TKR COLLEGE OF ENGINEERING & TECHNOLOGY (AUTONOMOUS)
M.TECH (POWER ELECTRONICS)
R-21 Regulation-Course Structure

M. Tech I Year–I Semester

S. No	Course Code	Course Title	L	T	P	C
1	C121PC1	Power Electronic Converters	3	0	0	3
2	C121PC2	Machine Modeling and Analysis	3	0	0	3
3	C121PE3	1. Power Electronics for Renewable Energy Systems 2. Smart Grid Technologies 3.Dynamics of Electrical Machines 4. Modern Control Theory	3	0	0	3
4	C121PE4	1. Power Semiconductor Devices and Modelling 2. Reactive Power Compensation and Management 3.High Frequency Magnetic Components 4. Hybrid Electric Vehicles	3	0	0	3
5	C121RM5	Research Methodology and IPR	2	0	0	2
6	C121PC6	Machine Modeling and Analysis Lab	0	0	4	2
7	C121PC7	Power Electronic Converters Lab	0	0	4	2
8	Audit-I	Audit I	2	0	0	0
Total Credits						**18**

M. Tech I Year–II Semester

S. No	Course Code	Course Title	L	T	P	C
1	C122PC1	Advanced Power Electronic Converters	3	0	0	3
2	C122PC2	Electrical Drives	3	0	0	3
3	C122PE3	1. Digital Control Systems 2.Advanced Digital Signal Processing 3. SCADA Systems and Applications 4. PWM Converters and Applications	3	0	0	3
4	C122PE4	1.Advanced Microcontroller Based Systems 2.Distributed Generation 3. Power Quality 4. Integration of Energy Sources	3	0	0	3
5	Mini Project	Mini Project with Seminar	0	0	4	2
6	C122PC6	Advanced Power Electronic Converters Lab	0	0	4	2
7	C122PC7	Electrical Drives Lab	0	0	4	2
8	Audit-II	Audit-II	2	0	0	0
Total Credits						**18**

M. Tech II Year-I Semester

S No.	Course Code	Course Title	L	T	P	C
1	C223PE1	1. Reliability Engineering 2. Flexible AC Transmission Systems 3. HVDC Transmission 4.Energy Storage Technologies	3	0	0	3
2	C223OE2	1. Artificial Intelligence and Machine Learning 2. Business Analytics 3. Industrial Safety 4. Operations Research 5. Cost Management of Engineering Projects 6. Composite Materials	3	0	0	3
3	Major Project	Phase-I Dissertation	0	0	20	10
Total Credits						**16**

M. Tech II Year-II Semester

S No.	Course Code	Course Title	L	T	P	C
1	Major Project	Phase-II Dissertation	0	0	32	16
Total Credits						**16**

Total Credits: 68

Audit Course I

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education

Audit Course II

1. Constitution of India
2. Pedagogy Studies
3. Stress Management by Yoga
4. Personality Development through Life Enlightenment Skills

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3	0	0	3

POWER ELECTRONIC CONVERTERS

Subject Code: C121PC1

Prerequisite: Power Electronics

Course Objectives:

- To understand the characteristics and principle of operation of modern power semi conductor devices.
- To comprehend the c o n c e p t s o f different power converters and their applications
- To analyze and design switched mode regulators for various industrial applications.

Course Outcomes: At the end of the course, the student is able to:

- Choose appropriate device for a particular converter topology.
- Use power electronic simulation packages for analyzing and designing power converters.

UNIT-I:
AC VOLTAGE CONTROLLERS

Single phase AC voltage controllers with Resistive, Resistive-inductive and Resistive-inductive- induced e.m.f. loads – ac voltage controllers with PWM Control – Effects of source and load inductances - Synchronous tap changers.

Three phase AC voltage controllers – Analysis of controllers with star and delta Connected Resistive, Resistive-inductive loads – Effects of source and load Inductances – Applications & Problems.

UNIT-II:
CYCLO-CONVERTERS

Single phase to single phase cyclo-converters – analysis of midpoint and bridge Configurations –Three phase to three phase cyclo-converters –analysis of Midpoint and bridge configurations – Limitations – Advantages – Applications & Problems - Matrix Converter.

UNIT-III:
SINGLE PHASE & THREE PHASE CONVERTERS

Single phase converters – Half controlled and Fully controlled converters – Evaluation of input power factor and harmonic factor – continuous and Discontinuous load current – single phase dual converters – power factor Improvements Techniques– Extinction angle control – symmetrical angle control, PWM – single phase sinusoidal PWM – single phase series converters – overlap analysis – Applications & Problems.

Three phase converters – Half controlled and fully controlled converters – Evaluation of input power factor and harmonic factor – continuous and Discontinuous load current – three phase dual converters – power factor Improvements Techniques– three phase PWM - twelve pulse converters – Applications – Problems – Design of converters.

UNIT-IV:

D.C. TO D.C. CONVERTERS

Analysis of step-down and step-up dc to dc converters with Resistive and Resistive-inductive loads – Switched mode regulators – Analysis of Buck Regulators - Boost regulators – buck and boost regulators – Cuk regulators – Condition for continuous inductor current and capacitor voltage – comparison of regulators –Multi output boost converters – advantages – Applications – Problems.

UNIT-V:

PULSE WIDTH MODULATED INVERTERS

Principle of operation – performance parameters – single phase bridge inverter- evaluation of output voltage and current with resistive, inductive and Capacitive loads– Voltage control of single phase inverters – single PWM – Multiple PWM – sinusoidal PWM – modified PWM – phase displacement Control – Advanced modulation techniques for improved performance – Trapezoidal, staircase, stepped, harmonic injection and delta modulation – Advantages – Applications & Problems.

Three phase inverters – analysis of 180 degree conduction for output voltage And current with resistive, inductive loads – analysis of 120 degree Conduction – voltage control of three phase inverters – sinusoidal PWM – Third Harmonic PWM – 60 degree PWM – space vector modulation – Comparison of PWM techniques – harmonic reductions – Problems.

TEXT BOOKS:

1. Mohammed H. Rashid "Power Electronics" Pearson Education Third Edition – First Indian reprint 2004.
2. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics" - John Wiley & Sons – Second Edition.

REFERENCES:

1. Milliman Shepherd and Lizang –"Power converters circuits" – Chapter 14 (Matrix converter) PP- 415-444,
2. M.H.Rashid - Power electronics hand book –
3. Marian P. Kaźmierkowski, Ramu Krishnan, FredeBlabjerg Edition:" Control in power electronics" illustrated Published by Academic Press, 2002

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3	0	0	3

MACHINE MODELING AND ANALYSIS

Subject Code: C121PC2

Prerequisite: Electrical Machines

Course Objectives:

- Identifying the methods and assumptions in modeling of machines.
- Recognize the different frames for modeling of AC machines.
- To write voltage and torque equations in state space form for different machines.

Course Outcomes: At the end of the course, the student is able to:

- Develop the mathematical models of various machines like, induction motor and Synchronous machines, permenant magnet synchronous motor, brushless DC motor using modeling equations.
- Analyze the developed models in various reference frames.

UNIT-I:

Basic Two-pole DC machine - primitive 2-axis machine – Voltage and Current relationship –Torque equation. Mathematical model of separately excited DC motor and DC Series motor in state variable form – Transfer function of the motor - Numerical problems. Mathematical model of D.C. shunt motor D.C. Compound motor in state variable form – Transfer function of the motor - Numerical Problems

UNIT-II:

Linear transformation – Phase transformation (a, b, c to α, β, o) – Active transformation (α .β, o to d, q). Circuit model of a 3 phase Induction motor – Linear transformation - Phase Transformation – Transformation to a Reference frame – Two axis models for induction motor - dq model based DOL starting of Induction Motors

UNIT-III:

Voltage and current Equations in stator reference frame – equation in Rotor reference frame –equations in a synchronously rotating frame – Torque equation - Equations in state – space form.

UNIT-IV:

Circuits model of a 3ph Synchronous motor – Two axis representation of Synchronous Motor.Voltage and current Equations in state – space variable form – Torque equation - dq model based short circuit fault analysis- emphasis on voltage, frequency and recovery time.

UNIT-V:

Modeling of Permanent Magnet Synchronous motor – Modeling of Brushless DC Motor.

TEXT BOOKS:

1. Generalized Machine theory - P.S. Bimbhra, Khanna Publishers
2. Analysis of electric machinery and Drives systems - Paul C. Krause, Oleg wasynezuk, Scott D. Sudhoff.

