microcontroller based Systems	3	-	-	3
	20EE2118	Distributed Generation				
	20EE2119	Smart Grids				
5	20EE2120	Mini Project	-	-	4	2
6	20EE2121	Power Converters Lab	-	-	4	2
7	20EE2122	Industrial Electric Drives Lab ( Virtual Lab)	-	-	4	2
<b>Audit Course- II</b>						
8	20HS0829	Constitution of India	2	-	-	-
<b>Contact Periods/Week</b>			14	-	12	<b>18</b>
			<b>Total 26/Week</b>			

**II Year I Semester**

S.No.	Course Code	Subject	L	T	P	C
1	20EE2123 20EE2124 20EE2125	<u>Programme Elective-I</u>	3	0	0	3
		SCADA Systems and Applications				
		FACTS and Custom power Devices				
		HVDC Transmission Systems				
2	20HS0824 20ME3026 20ME3027 20CE1028 20ME3028 20EE2128	<u>Open Elective-I</u>	3	0	0	3
		Business Analytics				
		Industrial Safety				
		Advances in Operations Research				
		Cost Management of Engineering Projects				
		Composite Materials				
Waste to Energy						
3	20EE2126	Dissertation Phase-I	0	0	20	10
Contact Periods / Week			<b>6</b>	<b>0</b>	<b>20</b>	
			<b>Total/Week 26</b>			
Total Credits						<b>16</b>

**II Year II Semester**

S.No.	Course Code	Subject	L	T	P	C
1	20EE2127	Dissertation Phase-II	0	0	32	16
Contact Periods / Week				<b>0</b>	<b>32</b>	
			<b>Total/Week 32</b>			
Total Credits						<b>16</b>

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<b>2</b>	-	-	<b>2</b>

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**(20HS0823) RESEARCH METHODOLOGY AND IPR**

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**Course Objectives:**

- 1. Understand some basic concepts of research and its methodologies.*
- 2. Identify and discuss appropriate research topics, select appropriate research design, and implement a research project.*
- 3. Understand the method of research writing and presenting research report and proposal*
- 4. Provide an understanding on the importance of intellectual property rights*
- 5. Understand the intricacies of grant of patent, patentability, licensing and revocation at national and international level.*

**Course outcomes:**

After the completion of the course, student would be able to:

- 1. Explain the key concepts and issues in research and basic framework of research process.*
- 2. Formulate appropriate research problem and implement suitable research design for the research problem.*
- 3. Identify various sources of information for literature review and data collection.*
- 4. Develop an understanding of ethics in conducting applied research and make use of components of scholarly writing in report preparation.*
- 5. Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.*
- 6. Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.*

**UNIT I:**

**Research Methodology:** Meaning, Objective and importance of research - Types of research - steps involved in research - Motivation in Research, Types of Research - Significance of Research - Research Methods versus Methodology - Importance of Knowing How Research is done - Research Process - Criteria of Good Research defining research problem - Errors in selecting a research problem

**UNIT II:**

**Research Design and Data Collection:** Research design - Different Research Designs - Effective literature studies - Classification of Data - Methods of Data Collection – Sampling - Sampling

techniques, procedure and methods - Ethical considerations in research - Responsibility of ethics in research

### UNIT III:

**Research Report Writing:** Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

### UNIT IV:

**Nature of Intellectual Property:** Patents, Designs, Trade and Copyright - Process of Patenting and Development: technological research, innovation, patenting, development - International Scenario: International cooperation on Intellectual Property- Procedure for grants of patents - Patenting under PCT

### UNIT V

**Patent Rights:** Scope of Patent Rights - Licensing and transfer of technology - Patent information and databases – Geographica

I Indications - New Developments in IPR: Administration of Patent System - New developments in IPR: IPR of Biological Systems, Computer Software etc - Traditional knowledge - Case Studies - IPR and IITs

### TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, “*Research methodology: an introduction for science & engineering students*” Juta & Co Ltd (December 1, 1996)
2. Wayne Goddard and Stuart Melville, “*Research Methodology: An Introduction*” Juta Academic; 2nd edition (April 28, 2004)

### REFERENCES:

1. Ranjit Kumar, 2nd Edition, “*Research Methodology: A Step by Step Guide for beginners*” Halbert, “*Resisting Intellectual Property*”, Taylor & Francis Ltd , 2007.
2. Mayall, “*Industrial Design*”, McGraw Hill, 1992. Niebel , “*Product Design*”, McGraw Hill, 1974.
3. Asimov, “*Introduction to Design*”, Prentice Hall, 1962.
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “*Intellectual Property in New Technological Age*”, 2016.
5. T. Ramappa, “*Intellectual Property Rights Under WTO*”, S. Chand, 2008

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**(19EE2101) ELECTRIC DRIVES SYSTEMS**

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**COURSE OBJECTIVES:**

1. Understand Basic electrical drives and their analysis.
2. Learn Design of controller for drives.
3. Understand Scalar control of electrical drives

**COURSE OUTCOMES:**

Students will be able to:

1. Model and simulate electric drive systems
2. Design modulation strategies of power electronics converters, for drives application
3. Design appropriate current/voltage regulators for electric drives
4. Select and implement the drives for Industrial Process
5. Implement various variable speed drives in Electrical Energy Conversion System.
6. Identify the suitable drive for the industrial applications.

**UNIT- I**

Dynamics of Electric Drives: Fundamentals of torque equation, Speed torque convention and Multi-quadrant operation, components of load torques.

**UNIT- II**

Classification of load torques steady state stability, Load equation, Speed control and drive classification, closed loop control of drives.

**UNIT- III**

DC motor Drives-Modeling of DC machines, Steady state characteristics with armature and speed control. Phase controlled DC motor drives, chopper controlled DC motor drives.

**UNIT- IV**

Poly-phase induction machines- Dynamic modeling of induction machines, Small signal equations, control characteristics of induction machines, Phase-controlled induction machines, Stator voltage control, Slip energy recovery scheme, frequency control and vector control of induction motor drives.

**UNIT -V**

Traction motor: Starting, Speed-Time characteristics, braking. Stepper motor, Servo motor and their Applications.

**TEXT BOOKS:**

1. G.K. Dubey, "Power semiconductor controlled Drives", Prentice Hall international, New Jersey, 1989.
2. R. Krishnan, "Electric motor drives modeling, analysis and control", PHI-India-2009.
3. G. K. Dubey, "Fundamentals of electric Drives, Narosa Publishing House", 2nd edition, 2011.

**REFERENCES:**

1. W. Leonhard, "Control of Electrical drives", Springer, 3<sup>rd</sup> edition, 2001.
2. P.C. Krause, "Analysis of Electric Machine", Wiley-IEEE press 3<sup>rd</sup> edition.
3. K. Bose, "Modern Power Electronics and AC Drives", Prentice Hall publication, 1st Edition, 2001.

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**(20EE2102) MODELING AND ANALYSIS OF ELECTRICAL  
MACHINES**

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**COURSE OBJECTIVES:**

1. To understand the operation of an electrical machine mathematically.
2. To understand how a machine can be represented as its mathematical equivalent.
3. To develop mathematical model of AC & DC machines and perform transient analysis on them

**COURSE OUTCOMES:**

Students will be able to:

1. Knowledge about the dynamic behavior rotating machines.
2. Able to understand equivalent circuit of synchronous machines.
3. To understand various practical issues of different machines.
4. To learn about the basic concepts of AC/DC machine modeling.
5. To analyze various methodologies in small signal machine modeling.
6. To learn the performance and dynamic modeling of synchronous machines

**UNIT-I**

Principles of Electromagnetic Energy Conversion, General expression of stored magnetic energy, Co-energy and force/torque, example using single and doubly excited system,

**UNIT-II:**

Basic Concepts of Rotating Machines-Calculation of air gap MMF and per phase, machine inductance using physical machine data; Voltage and torque equation of dc machine.

**UNIT-III**

Three phase symmetrical induction machine and salient pole synchronous machines in phase variable form, Application of reference frame theory to three phase symmetrical induction and synchronous machines, Dynamic direct and quadrature axis model in arbitrarily rotating reference frames.

**UNIT-IV**

Determination of Synchronous machine dynamic equivalent circuit parameters, Analysis and dynamic modelling of two phase asymmetrical induction machine and single phase induction machine.

**UNIT-V**



Special Machines - Permanent magnet synchronous machine, Surface permanent magnet (square and sinusoidal back emf type) and interior, permanent magnet machines, Construction and operating principle, dynamic modelling and self-controlled operation. Analysis of Switch Reluctance Motors, Brushless D.C. Motor for space Applications Recent trends.