REFERENCES:

1. Thyristor control of Electric Drives - VedamSubranmanyam.
2. Power System Stability and Control –PrabhaKundur, EPRI.
3. Performance optimization of induction motors during Voltage-controlled soft starting, Article inIEEE Transactions On Energy Conversion, July 2004.
4. A Novel Method for Starting of Induction Motor with Improved Transient Torque Pulsations, Nithin K.S, Dr.Bos Mathew Jos, MuhammedRafeek, Dr.Babu Paul. International Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 8, February 2013.

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POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

(PE-1)

Subject Code: C121PE3

Prerequisite: Power Electronics, Renewable Energy Systems

Course Objectives:

- To provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems. To develop maximum power point tracking algorithms.

Course Outcomes: At the end of the course, the student is able to:

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.

UNIT-I: 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.

UNI-II: ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT-III: 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-IV: 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-V: HYBRID RENEWABLE ENERGY SYSTEMS

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

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.

REFERENCES:

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

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SMART GRID TECHNOLOGIES
(PE-1)

Subject Code: C121PE3

Prerequisite: Power Systems, Electrical Measurements, Power Quality

Course Objectives:

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

Course Outcomes: At the end of the course, the student is able to:

- Appreciate the difference between smart grid & conventional grid
- Apply smart metering concepts to industrial and commercial installations
- Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
- Come up with smart grid solutions using modern communication technologies

UNIT-I:
Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust &Self Healing Grid Present development & International policies in Smart Grid. Introduction to Smart Meters, Real Time Prizing, 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:
Geographic Information System(GIS), 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:
Concept of micro-grid, 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:
Advanced Metering Infrastructure (AMI), Home Area Network(HAN), Neighborhood 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

REFERENCES:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2012
2. Stuart Borlase, "Smart Grid: Infrastructure, Technology and solutions " CRC Press
3. A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer

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DYNAMICS OF ELECTRICAL MACHINES
(PE-1)

Subject Code: C121PE3

Prerequisite: Machine Modeling and Analysis

Course Objectives:

- To introduce generalized modeling of electrical machines
- To analyze different electrical machines with dynamic modeling

Course Outcomes: After taking this course, the student will be able to:

- Understand the basic mathematical analysis of electrical machines and its characteristics.
- Understand behavior of electrical machines under steady state and transient state.
- Understand dynamic modeling of electrical machines.

UNIT-I: BASIC MACHINE THEORY
Electromechanical Analogy – Magnetic Saturation – Rotating field theory – Operation of Inductor motor – equivalent circuit – Steady state equations of DC machines – operations of synchronous motor – Power angle characteristics

UNIT-II: ELECTRODYNAMICAL EQUATION & THEIR SOLUTIONS
Spring and Plunger system - Rotational motion – mutually coupled coils – Lagrange's equation – Application of Lagrange's equation solution of Electro dynamical equations.

UNIT-III: DYNAMICS OF DC MACHINES
Separately excited d.c. generations – stead state analysis – transient analysis – Separately excited d. c. motors – stead state analysis – transient analysis – interconnection of machines – Ward Leonard system of speed control.

UNIT-IV: INDUCTION MACHINE DYNAMICS
Induction machine dynamics during starting and braking – accelerating time – induction machine dynamic during normal operation – Equation for dynamical response of the induction motor.

UNIT-V: SYNCHRONOUS MACHINE DYNAMICS
Electromechanical equation – motor operation – generator operation – small oscillations – general equations for small oscillations – representation of the oscillation equations in state variable form.

TEXT BOOKS:

1. Sen GuptaD.P. and J.W“ Electrical Machine Dynamics“Macmillan Press Ltd 1980.
2. Bimbhra P.S. “Generalized Theory of Electrical Machines “ Khanna Publishers 2002.

REFERENCES:

1. Thyristor control of Electric Drives - VedamSubranmanyam.
2. Performance optimization of induction motors during Voltage-controlled soft starting, Article in IEEE Transactions On Energy Conversion, July 2004.

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MODERN CONTROL THEORY
(PE-1)

Subject Code: C121PE3

Prerequisite: Control Systems

Course Objectives:

- To explain the concepts of basics and modern control system for the real time analysis and design of control systems.
- To explain the concepts of state variables analysis.
- To study and analyze non linear systems.
- To analyze the concept of stability for nonlinear systems and their categorization.
- To apply the comprehensive knowledge of optimal theory for Control Systems.

Course Outcomes: Upon completion of this course, students should be able to

- Various terms of basic and modern control system for the real time analysis and design of control systems.
- To perform state variables analysis for any real time system.
- Apply the concept of optimal control to any system.
- Able to examine a system for its stability, controllability and Observability.
- Implement basic principles and techniques in designing linear control systems.
- Formulate and solve deterministic optimal control problems in terms of performance indices.
- Apply knowledge of control theory for practical implementations in engineering and network analysis.

UNIT-I: MATHEMATICAL PRELIMINARIES AND STATE VARIABLE ANALYSIS
Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models - Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and it's properties. Complete solution of state space model due to zero input and due to zero state.

UNIT-II: CONTROLLABILITY AND OBSERVABILITY
General concept of controllability – Controllability tests, different state transformations such as diagonalization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms.

UNIT-III: STATE FEEDBACK CONTROLLERS AND OBSERVERS

State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers.

UNIT-IV: NON-LINEAR SYSTEMS

Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone -Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase- plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.

UNIT-V:STABILITY ANALYSIS

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems -Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.

TEXT BOOKS:

1. M.Gopal, Modern Control System Theory, New Age International - 1984
2. Ogata. K, Modern Control Engineering, Prentice Hall - 1997

REFERENCES:

1. N K Sinha, Control Systems, New Age International – 3rd edition.
2. Donald E.Kirk, Optimal Control Theory an Introduction, Prentice - Hall Network series – First edition.

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POWER SEMICONDUCTOR DEVICES AND MODELLING

(PE-2)

Subject Code: C121PE4

Prerequisite: Power Electronics

Course Objectives:

- To improve power semiconductor device structures for adjustable speed motor control applications.
- To understand the static and dynamic characteristics of current controlled power semiconductor devices
- To understand the static and dynamic characteristics of voltage controlled power semiconductor devices
- To enable the students for the selection of devices for different power electronics applications
- To understand the control and firing circuit for different devices.

Course Outcomes: Upon completion of this course, students should be able to

- Know the operating characteristics of various basic semiconductor devices and switches
- Understand the advanced power semiconductor devices operation.
- Know the modeling of basic and advanced semiconductor devices and switches through simulation
- Analyze the applications of various power semiconductor switches

UNIT-I: POWER DIODES

Basic structure and V-I characteristics, breakdown voltages and control, on- state losses, switching characteristics-turn-on transient, turn off transient and reverse recovery transient, Schottky diodes, snubber requirements for diodes, diode snubber, modeling and simulation of Power diodes. 5 Hrs. Power BJT'S: Basic structure and V-I characteristics, breakdown voltages and control, secondary breakdown and it's control- FBSOA and RBSOA curves - on state losses, switching characteristics, resistive switching specifications, clamped inductive switching specifications, turn on transient, turn-off transient, storage time, base drive requirements, switching losses.

UNIT-II:

POWER BJT'S: Device protection- snubber requirements for BJT'S and snubber design switching aids, modeling and simulation of power BJT'S.

SILICON CONTROLLED RECTIFIERS (THYRISTORS): Basic structure, V-I characteristics, turn-on process, on-state operation, turn -off process, switching characteristics, turn-on transient and di/dt limitations, turn-off transient, turnoff time and reapplied dv/dt limitations, gate drive requirements, ratings of thyristors, snubber requirements and snubber design, modelling and simulation of Thyristor.

TRIACS: Basic structure and operation-I characteristics, ratings, snubber requirements, modelling and simulation of triacs.

UNIT-III:

GATE TURNOFF THYRISTOR (GTO): Basic structure and operation, GTO switching characteristics, GTO turn-on transient, GTO turn -off transient, minimum on and off state times, gate drive requirements, maximum controllable anode current, over current protection of GTO'S, modelling and simulation of GTO'S.

POWER MOSFET'S: Basic structure, V-I characteristics, turn-on process, on state operation, turnoff process, switching characteristics, resistive switching specifications, clamped inductive switching specifications - turn-on transient and di/dt limitations, turn-off transient, turn off time, switching losses, effect of reverse recovery transients on switching stresses and losses - dv/dt limitations, gating requirements, gate charge - ratings of MOSFET'S, FBSOA and RBSOA curves, device protection -snubber requirements, modeling and simulation of Power MOSFET'S.

UNIT-IV: INSULATED GATE BIPOLAR TRANSISTORS (IGBT'S):

Basic structure and operation, latch up IGBT, switching characteristics, resistive switching specifications, clamped inductive switching specification – IGBT turn-on transient, IGBT turn off transient- current tailing - gating requirements ,ratings of IGBT'S, FBSOA and RBSOA curves, switching losses – minimum on and off state times, switching frequency capability – over current protection of IGBT'S, short circuit protection, snubber requirements and snubber design.