**TEXT BOOKS:**

1. Charles Kingsle, Jr., A.E. Fitzgerald, Stephen D. Umans, "Electric Machinery",
2. Tata McGraw Hill, R. Krishnan, "Electric Motor & Drives: Modelling, Analysis and Control"

**REFERENCES:**

1. Prentice Hall of India Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives".
2. Clarendon Press P.C. Krause "Analysis of Electric Machine" Wiley IEEE Press 3<sup>rd</sup> Edition.

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**(20EE2103) ADVANCED POWER ELECTRONIC CIRCUITS**

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**COURSE OBJECTIVES:**

1. Understand the operation of advanced power electronic circuit topologies.
2. Understand the control strategies involved.
3. Learn few practical circuits, used in practice.

**COURSE OUTCOMES:**

Students will be able to:

1. Knowledge about analysis and design of Load Commutated CSI and PWM CSI  
Learn analysis and design of series Inverters.
2. Acquire knowledge about analysis and design of Switched Mode Rectifiers, APFC,
3. Knowledge about DC-DC converters & resonant converters design
4. Select appropriate phase shifting converter for a multi-pulse converter and operation
5. Select appropriate phase shifting converter for a multi-pulse converter
6. Select appropriate phase shifting converter for a multi-pulse converter

**UNIT-I**

Special Inverter Topologies - Current Source Inverter. Ideal Single Phase CSI operation, analysis and waveforms - Analysis of Single Phase Capacitor Commutated CSI. Series Inverters. Analysis of Series Inverters. Modified Series Inverter. Three Phase Series Inverter

**UNIT- II:**

Switched Mode Rectifier - Operation of Single/Three Phase bilateral Bridges in Rectifier Mode. Control Principles. Control of the DC Side Voltage. Voltage Control Loop. The inner Current Control Loop. Single phase and three phase boost type APFC and control, three phase utility interphases and control

**UNIT- III**

Buck, Boost, Buck-Boost SMPS Topologies . Basic Operation- Waveforms - modes of operation – Output voltage ripple

**UNIT-IV**

Push-Pull and Forward Converter Topologies - Basic Operation . Waveforms - Voltage Mode Control. Half and Full Bridge Converters . Basic Operation and Waveforms- Flyback Converter . discontinuous mode operation . waveforms . Control - Continuous Mode Operation . Waveforms

**UNIT-V**

Introduction to Resonant Converters. Classification of Resonant Converters. Basic Resonant Circuit Concepts. Load Resonant Converter. Resonant Switch Converter. Zero Voltage Switching Clamped Voltage Topologies. Resonant DC Link Inverters with Zero Voltage Switching. High Frequency Link Integral Half Cycle Converter.

**TEXT BOOKS:**

1. Ned Mohan et.al “Power electronics: converters, applications, and design” John Wiley and Sons, 2006
2. Rashid “Power Electronics” Prentice Hall India 2007.
3. G.K.Dubey et.al “Thyristorised Power Controllers” Wiley Eastern Ltd., 2005, 06.

**REFERENCES:**

1. Dewan & Straughen “Power Semiconductor Circuits” John Wiley & Sons., 1975.
2. G.K. Dubey & C.R. Kasaravada “Power Electronics & Drives” Tata McGraw Hill., 1993.
3. IETE Press Book Power Electronics Tata McGraw Hill, 2003
4. Cyril W Lander “Power Electronics” McGraw Hill., 2005.

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**(20EE2104) OPTIMAL AND ADAPTIVE CONTROL**

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**COURSE OBJECTIVES:**

1. *To know the operation of closed and open loop optimal control.*
2. *Understand the adaptive control strategies.*
3. *Learn dynamic programming method*

**COURSE OUTCOMES:**

*Students will be able to:*

1. *Knowledge in the mathematical area of calculus of variation so as to apply the same for solving optimal control problems.*
2. *Problem formulation, performance measure and mathematical treatment of optimal Control problems.*
3. *Acquire knowledge on solving optimal control design problems by taking into*
4. *Consideration the physical constraints on practical control systems.*
5. *To obtain optimal solutions to controller design problems taking into consideration the Limitation on control energy in the real practical world.*
6. *Apply constrained optimization to various physical systems.*

**UNIT-I**

Optimal control problem, Fundamental concepts and theorems of calculus of variations Euler-Lagrange equation and external of functional.

**UNIT-II**

Variational approach to solving optimal control problems, Hamiltonian and different boundary conditions for optimal control problem

**UNIT-III**

Linear regulator problem, Potryangin's minimum principle, Dynamic programming Principle of optimality and its applications to optimal control problem.

**UNIT-IV**

MIT rule – Determination of adaptation gain - Lyapunov theory –Design of MRAS using Lyapunov theory – Relations between MRAS and STR- Case Study. PROPERTIES OF ADAPTIVE SYSTEMS: Nonlinear dynamics, Analysis of Indirect discrete time self-tuners, Stability of direct discrete time algorithms, Averaging, Application of averaging techniques, averaging in stochastic systems, robust adaptive controllers.

**UNIT-V**

Nonlinear dynamics, Analysis of Indirect discrete time self-tuners, Stability of direct discrete time algorithms, Averaging, Application of averaging techniques, averaging in stochastic systems, robust adaptive controllers

**TEXT BOOKS:**

1. Donald E. Kirk, "Optimal Control Theory, An introduction." Prentice Hall Inc., 2004
2. A.P. Sage, "Optimum Systems Control", Prentice Hall, 1977
3. HSU and Meyer , "Modern Control, Principles and Applications," McGraw Hill, 1968

**REFERENCES:**

1. Yoan D. Landu, "Adaptive Control" (Model Reference Approach), Marcel Dekker. 1981
2. Ioannou P A and Sun J, "Robust Adaptive Control", Prentice Hall, 1996

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**(20EE2105) POWER QUALITY**

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**COURSE OBJECTIVES:**

- 1. Understand the different power quality issues to be addressed*
- 2. Understand the recommended practices by various standard bodies like IEEE, IEC, etc. On voltage & frequency, harmonics*
- 3. Understanding STATIC VAR Compensators*

**COURSE OUTCOMES:**

*Students will be able to:*

- 1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads*
- 2. Develop analytical modeling skills needed for modeling and analysis of harmonics innetworks and components*
- 3. Introduce the student to active power factor correction based on static VAR compensators and its control techniques*
- 4. Introduce the student to series and shunt active power filtering techniques*
- 5. The students will be able to identify the power quality problems, causes and suggest suitable mitigating techniques.*
- 6. Ability to study about the various Active Passive power filters.*

**UNIT-I**

Power quality-voltage quality-overview of power quality Phenomena classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C message weights-flicker factor transient phenomena-occurrence of power quality problems power acceptability curves-IEEE guides, standards and recommended practices.

**UNIT-II**

Individual and total harmonic distortion RMS value of a harmonic waveform-Triplex harmonics-important harmonic introducing devices-SMPS- Three phase power converters- arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

**UNIT-III**

Modelling of networks and components under non-sinusoidal conditions transmission and distribution systems Shunt capacitors-transformers-electric machines-ground systems loads that cause power quality problems power quality problems created by drives and its impact on drive.

**UNIT-IV**

Passive Compensation Passive Filtering, Harmonic Resonance Impedance Scan Analysis- Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC Three Phase APFC and Control Techniques, PFC Based on Bilateral Single Phase and Three Phase Converter

**UNIT-V**

SVC and STATCOM Active Harmonic Filtering-Shunt Injection Filter for single phase, three-phase three-wire and three-phase four wire systems d-q domain control of three phase shunt active filters uninterruptible power supplies constant voltage transformers series active power filtering techniques for harmonic cancellation and isolation.

Dynamic Voltage Restorers for sag swell and flicker problems.

**TEXT BOOKS:**

1. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007
2. Math H. Bollen, "Understanding Power Quality Problems", IEEE Press, 2000
3. J. Arrillaga, "Power System Quality Assessment", John Wiley, 2000

**REFERNCES:**

1. J. Arrillaga, B.C. Smith, N.R. Watson & A. R. Wood, "Power system Harmonic Analysis", Wiley, 1997

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**(20EE2107) STATIC VAR CONTROLLER AND HARMONIC  
FILTERING**

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**COURSE OBJECTIVES:**

1. *Understand the various static converters*
2. *Understand the static converter control strategies*
3. *Understand the active and reactive power compensation and their control*
4. *Understand harmonic filtering and its control design*

**COURSE OUTCOMES**

*Students will be able to:*

1. *Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation*
2. *Obtain schemes at Transmission and Distribution level in Power Systems.*
3. *To introduce the student to various single phase and three-phase Static VAR Compensation schemes and their controls*
4. *To develop analytical modelling skills needed for modelling and analysis of such Static VAR*
5. *To compare Controlling methods of DVR*
6. *To design suitable converter for topology for applications.*

**UNIT-I**

Steady-State Reactive Power Control in Electric Transmission Systems. Reactive Power Compensation and Dynamic Performance of Transmission Systems.