UNIT-V: ADVANCED POWER SEMICONDUCTOR DEVICES:

MOS gated thyristors, MOS controlled thyristors or MOS GTO'S, base resistance controlled thyristors, emitter switched thyristor, thermal design of power electronic equipment, modelling and simulation, heat transfer by conduction, transient thermal impedance, heat sinks, heat transfer by radiation and convection- heat sink selection for power semiconductor devices.

TEXT BOOKS:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3rd Edition. Wiley India Pvt Ltd, 2011.
2. G. Massobrio, P. Antognetti, "Semiconductor Device Modeling with Spice", McGrawHill, 2nd Edition, 2010.

REFERENCES:

1. B. JayantBaliga, "Power Semiconductor Devices", 1st Edition, International Thompson Computer Press, 1995.
2. V. Benda, J. Gowar, and D. A. Grant, "Discrete and Integrated Power Semiconductor Devices: Theory and Applications", John Wiley & Sons,1999.

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REACTIVE POWER COMPENSATION AND MANAGEMENT
(PE-2)

Subject Code: C121PE4

Prerequisite: Power Systems

Course Objectives:

- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To illustrate reactive power coordination system
- To characterize distribution side and utility side reactive power management.

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

- Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads
- Observe various compensation methods in transmission lines
- Construct model for reactive power coordination
- Distinguish demand side reactive power management & user side reactive power management

UNIT-I: LOAD COMPENSATION

Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

UNIT-II: STEADY–STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM

Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation – examples

TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS:

Characteristic time periods – passive shunt compensation – static compensations - series capacitor compensation – compensation using synchronous condensers – examples

UNIT-III: REACTIVE POWER COORDINATION

Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences

UNIT-IV: DEMAND SIDE MANAGEMENT

Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels

DISTRIBUTION SIDE REACTIVE POWER MANAGEMENT:

System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks

UNIT-V:USER SIDE REACTIVE POWER MANAGEMENT

KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations

REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARE FURNACES:

Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace

TEXT BOOKS:

1. Reactive power control in Electric power systems by T.J.E.Miller, John Wiley and sons, 1982.
2. Reactive power Management by D.M.Tagare, Tata McGraw Hill, 2004.

REFERENCES:

1. Wolfgang Hofmann, JurgenSchlabbach, Wolfgang Just “Reactive Power Compensation: A Practical Guide, April, 2012, Wiely publication.

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HIGH FREQUENCY MAGNETIC COMPONENTS
(PE-2)

Subject Code: C121PE4

Prerequisite:None

Course Objectives:

- To have a knowledge on magnetic circuits
- To know the skin effect and proximity effect

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

- Design of magnetic components (i.e., inductor and transformer) in a converter.
- Perform steady-state analysis of switched mode power supply.
- Understand core loss in an electromagnetic device, recognize& describe its effect.
- Describe the engineering uses of electromagnetic waves, by frequency band, and the respective hazards associated with them

UNIT-I:

FUNDAMENTALS OF MAGNETIC DEVICES: Introduction, Magnetic Relationships, Magnetic Circuits, Magnetic Laws, Eddy Currents, Core Saturation, Volt-Second Balance, Inductance, Inductance Factor, Magnetic Energy, Self-Resonant Frequency, Classification of Power Losses in Magnetic Components, Non-inductive Coils.

MAGNETIC CORES: Introduction, Properties of Core Materials, Magnetic Dipoles, Magnetic Domains, Curie Temperature, Magnetization, Magnetic Materials, Hysteresis, Core Permeability, Core Geometries, Iron Alloy Cores, Amorphous Alloy Cores, Nickel–Iron and Cobalt–Iron Cores, Ferrite Cores, Powder Cores, Nano-crystalline Cores, Superconductors, Hysteresis Core Loss, Eddy-Current Core Loss, Total Core Loss, Complex Permeability.

UNIT-II:

SKIN EFFECT & PROXIMITY EFFECT: Introduction, Magnet Wire, Wire Insulation, Skin Depth, Ratio of AC-to-DC Winding Resistance, Skin Effect in Long Single Round Conductor, Current Density in Single Round Conductor, Impedance of Round Conductor, Magnetic Field Intensity for Round Wire, Other Methods of Determining the Round Wire Inductance, Power Density in Round Conductor, Skin Effect on Single Rectangular Plate. Proximity and Skin Effects in Two Parallel Plates, Anti-proximity and Skin Effects in Two Parallel Plates, Proximity Effect in Multiple-Layer Inductor, Appendix: Derivation of Proximity Power Loss.

WINDING RESISTANCE AT HIGH FREQUENCIES: Introduction, Winding Resistance, Square and Round Conductors, Winding Resistance of Rectangular Conductor, Winding Resistance of Square Wire, Winding Resistance of Round Wire, Leakage Inductance, Solution for Round Conductor Winding in Cylindrical Coordinates, Litz Wire, Winding Power Loss for Inductor Current with Harmonics, Effective Winding Resistance for Non-sinusoidal Inductor Current, Thermal Model of Inductors.

UNIT-III:

TRANSFORMERS: Introduction, Neumann's Formula for Mutual Inductance, Mutual Inductance, Energy Stored in Coupled Inductors, Magnetizing Inductance, Leakage Inductance, Measurement of Transformer Inductances, Stray Capacitance, High-Frequency Transformer Model, Non-interleaved Windings, Interleaved Windings, AC Current Transformers, Winding Power Losses with Harmonics, Thermal Model of Transformers.

DESIGN OF TRANSFORMERS: Introduction, Area Product Method, Optimum Flux Density, Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM, Transformer Design for Fly-back Converter in CCM, Transformer Design for Fly-back Converter in DCM.

UNIT-IV:

INTEGRATED INDUCTORS: Introduction, Resistance of Rectangular Trace, Inductance of Straight Rectangular Trace, Construction of Integrated Inductors, Meander Inductors, Inductance of Straight Round Conductor, Inductance of Circular Round Wire Loop, Inductance of Two- Parallel Wire Loop, Inductance of Rectangle of Round Wire, Inductance of Polygon Round Wire Loop, Bond-wire Inductors, Single-Turn Planar Inductor, Inductance of Planar Square Loop, Planar Spiral Inductors, Multi-metal Spiral Inductors, Planar Transformers, MEMS Inductors, Inductance of Coaxial Cable, Inductance of Two-Wire Transmission Line, Eddy Currents in Integrated Inductors, Model of RF Integrated Inductors, PCB Inductors.

DESIGN OF INDUCTORS: Introduction, Restrictions on Inductors,Window Utilization Factor, Temperature Rise of Inductors, Mean Turn Length of Inductors, Area Product Method, AC Inductor Design, Inductor Design for Buck Converter in CCM, Inductor Design for Buck Converter in DCM method.

UNIT-V:

SELF-CAPACITANCE: Introduction, High-Frequency Inductor Model, Self-Capacitance Components, Capacitance of Parallel-Plate Capacitor, Self-Capacitance of Foil Winding Inductors, Capacitance of Two Parallel Round Conductors, Capacitance of Round Conductor and Conducting Plane, Self-Capacitance of Single-Layer Inductors, Self-Capacitance of Multi-layer Inductors, Capacitance of Coaxial Cable.

TEXT BOOKS:

1. Design of Magnetic Components for Switched Mode Power Converters, Umanand L., Bhat,S.R., ISBN:978-81-224-0339-8, Wiley Eastern Publication, 1992.
2. High-Frequency Magnetic Components, Marian K. Kazimierczuk, ISBN: 978-0-470-71453-9 John Wiley& Sons, Inc.

REFERENCES:

1. G.C. Chryssis, High frequency switching power supplies, McGraw Hill, 1989 (2nd Edn.)
2. Eric Lowdon, Practical Transformer Design Handbook, Howard W. Sams& Co., Inc., 1980
3. "Thompson --- Electrodynamic Magnetic Suspension.pdf"
4. Witulski --- "Introduction to modeling of transformers and coupled inductors" Beattie --- "Inductance 101.pdf"
5. P. L. Dowell, "Effects of eddy currents in transformer windings.pdf"

6. Dixon--- “Eddy current losses in transformer windings.pdf”
7. J J Ding, J S Buckkeridge, “Design Considerations For A Sustainable Hybrid Energy System” IPENZ Transactions, 2000, Vol. 27, No. 1/EMCh.
8. Texas Instruments --- “Windings.pdf”
9. Texas Instruments --- “Magnetic core characteristics.pdf” Ferroxcube --- “3f3 ferrite datasheet.pdf” Ferroxcube --- “Ferrite selection guide.pdf” Magnetics, Inc., Ferrite Cores (www.mag-inc.com).