Sags, Swells, Unbalance, Flicker, Distortion. Current Harmonics. Sources of Harmonics in Distribution Systems and Ill Effects.

**UNIT-II**

Shunt Compensators. SVCs of Thyristor Switched and Thyristor Controlled types and their control, STATCOMs and their control. Series Compensators of thyristor Switched and Controlled Type and their Control. SSSC and its Control, Sub-Synchronous Resonance and damping.

**UNIT-III**

Single Phase and Three Phase Converters and Standard Modulation Strategies (Programmed Harmonic Elimination and SPWM). GTO Inverters. Multi-Pulse Converters and Interface Magnetics. Multi-Level Inverters of Diode Clamped Type.d



**UNIT-IV**

Single Phase Shunt Current Injection Type Filter and its Control. Three Phase Three-wire Shunt Active Filtering and their control using p-q theory and d-q modeling. Three phase four wire shunt active filters. Hybrid Filtering using Shunt Active Filters. Dynamic Voltage Restorer and its control.

**UNIT-V**

Series Active Filtering in Harmonic Cancellation Mode. Series Active Filtering in Harmonic Isolation Mode. V-I and power oscillation characteristics

**TEXT BOOKS:**

1. Ned Mohan et.al, "Power Electronics", John Wiley and Sons, 2006.
2. G. Massobrio, P. Antognet," Semiconductor Device Modeling with Spice", McGraw-Hill, Inc., 1988.

**REFERENCE BOOKS:**

1. B. J. Baliga," Power Semiconductor Devices", Thomson, 2004
2. V. Benda, J. Gowar, D. A. Grant," Power Semiconductor Devices. Theory and Applications", John Wiley & Sons 1994.

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**(19EE2108) PWM CONVERTERS AND APPLICATIONS**

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**COURSE OBJECTIVES:**

- 1. Understand the concepts and basic operation of PWM converters, including basic circuit operation and design.*
- 2. Understand the steady-state and dynamic analysis of PWM converters along with the applications like solid state drives and power quality.*

**COURSE OUTCOMES:**

*Students will be able to:*

- 1. Knowledge concepts and basic operation of PWM converters, including basic circuit operation and design*
- 2. Learn the steady-state and dynamic analysis of PWM converters along with the applications like solid state drives and power quality.*
- 3. Able to recognize and use the following concepts and ideas: Steady-State and transient modelling and analysis of power converters with various PWM techniques.*
- 4. Model the PWM Converters and Induction motor drives*
- 5. Apply various compensation techniques for the converters*
- 6. Ability to simulate the PWM technique on converter topologies*

**UNIT-I**

AC/DC and DC/AC power conversion, Overview of applications of voltage source converters and current source converters, Pulse width modulation techniques for bridge converters,

**UNIT-II**

Bus clamping PWM, Space vector based PWM, Advanced PWM techniques, Practical devices in converter.

**UNIT-III**

Calculation of switching and conduction power losses, Compensation for dead time and DC voltage regulation, Dynamic model of PWM converter.

**UNIT-IV**

Multilevel converters, Constant V/F induction motor drives, Estimation of current ripple and torque ripple in inverter fed drives, Line-side converters with power factor compensation.

**UNIT-V**

Active power filtering, Reactive power compensation, Harmonic current compensation Selective harmonic elimination PWM technique for high power electric drives.

**TEXT BOOKS:**

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

**REFERENCES**

1. Vithyathil. J, "Power Electronics: Principles and Applications", McGraw Hill.
2. D. Grahame Holmes "Pulse Width Modulation for Power Converters" IEEE PRESS

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**(20EE2109) ENERGY AUDITING, CONSERVATION & MANAGEMENT**

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**Course Objectives:**

*The objectives of this course include*

- *To learn about energy consumption and situation in India*
- *To learn about Energy Auditing.*
- *To learn about Energy Measuring Instruments.*
- *To understand the Demand Side Management*
- *To understand the payback and depreciation calculations*

**Course Outcomes:**

*After completion of the course the student should be able to:*

1. *Conduct energy auditing and evaluate energy audit results*
2. *Carry out motor energy audit*
3. *Students should be able to understanding the good lighting system design and practice*
4. *Analyse demand side management concepts through case study*
5. *Students should be able to calculate depreciation and payback calculation*
6. *To predict management of energy systems*

**UNIT -I**

**INTRODUCTION TO ENERGY AUDITING**

Energy Situation – World and India Energy Audit- Definitions, Concept, Types of Audit, Energy Index, Cost Index, Pie Charts, Sankey Diagrams, Load Profiles, and Energy Conservation Schemes. Measurements in Energy Audits, Presentation of Energy Audit Results.

**UNIT –II**

**ENERGY EFFICIENT MOTORS AND POWER FACTOR IMPROVEMENT**

Energy Efficient Motors , Factors Affecting Efficiency, Loss Distribution , Constructional Details , Characteristics - Variable Speed , Variable Duty Cycle Systems, RMS Hp-Voltage Variation-Voltage Unbalance- Over Motoring- Motor Energy Audit. Power Factor – Methods of Improvement, Power factor With Non Linear Loads

**UNIT –III**

**LIGHTING AND ENERGY INSTRUMENTS FOR AUDIT**

Good Lighting System Design and Practice, Lighting Control, Lighting Energy Audit -Energy Instruments- Watt Meter, Data Loggers, Thermocouples, Pyrometers, Lux Meters, Tong Testers, Application of PLC's

**UNIT –IV**

**INTRODUCTION TO DEMAND SIDE MANAGEMENT**

Introduction to DSM, Concept of DSM, Benefits of DSM, Different Techniques of DSM – Load Management, Load Priority Technique, Peak Clipping, Peak Shifting, Valley Filling, Strategic Conservation, Management and Organization of Energy Conservation Awareness Programs.

**UNIT –V****ENERGY ECONOMIC ANALYSIS**

Basic payback calculations, Methods of Determining Depreciation - Straight line method, Sum of years and digits method, Diminishing value method and Sinking fund method - Numerical Problems. Net present value calculations. Taxes and Tax Credit.

**TEXT BOOKS:**

1. *Industrial Energy Management Systems*, Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing Corporation, New York, 1994.
2. *Fundamentals of Energy Engineering* - Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey, 1984.
3. *Demand side management*, Jyothi Prakash, TMH Publishers, 2004

**REFERENCES:**

1. *Economic Analysis of Demand Side Programs and Projects - California Standard Practice Manual, June 2002* – Free download available online  
[http://www.calmac.org/events/spm\\_9\\_20\\_02.pdf](http://www.calmac.org/events/spm_9_20_02.pdf)
2. *Energy management* by W.R. Murphy & G. Mckay Butter worth, Heinemann publications, 2007.
3. *Energy efficient electric motors* by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995.
4. *Energy management and good lighting practice: fuel efficiency-booklet12-EEo, 1993*

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**(20EE2110) POWER ELECTRONICS SIMULATION LAB**

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**LIST OF EXPERIMENTS**

1. Write program and simulate dynamical system of following models:
  - (a) I/O Model (b) State variable model also identifies time domain specifications of each.
2. Obtain frequency response of a given system by using various methods:
  - (a) General method of finding the frequency domain specifications (b) Polar plot
  - (c) Bode plot Also obtain the Gain margin and Phase margin.
3. Determine stability of a given dynamical system using following methods: (a) Root locus (b) Bode plot (c) Nyquist plot (d) Liapunov stability criteria
4. Transform a given dynamical system from I/O model to state variable model and vice versa.
  - (a) Obtain model matrix of a given system, obtain it's diagonalize form if exists or obtain
  - (b) Jordon Canonical form of system.
5. Write a program and implement linear quadratic regulator
6. Design a compensator for a given systems for required specifications.
7. Conduct a power flow study on a given power system.
8. Design a PID controller.
9. Conduct a power flow study on a given power system network using Guass-Seidel iterative method.
10. Develop a program to solve Swing Equation.
11. Develop a Simulink model for a single area load frequency problem and simulate the same.
12. Develop a Simulink model for a two-area load frequency problem and simulate the same.
13. Design a PID controller for two-area power system and simulate the same.
14. PSPICE Simulation of Single phase full converter using RL and E loads.
15. PSPICE Simulation of Three phase full converter using RL and E loads.
16. PSPICE Simulation of Single phase AC Voltage controller using RL load.
17. PSPICE Simulation of Three phase inverter with PWM controller.
18. PSPICE Simulation of resonant pulse commutation circuit.
19. PSPICE Simulation of impulse commutation circuit.

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**(20EE2111) INDUSTRIAL AUTOMATION LAB  
(Virtual Lab)**

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**LIST OF EXPERIMENTS**

1. Study hardware and software platforms for DCS
2. Simulate analog and digital function blocks
3. Study, understand and perform experiments on timers and counters
4. Logic implementation for traffic Control Application
5. Logic implementation for Bottle Filling Application
6. Tune PID controller for heat exchanger using DCS
7. FBD for autoclavable laboratory fermenter
8. Develop graphical user interface for the fermenter plant

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**(20HS0818) ENGLISH FOR RESEARCH PAPER WRITING**

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**COURSE OBJECTIVES**

The objectives of this course:

1. *Understand that how to improve your writing skills and level of readability.*
2. *Learn about what to write in each section.*
3. *Understand the skills needed when writing a Title.*
4. *Ensure the good quality of paper at very first-time submission.*
5. *Understand critical thinking in research writing.*

**COURSE OUTCOMES (COs)**

On successful completion of this course, the student will be able to

1. *Familiarize students with the key concepts of linguistics and develop awareness of the latest trends in language study.*
2. *Lead to a greater understanding of the human communicative action through an objective study of language.*
3. *Know and appreciate the location of literature within humanities.*
4. *Gain knowledge of research methods in literary studies and advanced knowledge of literature in the English language and literary theory.*
5. *Carry out an independent, limited research project under supervision, in accordance with applicable norms, ideals and conditions for literary research.*
6. *Improve common and basic scholarly requirements of logical and empirical rigor.*



**UNIT-I**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

**UNIT-II**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts and Introduction.

**UNIT-III**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

**UNIT-IV**

Key skills needed when writing a Title, key skills needed when writing abstract, key skills needed when writing an Introduction, skills when writing a Review of the Literature.

**UNIT-V**

Skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions.

**TEXT BOOK**

1. Goldbort R, *Writing for Science*, Yale University Press. 2006.
2. Day R, *How to Write and Publish a Scientific Paper*, Cambridge University Press. 2006.

**REFERENCES**

1. Highman N, *Handbook of Writing for the Mathematical Sciences*, SIAM. Highman's Books, 1998.
2. Adrian Wall, *English for Writing Research Papers*, Springer New York Dordrecht. Heidelberg London, 2011.

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**I M.Tech – II Sem.**

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**(20EE2112) POWER ELECTRONIC CONVERTERS**

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**COURSE OBJECTIVES:**

- 1. Understand the concepts and basic operation of SCR, UJT and Commutation.*
- 2. Understand the various conversion techniques.*

**COURSE OUTCOMES:**

*Students will be able to:*

- 1. To understand the various power semiconductor devices.*
- 2. Obtain the knowledge on various conversion techniques of power semiconductor devices*
- 3. Design controllers for dc-dc converters for DC-DC applications*
- 4. To simulate the behavior of single phase and three phase Inverters*
- 5. To solve the problems on inverter control techniques*
- 6. Apply the mathematical modelling skill on the converter topologies.*

**UNIT- I**

Thyristors – Silicon Controlled Rectifiers (SCR's) – BJT – Power MOSFET – Power IGBT and their characteristics and other thyristors – Basic theory of operation of SCR – Static characteristics Turn on and turn off methods- Dynamic characteristics of SCR - Turn on and Turn off times - Salient points. Two transistor analogy – SCR - UJT firing circuit — Series and parallel connections of SCR's – Snubber circuit details – Specifications and Ratings of SCR's, BJT, IGBT - Numerical problems – Line Commutation and Forced Commutation circuits.

**UNIT- II**

Single-Phase and Three-Phase AC to DC converters: Half controlled configurations-operating domains of three phase full converters and semi-converters, Reactive power considerations.

**UNIT- III**

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

**UNIT -IV**

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

**UNIT -V**

Inverters – Single phase inverter – Basic series inverter, parallel inverter - operation and waveforms - Three phase inverters (180, 120 degrees conduction modes of operation) - Voltage control techniques for inverters, Pulse width modulation techniques - Numerical problems

**TEXT BOOKS**

1. Ned Mohan, Undeland and Robbin, "Power Electronics: converters, Application and Design", John's Wiley and sons. Inc, Newyork.
2. M.H.Rashid, "Power Electronics", Prentice Hall of India 1994.

**REFERENCES**

1. Power Electronics converters ,Aplications and Design Mohan undeland Robbins Willey publications

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**(20EE2113) DIGITAL CONTROL OF POWER ELECTRONICS AND  
DRIVES SYSTEMS**

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**COURSE OBJECTIVES:**

*To impart knowledge on operation and performance of induction Motor, Synchronous motors and brushless DC motor and their speed control techniques.*

**COURSE OUTCOMES:**

*Students will be able to:*

1. *Design static Scherbius and Kramer drives to implement slip power recovery schemes*
2. *Implement synchronous motor drives with fixed frequency and variable frequency sources*
3. *Obtain Knowledge on speed control schemes for Brushless D.C. motors and Permanent Magnet Synchronous motors.*
4. *To understand the concept Control of Wound-field Synchronous motor and SRM drives.*
5. *Apply the mathematical skills to solve the vector control of PMSM.*
6. *To know the control and operation of PMBDCM drive scheme*

**UNIT-I**

**Introduction to Induction motor Drives:** Induction machine Torque production, Equivalent circuit analysis – Speed-Torque Characteristics with Variable voltage, constant frequency operation, Variable frequency operation, constant v/f operation, Variable stator current operation, Induction motor characteristics in constant torque and field weakening regions

**UNIT -II**

**Scalar control of Induction motor drives:** Voltage fed inverter control, Open loop volts/Hz control, speed control slip regulation, speed control with torque and flux control, current controlled voltage fed inverter drive, current-fed inverter control, Independent current and frequency control, Speed and flux control in Current-Fed inverter drive, Volts/Hz control of Current-fed inverter drive, Efficiency optimization control by flux program

**UNIT-III**

**Slip power recovery Induction motor drives:** Static Kramer Drive, Phasor diagram, Torque expression, Speed control of a Kramer Drive, Static Scherbius Drive, modes of operation, Wound field machine, equivalent circuit, developed torque, salient pole machine characteristics, synchronous reluctance machine, sinusoidal PM machines, trapezoidal PM machines

**UNIT- IV**

**Control of Wound-field Synchronous motor and SRM drives:** Brush and brushless dc excitation, LCI drives and its control, scalar and vector control of cyclo converter drives, current vector control of SyRM drive, constant de-axis control, fast torque response control, maximum torque/ampere control, maximum power factor control.

**UNIT- V**

**Control of PM Synchronous motor and BLDC drives:** Vector control of PMSM, control strategies, Constant torque angle control, Unity power factor control Constant mutual flux linkage control, flux weakening operation, PMBDCM drive scheme, dynamic simulation, commutation-torque ripple, phase advancing, normalized system equations, Half wave PMBDCM drives.

**TEXT BOOKS:**

1. N. Mohan, Power Electronics- Converters, Applications and Design, 3<sup>rd</sup> Ed., John Wiley & Sons, 2003.
2. G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2003.

**REFERENCES:**

1. M. Rashid, Power Electronics- Circuits, Devices and Applications, 3<sup>rd</sup> Ed., Prentice Hall, 2004.
2. B. K. Bose, Modern Power Electronics and AC Drives, Pearson Education, 2003.
3. A. M. Trzynadlowski, Introduction to Modern Power Electronics, John Wiley & Sons, 1998.
4. M. Rashid, Power Electronics Handbook, Academic Press-Elsevier, 2001.

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**(20EE2114) SWITCHED MODE AND RESONANT CONVERTERS**

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**COURSE OBJECTIVES:**

1. *To understand different types of converters*
2. *To understand different switch mode topologies & control methods*
3. *To understand different resonant converter topologies*

**COURSE OUTCOMES:**

1. *Acquire knowledge about the principles of operation of non-isolated and isolated hard-switched DC-DC converters*
2. *Acquire knowledge on various loss components in a switched mode converter and choice of switching frequency with a view towards design of such converters*
3. *Analyse the harmonics of line commutated rectifiers*
4. *Understand and analyse the concept of resonant converter*
5. *To develop the mathematical transfer function of SMPS*
6. *Analyse the dynamics of switching converter*

**UNIT-I**

Buck, Boost, Buck-Boost SMPS Topologies, Basic Operation-Waveforms - modes of operation - switching stresses, Switching and conduction losses. Optimum switching frequency, Practical voltage, current and power limits - design relations, Voltage mode control principles, Push-Pull and Forward Converter Topologies - Basic Operation, Waveforms, Flux Imbalance Problem and Solutions.

**UNIT-II**

Transformer Design. Output Filter Design. Switching Stresses and Losses, Forward Converter Magnetics. Voltage Mode Control, Half and Full Bridge Converters. Basic Operation and Waveforms, Magnetics, Output Filter, Flux Imbalance, Switching Stresses and Losses, Power Limits, Voltage Mode Control.