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3 0 0 3

HYBRID ELECTRIC VEHICLES
(PE-2)

Subject Code: C121PE4

Prerequisite: Power Electronics, Power Semiconductor Drives, Advanced control of Electric Drives

Course Objectives:

- To understand upcoming technology of hybrid system
- To understand different aspects of drives application
- Learning the electric Traction

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

- Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid And electric vehicles.
- To learn electric drive in vehicles / traction.

UNIT-I:
History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source characterization Transmission characteristics, Mathematical models to describe vehicle performance

UNIT-II:
Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

UNIT-III:
Introduction to electric components used in hybrid and electric Vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

UNIT-IV:
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology, Communications, supporting subsystems

UNIT-V:
Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies

TEXT BOOKS

1. Sira -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices" Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design fundamentals, CRC Press, 2003.
2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
4. Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

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2 0 0 2

RESEARCH METHODOLOGY AND IPR

Subject Code: C121RM5

Prerequisite: None

Course Objectives:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

Course Outcomes: At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals &nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT-I:
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.Effective literature studies approaches, analysis Plagiarism, Research ethics

UNIT-II:
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-III:
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-IV:
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology .Patent information and databases. Geographical Indications.

UNIT-V:
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'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

REFERENCES:

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

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0 0 4 2

MACHINE MODELLING AND ANALYSIS LAB

Subject Code: C121PC6

Prerequisite: Electrical Machines, Machine Modeling Analysis

Course Objectives:

- Identifying the methods and assumptions in modeling of machines.
- Recognize the different frames for modeling of AC machines.
- To write voltage and torque equations in state space form for different machines.

Course Outcomes: At the end of the course, the student is able to:

- Develop the mathematical models of various machines like, induction motor and Synchronous machines, permanent magnet synchronous motor, brushless DC motor using Modeling equations.
- Analyze the developed models in various reference frames.

Note: Conduct any 10 experiments from the above using any simulation tool

1. Develop a dynamic model of open loop controlled dc motor
2. Develop a dynamic model of closed loop controlled dc motor
3. Convert ABC voltages into stationary frame
4. Convert ABC voltages into synchronous frames
5. Convert ABC voltages into rotor reference frames
6. Develop dynamic model of 3-phase Induction motor and generator
7. Develop a mathematical model for V/f controlled 3-phase Induction motor
8. Develop a mathematical model for 3-phase Synchronous motor
9. Develop a mathematical model for3-phase Permanent Magnet Synchronous motor
10. Develop a mathematical model for Brushless DC Motor
11. Develop a dynamic model for closed loop control of Induction Motor
12. Develop a dynamic model for closed loop control of Synchronous motor

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POWER ELECTRONIC CONVERTERS LAB

Subject Code: C121PC7

Prerequisite: Power Electronic Converters

Course Objectives:

- To Simulate Single phase, Three phase full converter using RLE loads
- To simulate Single phase AC Voltage controller using RL load.
- To develop the model of DC-DC Converters, Separately Excited DC Motor.
- To design a PID controller based on Bode plot.

Course Outcomes: At the end of the course, the student should be able to:

- Simulate Single phase, Three phase full converter using RLE loads
- Simulate Single phase AC Voltage controller using RL load.
- Simulate DC-DC Converters
- Identify stability methods and various controllers

PART A:

1. Single phase full converter using RL and E loads.
2. Three phase full converter using RL and E loads.
3. Single phase AC Voltage controller using RL load.
4. Three-phase inverter with PWM controller.
5. DC-DC Converters.
6. Modeling of Separately Excited DC Motor.
7. Resonant pulse commutation circuit.

PART B:

8. Write program and simulate dynamical system of following models:
   i. I/O Model
   ii. State variable model

   Also identify time domain specifications of each.
9. Obtain frequency response of a given system by using various methods:
   i. General method of finding the frequency domain specifications.
   ii. Polar plot
   iii. Bode plot
   iv. Also obtain the Gain margin and Phase margin.
10. Determine stability of a given dynamical system using following methods.
    a. Root locus
    b. Bode plot
    c. Nyquist plot
    d. Liapunov stability criteria

11. Transform a given dynamical system from I/O model to state variable model and vice versa

.

12. Design a compensator for a given systems for required specifications.

13. Design a PID controller based on Bode plot.

14. Develop a program to solve Swing Equation.

Note: Use the suitable software for each simulation. Any ten experiments, Six from PART A and Four from PART B, can be selected from the above list.

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ADVANCED POWER ELECTRONIC CONVERTERS

Subject Code: C122PC1

Prerequisite: Power Electronics, Power Electronic Converters

Course Objectives:

- To understand various advanced power electronics devices.
- To describe the operation of multi level inverters with switching strategies for high power
- Applications.
- To comprehend the design of resonant converters and switched mode power supplies.

Course Outcomes: After taking this course, student will be able to:

- Develop and analyze various converter topologies.
- Design AC or DC switched mode power supplies.

UNIT-I: MODERN POWER SEMICONDUCTOR DEVICES

Modern power semiconductor devices – Insulated Gate Bipolar Transistor (IGBT) – MOSFET- MOS Turn off Thyristor (MTO) – Emitter Turn Off Thyristor (ETO) – Integrated Gate- Commutated Thyristor (IGCTs) – MOS-controlled thyristors(MCTs)– Power integrated circuits (PICs) – symbol, structure and equivalent circuit – comparison of their features.

UNIT-II: RESONANT PULSE INVERTERS

Resonant pulse inverters – series resonant inverters – series resonant inverters with unidirectional switches – series resonant inverters with bidirectional switches – analysis of half bridge resonant inverter – evaluation of currents and voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverters – for series loaded inverter – for parallel loaded inverter – For series and parallel loaded inverters – parallel resonant inverters – Voltage control of resonant inverters – class E resonant inverter – class E resonant rectifier – evaluation of values of C's and L's for class E inverter and Class E rectifier – numerical problems.

UNIT-III: RESONANT CONVERTERS

Resonant converters – zero current switching resonant converters – L type ZCS resonant converter – M type ZCS resonant converter – zero voltage switching resonant converters – comparison between ZCS and ZVS resonant converters – Two quadrant ZVS resonant converters – resonant dc-link inverters – evaluation of L and C for a zero current switching inverter – Numerical problems.

UNIT-IV: MULTILEVEL INVERTERS

Multilevel concept – Classification of multilevel inverters – Diode clamped Multilevel inverter –principle of operation – main features – improved diode Clamped inverter – principle of operation– Flying capacitors multilevel inverter-principle of operation – main features – cascaded multilevel inverter – principle of operation – main features – Multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives - Switching device currents – dc link capacitor voltage balancing – features of Multilevel inverters – comparisons of multilevel converters.

UNIT-V: D.C & A.C POWER SUPPLIES

DC power supplies – classification - switched mode dc power supplies – fly back Converter –forward converter – push-pull converter – half bridge converter – Full bridge converter – Resonant d c power supplies – bidirectional power supplies – Applications.AC power supplies – classification – switched mode ac power supplies – Resonant AC power supplies – bidirectional ac power supplies – multistage conversions – control circuits – applications. Introduction – power line disturbances – power conditioners – Uninterruptible Power supplies – applications.

TEXT BOOKS

1. Mohammed H. Rashid –"Power Electronics"– Pearson Education-Third Edition – first Indian reprint -2004.
2. Ned Mohan, Tore M. Undeland and William P. Robbins- "Power Electronics"– John Wiley & Sons – Second Edition.

REFERENCES:

1. Milliman Shepherd and Lizang – "Power converters circuits" – Chapter 14 (Matrix converter) PP- 415-444,
2. M.H.Rashid - Power electronics hand book –
3. Marian P. Kaźmierkowski, Ramu Krishnan, FredeBlabjerg Edition:" Control in power electronics" illustrated Published by Academic Press, 2002

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3 0 0 3

ELECTRICAL DRIVES

Subject Code: C122PC2
Prerequisite: Power Electronic Converters, Electrical Machines

Course Objectives:

- To understand principle operation of scalar control of ac motor and corresponding speed torque characteristics
- To comprehend the vector control for ac motor drive (IM and SM)
- To explain the static resistance control and Slip power recovery drive
- To explain synchronous motor drive characteristics and its control strategies
- To comprehend the brushless dc motor principle of operation.

Course Outcomes: After taking this course, student will be able to

- Develop induction motor for variable speed operations using scalar and vector control techniques.
- Identify the difference between the rotor resistance control and static rotor resistance control method and significance of slip power recovery drives.
- Develop controllers for synchronous motor and variable reluctance motor.