**UNIT-III**

Classification of Resonant Converters. Basic Resonant Circuit Concepts, Load Resonant Converter, Resonant Switch Converter, Zero, Voltage Switching Clamped Voltage Topologies. Resonant DC Link Inverters with Zero Voltage Switching, High Frequency Link Integral Half Cycle Converter, and Fly back Converter- discontinuous mode operation, waveforms, control, Magnetics- Switching Stresses and Losses, Disadvantages – Continuous Mode Operation, waveforms, control, design relations.

**UNIT-IV**

Voltage Mode Control of SMPS- Loop Gain and Stability Considerations, Error Amp– frequency Response and Transfer Function, Trans-conductance Current Mode Control of SMPS, Current

Mode Control Advantages, Current Mode vs. Voltage Mode. Current Mode Deficiencies, Slope Compensation, Study of a typical Current Mode PWM Control IC UC3842. Modelling of SMPS.

**UNIT-V**

DC Transformer, Voltage Mode SMPS Transfer Function, General Control Law Consideration, MI Generation and Filtering in SMPS - Conducted and Radiated Emission Mechanisms in SMPS, Techniques to reduce Emissions, Control of Switching Loci, Shielding and Grounding, Power Circuit Layout for minimum EMI,EMI Filtering at Input and Output, Effect of EMI Filter on SMPS Control Dynamics, Introduction to Resonant Converters.

**TEXT BOOKS:**

1. Abraham I Pressman, "Switching Power Supply Design," McGraw Hill Publishing Company, 2001.
2. Daniel M Mitchell, "DC-DC Switching Regulator Analysis," McGraw Hill Publishing Company-1988.

**REFERENCES:**

1. Ned Mohan et.al, "Power Electronics," John Wiley and Sons 2006.

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**(20EE2115) INDUSTRIAL LOAD MODELLING AND CONTROL**

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**COURSE OBJECTIVES:**

1. To understand the energy demand scenario.
2. To understand the modeling of load and its ease to study load demand industrially.
3. To know Electricity pricing models.
4. Study Reactive power management in Industries.

**COURSE OUTCOMES:**

*Students will be able to:*

1. Knowledge about load control techniques in industries and its application.
2. Different types of industrial processes and optimize the process using tools like LINDO and LINGO.
3. Apply load management to reduce demand of electricity during peak time.
4. Apply different energy saving opportunities in industries
5. The student should gain a workable knowledge in analyzing Electric Drive Systems
6. Able to Forecast the Integrated Load management of industry.

**UNIT-I**

Demand Side Management-Industrial Load Management. Load Curves-Load Shaping Objectives-Methodologies, Barriers; Classification of Industrial Loads- Continuous and Batch processes -Load Modelling.

**UNIT-II**

Dynamic and spot pricing –Models. Direct load control- Interruptible load control. Bottom up approach- scheduling- Formulation of load models- Optimization and control algorithms.

**UNIT-III**

load profiling- Modelling., Cool storage-Types- Control strategies., Optimal operation-Problem formulation- Case studies., Selection of Schemes Optimal Operating Strategies.

**UNIT-IV**

Operating and control strategies- Power Pooling, Operation models. Energy banking-Industrial Cogeneration, Reactive power management in industries-controls-power quality impacts.

**UNIT-V**

Constraints-Problem formulation- Case study, Po for Industries, impacts, application of filters Energy saving in industries.



**TEXT BOOKS:**

1. C.O. Bjork "Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands, 1989.
2. C.W. Gellings and S.N. Talukdar, "Load management concepts," IEEE Press, New York, 1986, pp. 3-28.

**REFERENCES:**

1. Y. Manichaikul and F.C. Schweppe, "Physically based Industrial load", IEEE Trans. on PAS, April 1981.
2. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.

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**(20EE2116) ADVANCED DIGITAL SIGNAL PROCESSING**

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**COURSE OBJECTIVES:**

- 1. To understand the difference between discrete-time and continuous-time signals.*
- 2. To understand and apply Discrete Fourier Transforms (DFT).*

**COURSE OUTCOMES :**

*Students will be able to:*

- 1. Portray the fundamentals of Digital Signal Processing.*
- 2. Depict the concepts and applications of Motor control signal processors*
- 3. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems.*
- 4. Study the design techniques for IIR and FIR filters and their realization structures.*
- 5. Acquire knowledge about the finite word length effects in implementation of digital filters.*
- 6. Compare the various linear signal models and its algorithms*

**UNIT-I**

Analog to digital and Digital to Analog conversion, sampled and Hold circuit, Continuous time Fourier Transforms, Discrete time signals and systems, Discrete time Fourier transform, its properties and applications, Fast Fourier Transform (in time domain and Frequency domain), IDFT and its properties.

**UNIT-II**

Definition and properties, Rational z-transforms, Region of convergence of a rational z-Transform, The inverse z-Transform, z-Transform properties, Computation of the convolution sum of finite, length sequences, The transfer function.

**UNIT-III**

Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

**UNIT-IV**

Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.

FIR digital filter design: Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.

**UNIT-V**

The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms. The basic sample rate alteration devices, Multi rate structures for sampling rate conversion, Multistage design of decimator and interpolator, The Polyphase decomposition, Arbitrary rate sampling rate converter, Nyquist Filters and some applications of digital signal processing.

**TEXT BOOKS**

1. Digital Signal Processing, S.K. Mitra, Tata McGraw,Hill, Third Edition, 2006.
2. Principle of Signal Processing and Linear Systems, B.P. Lathi, Oxford International Student Version, 2009
3. Continuous and Discrete Time Signals and Systems, M. Mondal and A Asif, Cambridge, 2007

**REFERENCES**

1. Digital Signal Processing, Fundamentals and Applications, LiTan-Indian reprint,Elsevier,2008.
2. Discrete-Time Signal Processing, Alan V. Oppenheim, Ronald, W. Schafer, and John R.Buck, Pearson Education, 2008.

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**(20EE2117) ADVANCED MICRO-CONTROLLER BASED SYSTEMS**

**COURSE OBJECTIVES:**

1. *To understand the architecture of advance microcontrollers.*
2. *To understand the applications of these controllers.*
3. *To get some introduction to FPGA.*

**COURSE OUTCOMES**

*Students will be able to:*

1. *Learn how to program a processor in assembly language and develop an advanced processor based system.*
2. *Learn configuring and using different peripherals in a digital system.*
3. *Compile and debug a Microprocessor Program.*
4. *Generate an executable file and use it.*
5. *Obtain knowledge on the embedded boards*
6. *Obtain a skill to identify the suitable controller for the application.*

**UNIT – I**

Basic Computer Organization, Accumulator based processes-Architecture-Memory Organization-I/O Organization.

**UNIT – II**

Intel 8051, Intel 8056- Registers, Memories, I/O Ports, Serial Communication, Timers, Interrupts, Programming, Intel 8051 – Assembly language programming-Addressing-Operations-Stack & Subroutines, Interrupts-DMA.

**UNIT – III**

PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication.

**UNIT – IV**

Digital Signal Processor (DSP) - Architecture – Programming, Introduction to FPGA.

**UNIT – V**

Microcontroller development for motor control applications, Stepper motor control using micro controller

**TEXT BOOKS:**

1. John.F.Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons 1981.
2. Ramesh S.Gaonker: "Microprocessor Architecture, Programming and Applications with The 8085", Penram International Publishing (India), 1994.
3. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005.

**REFERENCES:**

1. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004.
2. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005.
3. Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with The PIC18F Series", Elsevier, 2008.
4. Microchip datasheets for PIC16F877.

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**(20EE2118) DISTRIBUTED GENERATION**

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**COURSE OBJECTIVES:**

- To understand renewable energy sources.*
- To gain understanding of the working of off-grid and grid-connected renewable energy generation schemes.*

**COURSE OUTCOMES**

*Students will be able to:*

- To understand the planning and operational issues related to Distributed Generation.*
- Acquire Knowledge about Distributed Generation Learn Micro-Grids.*
- Relate the conventional power generation and distributed generation*
- Analyze the concept of distributed generation and installation*
- Explicate the concept of AC/DC microgrids*
- Analyze power quality issues and control operation of micro grid*

**UNIT-I**

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

**UNIT-II**

Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces, Aggregation of multiple DG units, Technical impacts of DGs.

**UNIT-III**

Transmission systems Distribution Systems De-regulation Impact of DGs upon protective relaying, Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis.

**UNIT-IV**

Aspects of DGs Market facts, Issues and challenges Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality issues, Reliability of DG based systems, Transients in micro-grids, Protection of micro-grids, Case Studies, Advanced topics.

**UNIT-V**

Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids, Modelling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units.

**TEXT BOOKS:**

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.
2. M.GodoySimoes, Felix A.Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRC press.

**REFERENCES:**

1. Stuart Borlase. "Smart Grid: Infrastructure Technology Solutions" CRC Press

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**(20EE2119) SMART GRIDS**

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**COURSE OBJECTIVES:**

1. Understand concept of smart grid and its advantages over conventional grid.
2. Know smart metering techniques.
3. Learn wide area measurement techniques.
4. Understanding the problems associated with integration of distributed generation & its solution through smart grid.

**COURSE OUTCOMES:**

*Students will be able to:*

1. Understand the difference between smart grid & conventional grid.
2. Apply knowledge on smart metering concepts to industrial and commercial installations.
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
4. Explicate the need of smart grid technology.
5. Analyse the power quality issues in smart grid
6. Describe the concept of smart grid communication technologies

**UNIT-I**

Evolution of Electric Grid Concept of Smart Grid, Definitions

Need of Smart Grid, Self-Healing Grid Present development. Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart, Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

**UNIT-II**

Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

**UNIT-III**

Need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of micro-grid. Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources.



**UNIT-IV**

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

**UNIT-V**

Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN), Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols

**TEXT BOOKS:**

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 2011
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009
3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2012

**REFERENCES:**

1. Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions "CRC Press
2. A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer

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**(20EE2120) POWER CONVERTERS LAB**

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**LIST OF EXPERIMENTS**

1. Speed Measurement and closed loop control using PMDC motor.
2. Thyristorised drive for PMDC Motor with speed measurement and closed Loop control.
3. IGBT used single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop control.
4. Thyristorised drive for 1Hp DC motor with closed loop control.
5. 3-Phase input, thyristorised drive, 3 Hp DC motor with closed loop
6. 3-Phase input IGBT, 4 quadrant chopper drive for DC motor with closed Loop control equipment.
7. Cyclo-converter based AC Induction motor control equipment.
8. Speed control of 3 phase wound rotor Induction motor.
9. Single-phase fully controlled converter with inductive load.
10. Single phase half wave controlled converter with inductive load.

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**(20EE2122) INDUSTRIAL ELECTRIC DRIVES LAB  
(Virtual Lab)**

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**LIST OF EXPERIMENTS**

1. PLC Timer Instruction
2. PLC Counter Instruction
3. Garbage Shutter opening and closing using PLC
4. Container Filling Operations Limiter using PLC
5. Motor forward and reverse Process Using PLC
6. Simultaneous output interlock using PLC
7. Maximum Simultaneous direction control using PLC

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**(20HS0829) CONSTITUTION OF INDIA**

**COURSE OBJECTIVES**

- 1. To know the premises informing the twin themes of liberty and freedom from a civil rights perspective.*
- 2. To address the growth of Indian opinion regarding modern Indian intellectuals 'constitutional role*
- 3. To address entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*
- 4. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution*
- 5. To acquire knowledge for various competitive examinations*

**COURSE OUTCOMES**

- 1. Explain the key concepts of political economy*
- 2. Analyze the significant developments in the political ideologies*
- 3. Describe the salient features of the constitution of India interpret, integrate and critically*
- 4. Analyze the political economy of Indian international relations and gain knowledge in Judiciary system*
- 5. Apply their knowledge acquired to write various competitive examinations*
- 6. Apply knowledge on society on their rights*

**UNIT-I**

Introduction to the Constitution

**UNIT-II**

Historical Perspective of the Constitution of India- Salient features and characteristics of the Constitution of India

**UNIT-III**

Scheme of the fundamental rights-The scheme of the Fundamental Duties and its legal status-The Directive Principles of State Policy – Its importance and implementation

**UNIT-IV**

Parliamentary Form of Government in India – Powers and Functions-The President of India - Status and Powers -The historical perspectives of the constitutional amendments in India- Judiciary system - Powers and Functions

**UNIT-V**

Local Self Government – Constitutional Scheme in India -  
Election Commission: Role and Functions

**TEXT BOOKS**

1. Government of India Ministry of Law and Justice (Legislative Department) *The Constitution of India, 1950 (Bare Act)* Government Publication, 2015
2. Dr. S. N. Busi *Dr. B. R. Ambedkar framing of Indian Constitution*, 1st Edition, Government Publication 2015

**REFERENCES**

1. M. P.Jain *Indian Constitution Law* Lexis Nexis 7th Edn., 2014.
2. D.D. Basu *Introduction to the Constitution of India* Lexis Nexis, 2015
3. P.M.Bakshi *Constitution of India* Universal Law Publishing.15<sup>th</sup> Edition,2018

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**(20EE2123) SCADA SYSTEM AND APPLICATIONS**

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**Course Objectives:**

- To understand PLC and its functions.
- To understand SCADA and its functions
- To know SCADA communication.
- To get an insight into its application

**Course Outcomes**

Students will be able to:

1. *Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications.*
2. *Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.*
3. *Knowledge about single unified standard architecture IEC 61850.*
4. *To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.*
5. *Learn and understand about SCADA applications in transmission and distribution sector, industries etc.*
6. *knowledge about various system components and communication protocols of SCADA system and its applications.*

**UNIT-I**

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

**UNIT-II**

Introduction to SCADA , Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, SCADA System Components.

**UNIT-III**

Need of computer control of power systems, concept of energy control center (or) load dispatch center and the functions, system monitoring, data acquisition and control, system hardware configuration, SCADA and EMS functions, network topology, state estimation, security analysis and control, operating states.

**UNIT-IV**

SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

**UNIT-V**

Utility applications- Transmission and Distribution sector -operations, monitoring, analysis and improvement. Industries - oil, gas and water. Case studies, Implementation, Simulation Exercises.

**TEXT BOOKS**

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

**REFERENCES:**

1. P.Kundur ; "Power System Stability and Control", EPRI Publications, California 1994.
2. Nagrath, I.J. and Kothari D.P., 'Modern Power System Analysis', TMH, New Delhi, 1980
3. D.P.Kothari & J.S.Dhillon, Power System Optimization, PHI, 2004

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**(20EE2124) FACTS AND CUSTOM POWER DEVICES**

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**Course Objectives:**

- To learn the active and reactive power flow control in power system
- To understand the need for static compensators
- To develop the different control strategies used for compensation

**Course Outcomes:**

Students will be able to:

1. *Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.*
2. *Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled.*
3. *To compare the Reactive Power Compensation techniques*
4. *To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems*
5. *Demonstrate the use of SVC to mitigate power system problems*
6. *Suggest suitable techniques for coordinating various FACTS devices*

**UNIT-I**

Reactive power control of dynamic power unbalances in Power System - Power flow control Constraints of maximum transmission line loading Benefits of FACTS Transmission line compensation Uncompensated line -Shunt compensation, Series compensation Phase angle control Reactive power compensation Shunt and Series compensation principles Reactive compensation at transmission and distribution level

**UNIT-II**

Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM Operation and control of TSC, TCR and STATCOM –Compensator control Comparison between SVC and STATCOM

**UNIT-III**

TSSC, SSSC -Static voltage and phase angle regulators TCVR and TCPAR Operation and Control, Applications, Static series compensation GCSC, TSSC, TCSC and Static synchronous series compensators and their Control

**UNIT-IV**

SSR and its damping Unified Power Flow Controller, Circuit Arrangement, Operation and control of UPFC, Basic Principle of P and Q control, Independent real and reactive power flow control-Applications.

**UNIT-V**



Modelling and analysis of FACTS Controllers Simulation of FACTS controllers Power quality problems in distribution systems, harmonics, loads that create harmonics modelling, harmonic propagation, series and parallel resonances  
Mitigation of harmonics passive filters, active filtering – shunt, series and hybrid and their control

**TEXT BOOKS:**

1. K R Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International Publishers, 2007
2. X P Zhang, C Rehtanz, B Pal, “Flexible AC Transmission Systems- Modelling and Control”, SpringerVerlag, Berlin, 2006

**REFERENCES:**

1. N.G. Hingorani, L. Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
2. K.S.Sureshkumar, S.Ashok, “FACTS Controllers & Applications”, E-book edition, Nalanda DigitalLibrary, NIT Calicut, 2003

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**(20EE2125) HVDC TRANSMISSION SYSTEMS**

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**Course Objectives:**

- To introduce students with the concept of HVDC Transmission system
- To familiarize the students with the HVDC converters and their control system.
- To expose the students to the harmonics and faults occur in the system and their prevention.

**Course Outcomes:**

Students will be able to:

1. *Choose intelligently AC and DC transmission systems for the dedicated application(s).*
2. *Identify the suitable two-level/multilevel configuration for high power converters.*
3. *Select the suitable protection method for various converter faults.*
4. *Demonstrate the modern trends in planning of HVDC system*
5. *Design AC and DC filters to eliminate Harmonics*
6. *Model HVDC systems for Digital Dynamic Simulation and demonstrate the grounding of HVDC systems.*

**UNIT-I**

HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DC links, Layout of HVDC Converter station and various equipments. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations

**UNIT-II**

Pulse number, Choice of converter configuration, Simplified analysis of Graetz circuit, Converter bridge characteristics, Characteristics of a twelve-pulse converter, Detailed analysis of converters with and without overlap.