UNIT–I: RECTIFIER CONTROLLED DC MOTOR:
Separately excited DC motors and DC series motors with single phase semi converter and single phase full converter-Three-phase controlled converter, control circuit, control modeling of three phase converter – Steady state analysis of three phase converter control DC motor drive – Two quadrant, Three phase converter controlled DC motor drive – DC motor and load, converter.

CLOSED LOOP CONTROL OF DC DRIVE:
Current and speed controllers - Current and speed feedback – Design of controllers – Current and speed controllers – Motor equations – filter in the speed feedback loop speed controller – current reference generator – current controller and flow chart for simulation – Harmonics and associated problems – sixth harmonics torque.

UNIT–II: CHOPPER CONTROLLED DC MOTOR DRIVES:
Principle of operation of the chopper – Chopper with other power devices – model of the chopper – input to the chopper – steady state analysis of chopper controlled DC motor drives – Closed loop operation: Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current controller.

UNIT–III: CONTROL OF INDUCTION MOTOR:
Introduction to motor drives – Torque production – Equivalent circuit analysis – Speed – Torque Characteristics with variable voltage operation Variable frequency operation constant v/t operation – Variable stator current operation – Induction motor

characteristics in constant torque and field weakening regions.

STATOR SIDE CONTROL:

Scalar control – Voltage fed inverter control – Open loop volts/Hz control – speed control slip regulation – speed control with torque and flux control – current controlled voltage fed inverter drive

ROTOR SIDE CONTROL OF INDUCTION MOTOR DRIVES:

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

UNIT–IV: VECTOR CONTROL OF INDUCTION MOTOR DRIVES:

Principles of Vector control – Vector control methods – Direct methods of vector control – Indirect methods of vector control – Adaptive control principles – Self tuning regulator Model referencing control – Direct torque control of AC motors.

UNIT–V: CONTROL OF SYNCHRONOUS MOTOR DRIVES:

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

TEXT BOOKS:

1. Electric Motor Drives Pearson Modeling, Analysis and control – R. Krishnan – Publications – 1st edition – 2002.
2. Modern Power Electronics and AC Drives B K Bose – Pearson Publications 1st edition

REFERENCES:

1. Power Electronics and Control of AC Motors – MD Murthy and FG Turn Bull Pergman Press 1st edition
2. Power Electronics and AC Drives – BK Bose – Prentice Hall Eagle wood diffs New Jersey - 1st edition
3. Power Electronic circuits Deices and Applications – M H Rashid – PHI – 1995.
4. Fundamentals of Electrical Drives – G. K. Dubey – Narosa publications – 1995.

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M.Tech I Year – II Sem.

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DIGITAL CONTROL SYSTEMS

(PE-3)

Subject Code: C122PE3

Course Objective: The objective of the course is to

- Understand difference between the Discrete control systems and Digital control systems and z-transforms
- Understand conversion of A/D and D/A of the control system, sample and hold, data conversion and quantization.
- Understand the state space modeling of digital systems and computation of state transition matrix. Understand Stability tests and second method of lyapunov.
- Understand the transient and study state analysis of digital control systems and controllability and Observability.

Course Outcomes: After completion of the course, the student acquires knowledge on

- Converting an A/D and D/A control system, sampling theorem, reconstruction of sampled signals.
- Mapping between s-plane and z-plane, theorems and limitations of Z-transforms.
- Transient and study state analysis of digital control systems and controllability and Observability.
- Designing digital PID, full order observer and reduced order observer, discrete Euler Lagrance equation and maximum principle.

UNIT-I:

Introduction: Block diagram of typical control system -advantages of sampling in control systems-examples of discrete data and digital systems-data conversion and quantization-sample and hold devices-D/A and A/D conversion-sampling theorem-reconstruction of sampled signals-ZOH.

Z-Transform: Definition and evaluation of Z-transforms-mapping between s-plane and z-plane-inverse z-plane transform-modified z-transforms-theorems of the Z-transforms-limitations of z-transforms-pulse transfer function- pulse transfer function ZOH-relation between G(S) and G(Z)-signal flow graph method applied to digital systems

Unit-II:

State Space Analysis: State space modeling of digital systems with sample and hold-state transition equation of digital time invariant systems-solution of time invariant discrete state equations by the Z-Transformation-transfer function from the state model-Eigen values-Eigen

vector and diagonalisation of the A-matrix-Jordan canonical form. Computation of state transition matrix- the state diagram-decomposition of digital system-Response of sample data system between sampling instants using state approach.

Stability: Definition of stability-stability tests-the second method of Lyapunov

Unit-III:

Time Domain Analysis: comparison of time response of continuous data and digital control systems-correlation between time response and root locus j the s-plane and z-plane-effect of pole-zero configuration in the z-plane upon the maximum overshoot and peak time of transient response-Root loci for digital control systems-steady state error analysis of digital control systems-Nyquists plot-Bode plot-G.M and P.M.

Unit-IV:

Design: The digital control design with digital controller with bilinear transformation -Digital PID controller-Design with deadbeat response-Pole placement through state feedback-Design of full order state observer-Discrete Euler Lagrance Equation-Discrete maximum principle.

Unit-V:

Digital State Observer: Design of full order and reduced order observers. Design by max .principle: Discrete Euler language equation-discrete maximum principle.

TEXT BOOKS:

1. Discrete Time Control systems-K.Ogata,Pearson Education/PHI,2nd edition 2003.
2. Digital control and state variable methods by M.Gopal,TMH.
3. Digital control systems by v.i.George, C.P.Kurian, cengage learning.

REFERENCE BOOKS:

1. Digital control systems by Kuo, oxford University Press, 2nd edition, 2003
2. Digital control Engineering by M.Gopal.

M.Tech I Year – II Sem.

ADVANCED DIGITAL SIGNAL PROCESSING
(PE-3)

Subject Code: C122PE3
Prerequisite: Digital Signal Processing

Course Objectives:

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

Course Outcomes: After taking this course, student will be able to:

- Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems
- Study the design techniques for IIR and FIR filters and their realization structures.
- Acquire knowledge about the finite word length effects in implementation of digital filters.
- Knowledge about the various linear signal models and estimation of power spectrum of stationary Random signals
- Design of optimum FIR and IIR filters

UNIT-I:
Discrete time signals, Linear shift invariant systems-Stability and causality, Sampling of continuous time signals-Discrete time Fourier transform- Discrete Fourier series-Discrete Fourier transform, Z transform-Properties of different transforms

UNIT-II:
Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method

UNIT-III:
FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantisation effects in IIR and FIR filters

UNIT-IV:
A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models

UNIT-V:
All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals. Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters

TEXT BOOKS:

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ",TataMc Grow- HillEdition 1998
2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive SignalProcessing", Mc Grow Hill international editions .-2000

REFERENCES:

1. S Salivahanan. A. Vallavaraj C. Gnanapriya, Digital Signal Processing – TMH – 2nd reprint 2001.
2. Lourens R RebinarandBernold, Theory and Applications of Digital Signal Processing.
3. Auntoniam, Digital Filter Analysis and Design, TMH.

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SCADA SYSTEMS AND APPLICATIONS
(PE-3)

Subject Code: C122PE3
Prerequisite: None
Course Objectives:

- To understand what is meant by SCADA and its functions.
- To know SCADA communication.
- To get an insight into its application.
-

Course Outcomes: After taking this course, student will be able to:

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

UNIT-I:
Introduction to S C A D A :
Data a c q u i s i t i o n systems, Evolution of S C A D A, Communication technologies. Monitoring and Supervisory functions, SCADA applications in Utility Automation ,Industries SCADA

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

UNIT-III:
SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture –IEC61850.

UNIT-IV:
SCADA Communication: various industrial communication technologies-wired and wireless methods and fiber optics. open standard communication protocols.

UNIT-V:
SCADA Applications: Utility applications- Transmission andDistribution 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 ofAmericaPublications, USA,2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 andRelatedSystems", Newnes Publications, Oxford, UK,2004.

REFERENCES:

1. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006.
2. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
3. Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electricpower",PennWell 1999.

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Subject Code: C122PE3

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PWM CONVERTERS AND APPLICATIONS
(PE-3)

Prerequisite: Power Electronics

Course Objectives:

Understand the concepts and basic operation of PWM converters, including basic circuit operation and design.

- Understand the steady-state and dynamic analysis of PWM converters along with the
- applications like solid state drives and power quality.

Course Outcomes: After taking this course, student will be able to:

- Knowledge concepts and basic operation of PWM converters, including basic circuit operation and design
- Learn the steady-state and dynamic analysis of PWM converters along with the applications like solid state drives and power quality
- Able to recognize and use the following concepts and ideas: Steady-State and transient modeling and analysis of power converters with various PWM techniques.