**UNIT-III**

General, Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Current and extinction angle control, Starting and stopping of DC link, Power control, Higher level controllers

**UNIT-IV**

Harmonics in HVDC systems, harmonics elimination, AC & DC filter, Interaction between HVAC & DC systems –voltage interaction, harmonic instability problems and DC power modulation.

Multi-terminal DC link and systems; series, parallel and series parallel systems, their operation and control.

**UNIT-V**

Transient over voltage in HVDC systems: Over voltages due to disturbance on DC side,

over voltages due to DC and AC side line faults. Converter faults and protection in HVDC systems: Converter faults, over current protection-valve group and DC line protection. Over voltage protection of converters, surge arresters

**TEXT BOOKS:**

1. K.R.Padiyar: High Voltage Direct current Transmission, Wiely Eastern Ltd.
2. J.Arillaga: H.V.D.C.Tranmission peter peregrilnus ltd., London UK 1983

**REFERENCES:**

1. E.W.Kimbark: Direct current Transmission, Wiely inter Science-New york.
2. E.Uhlman: Power Transmission by Direct Current Springer Verlag, Berrlin

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**(20HS0824) BUSINESS ANALYTICS**

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**Course objectives:**

- 1. Understand the concepts and methods of business analytics.*
- 2. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.*
- 3. Identify the management related issues and processes to resolve*
- 4. Understand the significance of forecasting models helpful in decision making*
- 5. To become familiar with processes needed to develop, report, and analyze business data.*

**Course Outcomes:**

After the completion of the course, student would be able to:

- 1. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.*
- 2. Design alternatives to solve business problems utilizing quantitative analysis, critical thinking and sound ethical decision making.*
- 3. Summarize, process and transform data for obtaining meaningful conclusions*
- 4. Interpret data using latest data analytics tools to address organisational problems*
- 5. Organize and critically apply the concepts and methods of business analytics*
- 6. Assess decision problems and build models for creating solutions using business analytical tools.*

**UNIT I**

**Business analytics:** Overview of Business analytics - Scope of Business analytics - Business Analytics Process - Relationship of Business Analytics Process and organisation - competitive advantages of Business Analytics - Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

**UNIT II**

**Trendiness and Regression Analysis:** Modelling Relationships and Trends in Data - simple Linear Regression - Important Resources - Business Analytics Personnel - Data and models for Business analytics - problem solving - Visualizing and Exploring Data, Business Analytics Technology

**UNIT III**

**Organization Structures of Business analytics:** Team management - Management Issues - Designing Information Policy – Outsourcing - Ensuring Data Quality - Measuring contribution of

Business analytics - Managing Changes - Descriptive Analytics - predictive analytics - predicative Modelling - Predictive analytics analysis - Data Mining - Data Mining Methodologies - Prescriptive analytics and its step in the business analytics Process - Prescriptive Modelling - nonlinear Optimization.

#### UNIT IV

**Forecasting Techniques:** Qualitative and Judgmental Forecasting - Statistical Forecasting Models - Forecasting Models for Stationary Time Series - Forecasting Models for Time Series with a Linear Trend - Forecasting Time Series with Seasonality - Regression Forecasting with Casual Variables - Selecting Appropriate Forecasting Models - Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform - New-Product Development Model - Newsvendor Model - Overbooking Model - Cash Budget Model.

#### UNIT V

**Decision Analysis:** Formulating Decision Problems - Decision Strategies with the Outcome Probabilities - Decision Trees - The Value of Information - Utility and Decision Making - Recent Trends in Embedded and collaborative business intelligence - Visual data recovery - Data Storytelling and Data journalism.

#### TEXT BOOKS:

1. *Business Analytics: Data analysis & Decision making*, S. Christian Albright, Cengage Learning
2. *Essentials of Business Analytics*, Jeffery Camm, & others, Cengage Learning

#### REFERENCES:

1. *Business analytics Principles, Concepts, and Applications*, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. *Business Analytics* James Evans, Pearsons Education.
3. *Data mining for business analytics: Concepts, Techniques and Applications*, Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl Jr., WILEY

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**(20ME3026) INDUSTRIAL SAFETY**

**COURSE OBJECTIVES:**

1. *To learn about mechanical and electrical hazards.*
2. *To learn about Fundamentals of Maintenance Engineering.*
3. *To learn about Wear and Corrosion and their prevention.*
4. *To know about Fault Tracking*
5. *To learn about Periodic and preventive maintenance.*

**COURSE OUTCOMES:**

*Students undergoing this course are able to*

1. *Understand the points of factories act 1948 for health and safety.*
2. *Understand the cost & its relation with replacement economy.*
3. *Understand the concepts of Wear and Corrosion Prevention*
4. *Understand the concepts of sequence of fault finding activities*
5. *Understand the Program and schedule of preventive maintenance of mechanical and electrical equipment.*
6. *Understand the Periodic Maintenance of Equipments*

**UNIT-I**

**Industrial Safety:** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

**UNIT-II**

**Fundamentals of Maintenance Engineering:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

**UNIT-III**

**Wear and Corrosion and their Prevention:** Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

**UNIT-IV**

**Fault Tracing:** Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

**UNIT-V**

**Periodic and Preventive Maintenance:** Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

**TEXT BOOKS:**

1. Higgins & Morrow, *Maintenance Engineering Handbook*, Da Information Services.
2. H. P. Garg, *Maintenance Engineering*, S. Chand and Company.

**REFERENCE BOOKS:**

1. Audels, *Pump-hydraulic Compressors*, Mcgrew Hill Publication.
2. Winterkorn, *Foundation Engineering Handbook*, Chapman & Hall London.

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**(20ME3027) ADVANCES IN OPERATIONS RESEARCH**

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**COURSE OBJECTIVES:**

*On successful Completion of this course the student will be able to*

1. Enumerate the fundamentals of Linear Programming
2. Learn classical optimization techniques
3. Develop the best strategy of Game and identifying the Queuing theory.
4. Understand about sequence and optimum Duration of the Project
5. Develop the importance of Replacement models and Inventory control

**COURSE OUTCOMES**

*On successful Completion of this course the student will be able to*

1. Create mathematical models of the real time situations.
2. Implement Transportation and Assignment problems to solve in real time industry
- 3 Choose the best strategy of Game and capable of identifying the suitable queuing theory
4. Enumerate fundamental techniques and apply it to solve various optimization areas
5. Investigate, study, Apply knowledge in Replacement models and
6. Understand the Inventory control Models

**UNIT-I**

**Introduction to OR and Linear Programming**-OR definition–Types of Operations Research models; Linear Programming- Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Degeneracy - Problems

**UNIT-II**

**Transportation Problem** – Formulation; Initial Basic Feasible Solution-North-West Corner Rule, Least Cost Method, Vogel’s Approximation Method, Modified Distribution (MODI) Method, Unbalanced Transportation - Problems

**Assignment Problem** – Formulation, Optimal Solution -Traveling Salesman problem.

**UNIT-III**

**Game Theory** - Introduction – Minimax (Maxi mini) Criterion and Optimal Strategy, Saddle Point, Solution of Games with Pure Strategy and Mixed Strategies – 2 X 2 Games – Dominance Principle.

**Queuing Theory**- Introduction to queuing system–Service Channel, Arrival Pattern, Size of Population, Service Pattern, Queue Discipline, Customer Behavior, Probability Distribution-



Birth & Death Process, Simple Problems on Single Service channel only.

#### UNIT-IV

**Sequencing** –Terminology - Johnson’s Algorithm for n-jobs x 2 Machines and n-jobs x 3 machines models - Problems

**PERT & CPM:** Introduction, Difference between PERT and CPM, Terminology- Activities, Events, Predecessor, Early Start, Early Finish, Late Start & Late Finish Times, Earliest Occurrence and Latest Occurrence of the Event, Total Float, Free Float, Independent Float; CPM- Deterministic Model; PERT- Probabilistic Model, Critical Path, Optimal Project Duration, Least Possible Project Duration- Problems.

#### UNIT-V

**Replacement** – Failure Mechanism of Items, Types of Replacements- Individual Replacement policy, Group Replacement policy, Replacement of items fail suddenly – problems

**Inventory** - Necessity for maintaining inventory, inventory costs, classification of fixed order quantity inventory models, selective inventory management techniques.

#### TEXT BOOKS:

1. S D. SHARMA *Operations Research* KNRN Publications. 17th edition 2015
2. Hamdy A Taha , *Operations Research* Pearson Publications, 9 th edition 2015

#### REFERENCES BOOKS

1. Manohar Mahajan *Operations Research*, Dhanpat Rai &Co 2016
2. Er. Prem kumar Guptha & Dr.D.S.Hira *Operations Research*, Schand publications 2012.
3. R Panneerselvam *Operations Research* PHI, 2nd edition, 2012.