UNIT-I:
AC/DC and DC/AC power conversion, Overview of applications of voltage source converters and current source converters.

UNIT-II:
Pulse width modulation techniques for bridge converters, Bus clamping PWM. Space vector based PWM, Advanced PWM techniques.

UNIT-III:
Practical devices in converter, Calculation of switching and conduction power losses.

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

UNIT-V:
Estimation of current ripple and torque ripple in inverter fed drives, Line-side converters with power factor compensation. 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

TKR COLLEGE OF ENGINEERING & TECHNOLOGY (AUTONOMOUS)
M.TECH (POWER ELECTRONICS)
(R-21)

ADVANCED MICROCONTROLLER BASED SYSTEMS
(PE-4)

L	T	P	C
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M.Tech I Year – II Sem.
Subject Code: C122PE4
Prerequisite: Microprocessors and Microcontrollers

Course Objectives:

- To understand the architecture of advance microcontrollers
- To understand the applications of these controllers
- To get some introduction to FPGA.

Course Outcomes: After taking this course, student will be able to:

- To learn how to program a processor in assembly language and develop an advanced processor based system
- To learn configuring and using different peripherals in a digital system
- To compile and debug a Program
- To generate an executable file and use it

UNIT-I:
Basic Computer Organization, Accumulator based processes-Architecture-MemoryOrganization-I/O Organization

UNIT-II:
Micro-Controllers-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/Oand 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.

REFERENCES:

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

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M.Tech I Year – II Sem. **L T P C**

3 0 0 3

DISTRIBUTED GENERATION
(PE-4)

Subject Code: C122PE4

Prerequisite: Power Systems, Power Electronics

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: After taking this course, student will be able to:

- To understand the planning and operational issues related to Distributed Generation.
- Acquire Knowledge about Distributed Generation Learn Micro-Grids

UNIT-I:
Need for Distributed generation, Renewable sources in distributed generation and current scenario in Distributed Generation.

UNIT-II:
Planning of DGs,Sitting and sizing of DGs optimal placement of DG sources in distribution systems, Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces, Aggregation of multiple DG units.

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

UNIT-IV:
Economic and control aspects of DGs Market facts, Issues and challenges Limitations of DGs, Voltage control techniques, Reactive power control, Harmonics Power quality issues, Reliability of DG based systems.

UNIT-V:
Introduction to micro-grids, Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids, Modeling & analysis of Micro-grids with multiple DGs, Micro-grids with power electronic interfacing units. Transients in micro-grids, Protection of micro-grids, Casestudies, Advanced topics.

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 withInduction Generators", CRC press.

REFERENCES:

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

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3 0 0 3

POWER QUALITY
(PE-4)

Subject Code: C122PE4

Prerequisite: Power Systems

Course Objectives:

- To Study the basics of power quality , power quality problems and power quality standards,
- To Study about the characteristics of non-linear loads
- To Study Voltage, Current, Power and Energy measurements and analysis methods of Laplace's, Fourier and Hartley and Wavelet Transforms
- To Study the analysis and conventional mitigation methods
- To Study about various devices used to enhance power quality.

Course Outcomes: After taking this course, the student will be able to:

- Know the different characteristics of electric power quality in power systems,
- Learn about the applications of non-linear loads ,
- Know the applications of Hartley and Wavelet Transforms ,
- Learn how to mitigate the power quality problems
- Learn about the application of FACTS device on DG side.

UNIT-I:
INTRODUCTION

Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring.

UNIT-II:
LONG & SHORT INTERRUPTIONS

Interruptions – Definition – Difference between failures, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption – Overview of Reliability evaluation to power quality, comparison of observations and reliability evaluation.

SHORT INTERRUPTIONS: definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

UNIT-III:
SINGLE AND THREE-PHASE VOLTAGE Sag CHARACTERIZATION

Voltage sag – definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration.

Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

UNIT-IV:

POWER QUALITY CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS

Voltage sag – equipment behavior of Power electronic loads, induction motors, synchronous motors, computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

UNIT-V:

MITIGATION OF INTERRUPTIONS & VOLTAGE SAGS

Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

POWER QUALITY AND EMC STANDARDS:

Introduction to standardization,IEC Electromagnetic compatibility standards, European voltage characteristics standards, PQ surveys.

TEXT BOOKS:

1. "Understanding Power Quality Problems" by Math H J Bollen. IEEE Press.
2. "Power Quality VAR Compensation in Power Systems", R. SastryVedamMulukutla S. Sarma,CRC Press.

REFERENCES:

1. Power Quality, C. Sankaran, CRC Presss.
2. Electrical Power Systems Quality, Roger C. Dugan , Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, Tata McGraw Hill Education Private Ltd

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M.Tech I Year – II Sem.

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INTEGRATION OF ENERGY SOURCES
(PE-4)

Subject Code: C122PE4

Prerequisite: Power Electronics, Renewable Energy Systems

Course Objectives:

- To introduce the characteristics of various types of renewable energy sources and converters.
- To explain the importance of storage and sizing of hybrid systems.
- To introduce the control issues of isolated systems.
- To explain the harmonics, power quality, voltage imperfections, power injection issues on the grid by integrating renewable energy sources.

Course Outcomes: At the end of the course, the student should be able to:

- Identify the characteristics of renewable energy sources and converters.
- Analyze the importance of storage and sizing of hybrid systems.
- Realize the problems related to isolated systems.
- Analyze the challenges faced by the grid by integrating renewable energy sources.

UNIT- I:

REVIEW OF CHARACTERISTICS OF POWER SOURCES: Basic review of power generation from wind - Solar PV - Thermal - Small hydro - Biomass power strategies in each of these energy conversion systems - Review of maximum power point tracking techniques in solar PV and wind (perturb & observe, hill climbs, incremental conductance).

UNIT-II:

CONVERTER TOPOLOGIES:DC/DC converter (buck, boost, buck boost) - DC/AC inverters (sine, triangular, PWM techniques) - Phase locked loop for inverters.

UNIT-III:

HYBRID SYSTEMS: Advantages of hybrid power systems - Importance of storage in hybrid Power systems - Design of hybrid power system based on load curve - Sizing of hybrid power systems.

UNIT-IV:

ISOLATED SYSTEMS: Control issues in isolated systems for voltage and frequency – Small signal stability in isolated power systems - Importance of storage and dump load in isolated systems.

UNIT-V:

ISSUES IN INTEGRATION OF RENEWABLE ENERGY SOURCES: Overview of challenges in integrating renewable sources to the grid - Impact of harmonics on power quality - Need to maintain voltage within a band and fluctuations in voltage because of renewable integration - Power inverter and converter technologies - Mechanism to synchronize power from renewable sources to the grid - Overview of challenges faced in designing power injection from offshore generation sources - Challenges in modeling

intermittent nature of renewable power in a power system.

TEXT BOOKS:

1. Power Electronics, Converters, Applications and Design" by N. Mohan; T.M. Undeland;
W.P. Robbins. 1995, John Wiley and Sons.
2. Renewable Energy Integration Challenges and Solutions Series:Green Energy and
TechnologyHossain, Jahangir, Mahmud, Apel (Eds.).

REFERENCES:

1. Integration of Alternative Sources of Energy Felix A. Farret, M. Godoy Simões, December
2005, Wiley-IEEE Press

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ADVANCED POWER ELECTRONIC CONVERTERS LAB

Subject Code: C122PC6
Prerequisite: Power Electronic Converters

Course Objectives:

- Gate drive circuit configurations for converter circuits
- Advanced converter topologies
- Simulation and hardware implementation of various AC-DC, AC-AC, DC-DC converter topologies

Course Outcomes: At the end of the course, the student should be able to:

- Know the different converter strategies of AC to DC, AC-AC and DC-DC
- Analysis of various topologies developed
- Get the knowledge on multi-level inverter/converter topologies
- Use power electronic simulation packages to develop the power converter topologies

List of Experiments:

1. To study Single phase diode clamped multilevel inverter.
2. To study Single phase flying capacitor multilevel inverter
3. To study Single phase cascaded multilevel inverter
4. To study Push pull converter
5. To study Fly back converter
6. To study Forward converter
7. To study Series resonant converter
8. To study ZVS
9. Experimental study of Single Phase full converter using R, RL and E loads.
10. Experimental study of Three Phase full converter using R, RL and E loads.
11. Experimental study of Three Phase semi converter using R, RL and E loads.
12. Experimental study of Single phase AC Voltage controller using R and RL loads
13. Experimental study of Single Phase Cyclo-converter using RL load
14. Experimental study of Buck and Boost regulators

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ELECTRICAL DRIVES LAB
(Lab4)

Subject Code: C122PC7
Prerequisite: Power Electronic Devices and Circuits and Electrical Machines

Course Objectives:

- To understand principle operation of scalar control of ac motor and corresponding speed torque characteristics
- To comprehend the vector control for ac motor drive (IM and SM)
- To explain the static resistance control and Slip power recovery drive
- To explain the Characteristics of solar PV Systems and Maximum Power Point Tracking Charge Controllers.
- To understand the Inverter control for Solar PV based systems.

Course Outcomes: After taking this course, student will be able to:

- Develop induction motor for variable speed operations using scalar and vector control Techniques.
- Identify the difference between the rotor resistance control and static rotor resistance Control method and significance of slip power recovery drives.
- Develop controllers for PV systems.

Note: Any ten experiments can be conducted.

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.
11. Isolated Gate Drive circuits for MOSFET / IGBT based circuits.
12. Characteristics of solar PV Systems.
13. Maximum Power Point Tracking Charge Controllers.
14. Inverter control for Solar PV based systems.

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M.Tech II Year – I Sem. **L T P C**

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RELIABILITY ENGINEERING
(PE-5)

Subject Code: C223PE1
Prerequisite: Mathematics
Course Objectives:

- To comprehend the concept of Reliability and Unreliability
- Derive the expressions for probability of failure, Expected value and standard deviation of Binominal distribution, Poisson distribution, normal distribution and weibull distributions.
- Formulating expressions for Reliability analysis of series-parallel and Non-series parallel systems
- Deriving expressions for Time dependent and Limiting State Probabilities using Markov models.

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

- Apply fundamental knowledge of Reliability to modeling and analysis of series- parallel and Non-series parallel systems.
- Solve some practical problems related
- Understand or become aware of various failures, causes of failures and remedies for failures in practical systems.

UNIT-I:
RELIABILITY AND PROBABILITY: Rules for combining probabilities of events, Definition of Reliability. Significance of the terms appearing in the definition. Probability distributions: Random variables, probability density and distribution functions. Mathematical expectation, Binominal distribution, Poisson distribution, normal distribution, exponential distribution weibull distribution.

UNIT-II:
HAZARD RATE: Derivation of the reliability function in terms of the hazard rate. Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failures). Bath tub curve. Preventive and corrective maintenance. Modes of failure. Measures of reliability: mean time to failure and mean time between failures.

UNIT-III:
CLASSIFICATION OF ENGINEERING SYSTEMS: series, parallel and series-parallel systems- Expressions for the reliability of the basic configurations.
Reliability evaluation of Non-series-parallel configurations: Decomposition, Path based and cutest based methods, Deduction of the Paths and cut-sets from Event tree.

UNIT-IV:
DISCRETE MARKOV CHAINS: General modeling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation of one component repairable model. Absorbing states.
Continuous Markov Processes: Modeling concepts, State space diagrams, Stochastic

Transitional Probability Matrix, Evaluating time dependent and limiting state Probabilities of one component repairable model. Evaluation of limiting state probabilities of two component repairable model.

UNIT-V:

FREQUENCY AND DURATION TECHNIQUES: Frequency and duration concepts, application to multi state problems, Frequency balance approach. Approximate System Reliability Evaluation: Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

TEXT BOOKS:

1. "Reliability evaluation of Engineering systems", Roy Billinton and Ronald N Allan, BS Publications.
2. "Reliability Engineering", Elsayed A. Elsayed, Prentice Hall Publications.

REFERENCES:

1. "Reliability Engineering: Theory and Practice", By Alessandro Birolini, Springer Publications.
2. "An Introduction to Reliability and Maintainability Engineering", Charles Ebeling, TMH Publications.
3. "Reliability Engineering", E. Balaguruswamy, TMH Publications.

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FLEXIBLE AC TRANSMISSION SYSTEMS
(PE-5)

Subject Code: C223PE1
Prerequisite: Power Electronics and Power Systems

Course Objectives:

- To develop the understanding of uncompensated lines and their behavior under heavy loading conditions.
- To understand the concept and importance controllable parameters of FACTS controllers.
- To emphasize the objectives of Shunt compensation, and basic operation of SVC and STATCOM.
- To analyze the functioning of series controllers like GCSC, TSSC and TCSC

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

- Choose proper controller for the specific application based on system requirements
- Understand various systems thoroughly and their requirements
- Interpret the control circuits of Shunt Controllers SVC & STATCOM for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
- Detect the Power and control circuits of Series Controllers GCSC, TSSC and TCSC

UNIT-I:
FACTS CONCEPTS
Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

UNIT-II:
VOLTAGE SOURCE CONVERTERS
Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT-III:
STATIC SHUNT COMPENSATION
Objectives of shunt compensation, mid-point voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators switching converter type VAR generators hybrid VAR generators.

UNIT-IV:

SVC AND STATCOM

The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT-V:

STATIC SERIES COMPENSATORS

Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, and functional requirements of GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC) Control schemes for GSC TSSC and TCSC.

TEXT BOOKS:

1. Hingorani H G and Gyugyi. L " Understanding FACTS-Concepts and Technology of Flexible ACTransmission Systems" New York, IEEE Press, 2000.
2. Padiyar.K.R, " FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007.

REFERENCES:

1. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash "Flexible AC Transmission Systems: Modeling and Control", Springer, 2012.
2. Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET, 1999.

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HVDC TRANSMISSION

(PE-5)

Subject Code: C223PE1
Prerequisite: Power Electronics and Power Systems
Course Objectives:

- Understand state of the art HVDC technology.
- Learn the Methods to carry out modeling and analysis of HVDC system frontier-area power flow regulation.

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

- Expose the students to the state of the art HVDC technology.
- Knowledge of modelling and analysis of HVDC system for inter-area power flow regulation.

UNIT-I:
Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration. Rectifier and Inverter operation, Digital Simulation of converters, Control of HVDC converters and Systems.

UNIT-II:
Individual phase control, Equidistant firing controls, Higher level controls. Characteristics and non characteristics harmonics filter design. Fault development and protection.

UNIT-III:
Interaction between AC-DC power systems. Over voltages on AC/DC side, multi-terminal HVDC systems, control of MTDC systems..

UNIT-IV:
Modelling of HVDC systems, per unit system, Representation for power flow solution, representation for stability studies.

UNIT-V:
Introduction to relevant national and international standards, safe clearances for HV, Study regulations for HV tests, Digital techniques in HV measurements.

TEXT BOOKS:

1. J. Arrillaga, “High Voltage Direct Transmission”, Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, “HVDC Power Transmission Systems”, Wiley Eastern Ltd., 1990.

REFERENCES:

1. E. W. Kimbark, “Direct Current Transmission”, Vol. I, Wiley Interscience, 1971.
2. Erich Uhlmann, “Power Transmission by Direct Current”, B.S. Publications, 2004.

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ENERGY STORAGE TECHNOLOGIES

(PE-5)

Subject Code: C223PE1
Prerequisite: None
Course Objectives:

- To introduce generalized storage techniques
- To analyze the different features of energy storage systems
- To know the management and applications of energy storage technologies
- To have an idea about electrical energy storage market potential by different forecasting methods

Course Outcomes: After taking this course, the student will be able to:

- Understand the role of electrical energy storage technologies in electricity usage
- Know the behavior and features of electrical energy storage systems
- Analyze the applications of energy storage system
- Understand the hierarchy, demand for energy storage and valuation techniques.
- Get knowledge about energy storage forecasting methods

UNIT-I:
THE ROLES OF ELECTRICAL ENERGY STORAGE TECHNOLOGIES IN ELECTRICITY USE: Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable, Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT-II:
TYPES AND FEATURES OF ENERGY STORAGE SYSTEMS: Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Lead-Acid Batteries, Lithium-Ion Batteries, Flow batteries, Other Batteries in Development, Chemical energy storage, Hydrogen (H2), Synthetic natural gas (SNG), Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES),Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

UNIT-III:
APPLICATIONS OF EES: Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), EES installed capacity worldwide, New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles,

UNIT-IV:

MANAGEMENT AND CONTROL HIERARCHY OF EES: Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems and distributed generation (Virtual Power Plant), "Battery SCADA" – aggregation of many dispersed batteries. DEMAND FOR ENERGY STORAGE: Growth in Variable Energy Resources, Relationship between balancing services and variable energy resources, Energy Storage Alternatives, Variable Generator Control, Demand Management, Market Mechanisms, and Longer Term Outlook. VALUATION TECHNIQUES: Overview, Energy Storage Operational Optimization, Market Price Method, Power System Dispatch Model Method, Ancillary Service Representation, Energy Storage Representation, Survey of Valuation Results.