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**(20CE1028) COST MANAGEMENT OF ENGINEERING PROJECTS**

**COURSE OBJECTIVES**

1. *Establish systems to help streamline the transactions between corporate support departments and the operating units.*
2. *Devise transfer pricing systems to coordinate the buyer-supplier interactions between decentralized organizational operating units.*
3. *Use pseudo profit centres to create profit maximizing behaviour in what were formerly cost centres.*

**COURSE OUTCOMES (COs)**

*On successful Completion of this course the student will be able to*

1. *Summarise the concept of strategic cost management, strategic cost analysis – target costing, life cycle costing and Kaizen costing and the cost drive concept.*
2. *Describe the decision-making; relevant cost, differential cost, incremental cost and opportunity cost, objectives of a costing system.*
3. *Summarise the meaning and different types of project management and project execution, detailed engineering activities.*
4. *Understand the project contracts,*
5. *Describe the cost behaviour and profit planning types and contents, Bar charts and Network diagram.*
6. *Analyse by using quantitative techniques for cost management like PERT/CPM.*

**UNIT – I**

Introduction and Overview of the Strategic Cost Management Process.

**UNIT-II**

**Cost Concepts:** Cost concepts in decision-making - Relevant cost - Differential cost - Incremental cost and Opportunity cost - Objectives of a Costing System - Inventory valuation - Creation of a Database for operational control - Provision of data for Decision Making.

**Unit – III**

**Project Management:** Project: meaning - Different types - why to manage - cost overruns centers - various stages of project execution: conception to commissioning - Project execution as conglomeration of technical and nontechnical activities - Detailed Engineering activities - Pre project execution main clearances and documents - Project team: Role of each member - Importance Project site: Data required with significance - Project contracts - Types and contents - Project execution Project cost control - Bar charts and Network diagram - Project commissioning: mechanical and process.

**UNIT – IV**

**Cost Behavior and Profit Planning:** Cost Behavior and Profit Planning Marginal Costing - Distinction between Marginal Costing and Absorption Costing - Break-even Analysis - Cost-

Volume-Profit Analysis - Various decision-making problems - Standard Costing and Variance Analysis - Pricing strategies: Pareto Analysis - Target costing - Life Cycle Costing - Costing of service sector - Just-in-time approach - Material Requirement – Planning - Enterprise Resource Planning - Total Quality Management and Theory of constraints - Activity-Based Cost Management - Bench Marking - Balanced Score Card and Value-Chain Analysis - Budgetary Control - Flexible Budgets - Performance budgets - Zero-based budgets - Measurement of Divisional profitability pricing decisions including transfer pricing.

#### **UNIT-V**

**Quantitative Techniques:** Quantitative techniques for cost management-Linear Programming, PERT/CPM - Transportation Problems - Assignment problems – Simulation - Learning Curve Theory.

#### **TEXT BOOKS:**

1. Robert S Kaplan Anthony A. Alkinson, *Management & Cost Accounting*.
2. N.D. Vohra, *Quantitative Techniques in Management*, Tata McGraw Hill Book Co. Ltd.

#### **REFERENCES:**

1. *Cost Accounting A Managerial Emphasis*, Prentice Hall of India, New Delhi.
2. Charles T. Horngren and George Foster *Advanced Management Accounting*.
3. Ashish K. Bhattacharya, *Principles & Practices of Cost Accounting* A. H. Wheeler publisher.

#### **WEB REFERENCES:**

1. <https://nptel.ac.in/courses/110/101/110101132/>
2. <https://nptel.ac.in/courses/105104161/>

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**(20ME3028) COMPOSITE MATERIALS**

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**COURSE OBJECTIVES**

- To understand the mechanical behavior of composite materials*
- To get an overview of the methods of manufacturing composite materials.*
- To know the fundamentals of composite materials.*
- To understand the fabrication and process of composites.*
- To recognize the applications of composite materials.*

**COURSE OUTCOMES**

*Upon completion of this course, the students will have an overview of*

- Fundamental concept of composite materials.*
- Different types of composite materials.*
- To understand the Fabrication and processing of composite materials.*
- Comparison of MMC & CMC*
- Apply knowledge on Mechanical behaviour of composite materials.*
- Application of composite materials.*

**UNIT-I**

**Introduction To Composites:** Fundamentals of composites – need– enhancement of properties – classifications —Introduction to Reinforcement composites–types. Applications. Fiber production techniques for glass, carbon and ceramic fibers –Resin materials-Types.

**UNIT-II**

**Polymer Matrix Composites:** Fabrication of PMC's ,Fabrication of Fibers, Plastic Fiber Forms, Pre-pregs, Molding Compounds-Processes, Lay-Ups, Filament Winding, Pultrusion, and Recycling. Matrix – Reinforcement Interface, Wettability.

**UNIT-III**

**MMC&CMC :** Fabrication of MMC'S, Liquid Infiltration- Casting, Solid State Processes-Diffusion Bonding &In Situ Technique. Fabrication of CMC's, Hot-Pressing, Infiltration, In Situ Chemical reaction Techniques. CVD& CVI, Sol-gel.

**UNIT-IV**

**Mechanics of Composites:** Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, Von -Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates

**UNIT-V**

**Applications Of Composites:** Applications of advanced composite materials. Environmental effects in Composites, Green composites, Synthesis and Properties of Nano composites. Surface Composites & Surface metal matrix composites: Need, Synthesis, Properties and applications.

**TEXT BOOKS:**

1. Mathews F. L. and Rawlings R. D., “*Composite Materials: Engineering and Science*”, 1st Edition, Chapman and Hall, London, England, 1994.
2. Chawla K. K., “*Composite materials*”, Second Edition, Springer – Verlag, 1998.

**REFERENCES:**

1. Clyne, T. W. and Withers, P. J., “*Introduction to Metal Matrix Composites*”, Cambridge University Press, 1993.
2. Strong, A.B., “*Fundamentals of Composite Manufacturing*”, SME, 1989.
3. Sharma, S.C., “*Composite materials*”, Narosa Publications, 2000.

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**(20EE2128) WASTE TO ENERGY**

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**COURSE OBJECTIVES**

The objectives of this course:

1. *To learn different types of waste materials available for energy conversion*
2. *To understand Pyrolytic oil and gases*
3. *To introduce gasification methods for biomass*
4. *To learn concepts of biomass resources, combustion types and biogas plant technology*

**COURSE OUTCOMES (COs)**

On successful completion of this course, the student will be able to

1. *Analyse agro based, forest residue and industrial waste conversion processes.*
2. *Manufacture of Pyrolytic oils and gases*
3. *Manufacture of charcoal, yields and applications*
4. *Understand various types of gasifiers operation*
5. *Understand inclined and fluidized bed combustors operation*
6. *Understand types of biogas plants and biomass energy programme in India*

**UNIT- I**

**Introduction to Energy from waste:** Classification of waste as fuel – Agro based- Forest residue- Industrial waste- MSW- conversion devices- Incinerators- Gasifiers-Digestors.

**UNIT- II**

**Bio-mass Pyrolysis:** Pyrolysis- Types- Slow-Fast- Manufacture of Charcoal- methods- yields and application. Manufacture of Pyrolytic oils and gases – yields and applications.

**UNIT- III**

**Biomass Gasification:** Gasifiers- Fixed bed system- Downdraft and Updraft gasifiers- Fluidized bed gasifiers- construction and operation- Gasifier burner arrangement for thermal heating.

**UNIT- IV**

**Biomass Combustion:** Biomass stoves- Types- Inclined combustors- Fluidized bed combustors- construction and operation of above biomass combustors.

**UNIT- V**

**Properties of Biogas:** Biogas plant Technology and status – Biomass resources and their classification- Biomass conversion processes- thermo chemical conversion – Direct Combustion- Biomass gasification- Pyrolysis and liquefaction – bio-chemical conversion- anaerobic digestion- Types of biogas plants- applications-Biomass Energy Programme in India.

**TEXT BOOKS**

1. Non-Conventional Energy- Desai Ashok V. Wiley Eastern Ltd 1990.
2. Biogas Technology – A Practical Hand Book – Khandelwal K.C. and Mahdi SS, Vol I & II. Tata Mc Graw Hill Publishing Co Ltd.,1983.

**REFERENCES**

1. Food, Feed and Fuel from Biomass – Challal D.S., IBH Publishing Co Pvt Ltd.,1991.
2. Non-conventional Energy Sourcers- GD Roy, Khanna Publishers, 6<sup>th</sup> Edition
3. Biomass & Bioenergy – Khahid Rehman Hekeem, Mohammad Jawald., Umar Rashid- Springer International Publishing Ltd.