UNIT-V:

FORECAST OF EES MARKET POTENTIAL BY 2030: EES market potential for overall applications, EES market estimation by Sandia National Laboratory (SNL), EES market estimation by the Boston Consulting Group (BCG), EES market estimation for Li-ion batteries by the Panasonic Group, EES market potential estimation for broad introduction of renewable energies, EES market potential estimation for Germany by Fraunhofer, Storage of large amounts of energy in gas grids, EES market potential estimation for Europe by Siemens, EES market potential estimation by the IEA, Vehicle to grid concept, EES market potential in the future

TEXT BOOKS:

1. Power System Energy Storage Technologies, 1st Edition by Paul Breeze, Academic Press
2. Energy Storage: Systems and Components, by Alfred Rufer, CRC Press, 2017

REFERENCES:

1. Energy Storage Fundamentals, Materials and Applications, by Huggins and Robert, Springer.
2. andreasoberhofer@gmx.de
3. www.ecofys.com/com/publications
4. www.iec.ch

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ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(OE1)

Subject Code: C223OE2
Course Objective: To acquire knowledge on intelligent systems and agents, formalization of knowledge, reasoning with and without uncertainty, machine learning.

Course Outcomes:

After completion of course, students would be able to:

- Understand the various characteristics of intelligent agents.
- Learn about the different search strategies in AI.
- Learn to represent knowledge in solving AI problems.
- Analyse various machine learning algorithms and techniques with a modern.
- Explore supervised and unsupervised learning paradigms of machine learning.

UNIT I: INTRODUCTION

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT II: PROBLEM SOLVING METHODS

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games.

UNIT III: KNOWLEDGE REPRESENTATION

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information

UNIT IV: SUPERVISED LEARNING (REGRESSION/CLASSIFICATION)

Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking.

UNIT V: UNSUPERVISED LEARNING

Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models).

TEXT BOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

REFERENCES:

1. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.; First Edition, 2008.
2. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.
3. William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, the Elements of Statistical Learning, Springer 2009 (freely available online).
5. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

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BUSINESS ANLYTICS

(OE2)

Subject Code: C223OE2
Prerequisite: -None
Course objectives:

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques.
- Manage business process using analytical and management tools.
- Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes:

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT-I:
Business analytics: Overview o f Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, 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, News vendor Model, Overbooking Model, Cash Budget Model.

UNIT-V:

Decision Analysis: Formulating Decision Problems, Decision Strategies withthe without Outcome Probabilities, Decision Trees, The Value ofInformation, Utility and Decision Making. Recent Trends in : Embedded and collaborative business intelligence, Visualdata recovery, Data Storytelling and Data journalism.

TEXT BOOKS:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

REFERENCES:

1. Business Analytics with Management Science Models and Methods by ArbeenAsllani, Pearson
2. Business Analytics: Data Analysis And Decision Making, by Albright and Winston 5Th Edn, Cingage.
3. R for Business Analytics, by A.Ohri

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INDUSTRIAL SAFETY
(OE3)

Subject Code: C223OE2
Prerequisite: None

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 1948for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, 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. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

REFERENCES:

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

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OPERATIONS RESEARCH
(OE4)

Subject Code: C223OE2
Prerequisite: None
Course Outcomes:
At the end of the course, the student should be able to

- Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should able to apply the concept of non-linear programming
- Students should able to carry out sensitivity analysis
- Student should able to model the real world problem and simulate it.

UNIT-I:
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT-II:
Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming

UNIT-III:
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow Problem - CPM/PERT

UNIT-IV:
Scheduling and sequencing - single server and multiple server models – deterministic inventory Models - Probabilistic inventory control models - Geometric Programming.

UNIT-V:
Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

TEXT BOOKS:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

REFERENCES:

1. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
2. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
3. Pannerselvam, Operations Research: Prentice Hall of India 2010
4. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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COST MANGEMENT OF ENGINEERING PROJECTS

(OE5)

Subject Code: C223OE2

Prerequisite: None

UNIT-I:

Introduction and Overview of the Strategic Cost Management Process 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-II:

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-III:

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.

UNIT-IV:

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 for cost management, Linear Programming,PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TEXT BOOKS:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting

REFERENCES:

1. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

3. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

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COMPOSITE MATERIALS

(OE6)

Subject Code: C223OE2
Prerequisite: None

UNIT–I:

INTRODUCTION: Definition–Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II:

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III:

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding –Hot isostatic pressing.Properties and applications. Manufacturing of Ceramic MatrixComposites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carboncomposites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV:

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V:

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure- insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.Tasi.

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ENGLISH FOR RESEARCH PAPER WRITING

(Audit-I)

Prerequisite: None

Course objectives:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

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. Introduction

UNIT-III:
Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check.

UNIT-IV:
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction ,skills needed when writing a Review of the Literature,

UNIT-V:
skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT BOOKS:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

REFERENCES:

1. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
2. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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DISASTER MANAGEMENT
(Audit-I)

Prerequisite: None

Course Objectives:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches,
- Planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I:
INTRODUCTION:
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT-II:
REPERCUSSIONS OF DISASTERS AND HAZARDS:
Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT-III:
DISASTER PRONE AREAS IN INDIA:
Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post- Disaster Diseases And Epidemics

UNIT-IV:
DISASTER PREPAREDNESS AND MANAGEMENT:
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT-V:

RISK ASSESSMENTDISASTER RISK:

Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

DISASTER MITIGATION:

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

TEXT BOOKS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.

REFERENCES:

1. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

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SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit-I)

Prerequisite: N o n e

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT-I:
Alphabets in Sanskrit,

UNIT-II:
Past/Present/Future Tense, Simple Sentences

UNIT-III:
Order, Introduction of roots,

UNIT-IV:
Technical information about Sanskrit Literature

UNIT-V:
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

REFERENCES:

1. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

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VALUE EDUCATION

(Audit-I)

Prerequisite: None

Course Objectives:

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes: Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- developing the overall personality

UNIT-I:

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgments

UNIT-II:

Importance of cultivation of values. Sense of duty. Devotion, Self reliance.Confidence,Concentration.Truthfulness, Cleanliness.Honesty, Humanity.Power of faith, National Unity. Patriotism. Love for nature ,Discipline

UNIT-III:

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking.Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self destructive habits. Association and Cooperation. Doing best for saving nature

UNIT-V:

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

TEXT BOOKS:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford UniversityPress, New Delhi

REFERENCES:

1. “Value Education The Indian Tradition” , by D.P.Mukharjee, Bhavans Book University.
2. “Value Education ”, by Jagadish Chand

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CONSTIOTUTION OF INDIA (Audit-II)

Prerequisite: N o n e

Course Objectives:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- 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.

Course Outcomes: Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:
HISTORY OF MAKING OF THE INDIAN CONSTITUTION: History Drafting Committee, (Composition& Working)
PHILOSOPHY OF THE INDIAN CONSTITUTION: Preamble, Salient Features

UNIT-II:
CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES: Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-III:
ORGANS OF GOVERNANCE: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT-IV:
LOCALADMINISTRATION:District'sAdministrationhead:RoleandImportance,Municipalities :Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-V:

ELECTION COMMISSION: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.

REFERENCES:

1. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
2. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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PEDAGOGY STUDIES
(Audit-II)

Prerequisite: None

Course Objectives:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:
INTRODUCTION AND METHODOLOGY: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum,Teacher education.Conceptual framework, Research questions.Overview of methodology and Searching.

UNIT-II:
THEMATIC OVERVIEW: Pedagogical practices are being used by teachers informal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:
EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES, METHODOLOGY FOR THE IN DEPTH STAGE: quality assessment of included studies .How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:
PROFESSIONALDEVELOPMENT: alignment with classroom practices and follow up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:
RESEARCH GAPS AND FUTURE DIRECTIONS: Research design,Contexts, Pedagogy,Teacher education, Curriculum and assessment, Dissemination and research impact.

TEXT BOOKS:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

REFERENCES:

1. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
2. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
3. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
4. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
5. www.pratham.org/images/resource%20working%20paper%202.pdf.

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STRESS MANGEMENT BY YOGA

(Audit-II)

Prerequisite: None

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes: Students will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:
Definitions of Eight parts of yog.(Ashtanga)

UNIT-II:
Yam and Niyam.

UNIT-III:
Do`s and Don't's in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii)
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:
Asan and Pranayam

UNIT-V:
i) Various yog poses and their benefits for mind & body
ii)Regularization of breathing techniques and its effects-Types of pranayam

TEXT BOOKS:

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

REFERENCES:

1. ' Stress and Its Mangaement by Yoga" : by K.N.Udupa and R.C Prasad

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PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Audit-II)

Prerequisite: None

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day to day work and duties.

- ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

REFERENCES:

1. " Personality Development and soft skills" by Barun K. Mitra, 2nd Edition, Oxford Publishers.