Scheme of Examination
&
Syllabus of

First, Second, Third & Fourth Semester Choice Based Credit System (CBCS)
of
Master of Technology (M.Tech)
in
Industrial Drives and Control (IDC)

Priyadarshini College of Engineering, Nagpur

First Semester M.Tech. IDC

Course Code: 23PID101T **Course: Advanced Power Electronics**

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objective:

1 To overview various power semiconductor devices for power electronic applications.
2 Performance and analysis of low and high Frequency switched power electronic converters for various applications.
3 Selection of drives and power converter for particular application.
4 Operation & design of electric motor drives-controlled fed by power electronic converter.

Course Outcome:

After the completion of this course, the students shall be able to:

1. Select various power semiconductor switches on the basics of their characteristics
2. Utilise various ac-ac converters as per applications performance.
3. Analyse performance of dc-dc converters and its applications.
4. Classify soft switching converters, analyse their performance and applications.
5. Analyse performance of inverters and selection of PWM as per its applications.

Unit-I

Power Semiconductor Devices: Characteristics, protection and industrial applications of power devices. Various pulse width modulation techniques for different converter topologies.

Unit-II

AC-AC Converters: Introduction, single and three-phase ac–ac voltage controllers, Cyclo-converter, Matrix converters, application of ac-ac converters.

Unit-III

DC-DC Converters: Introduction, step-down converters- Buck, transformer version of buckconverters, step up converters, Buck-Boost converters, application of dc to dc converters

Unit-IV

Resonant and soft switching converters: Introduction, classification, resonant switch-ZCResonant switch, ZV Resonant switch, Quasi resonant converters, multi resonant converters, load resonant converters and their applications.

Unit-V

DC-AC converters: Introduction, classification, single-phase VSI (Half & Full Bridge), Three-phase VSI with SPWM, SVPWM, Selective harmonic elimination, SPWM with zero sequencesignal injection with industrial applications.

Text Books:

1. “Power electronics handbook by Muhammad Rashid , Academic Press.
2. Modern Power Electronics” by P. C. Sen , A. H. Wheeler Publishing Co.
3. “Thyristorized Power Controller” by Dubey, Joshi Doradla Sinha PHI Publication

Reference Books:

1. “Power Electronics” Cyril W Lander, MHL
2. “Power Electronics”, Ned Mohan, Tora M. Udeland, William P. Riobbins, John Wiley & sons
3. Related IEEE Papers / NPTEL Lectures.

First Semester M.Tech. IDC

Course Code: 23PID101P **Course: Advanced Power Electronics**

Credits: 1 **Teaching Scheme: L – T – P : 0-0-2**

Based on the Theory Syllabus practical must be performed in the Lab.
Maximum 8 Experiment in session.

Note: Practical experiments may be adjusted or modified based on the availability of laboratory equipment, software resources, and the specific focus areas of the course.

First Semester M.Tech. IDC

Course Code: 23PID102T **Course: DC Drives**

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objective:

1 Specify the appropriate power circuit configuration amongst the phase controlled rectifiers and choppers for the speed control of DC motor drives for four-quadrant operation with current limit
2 Design the control circuit and the power circuit for DC-DC converters.
3 Critically compare various options available for the drive circuit requirements

Course Outcome:

After the completion of this course, the students shall be able to:

1 Analyze transient performance of AC and DC machine
2 Analyze dynamic performance of DC motor
3 Obtain transient performance of single phase SCR drives
4 Implement various power factor improvement methods for drives.
5 Analyze transient performance of three phase SCR drives

Unit-I

Transient Analysis of D.C. Motor: Performance & analysis of A.C. & D.C. Commutator machines – Compound wound D.C. motor, Steady state analysis of D.C. shunt motor, D.C. series motor, Transient analysis, Stability of Compound wound D.C. motor, Universal Motor, Separately excited D.C. generator.

Unit-II

Dynamics of D.C. machine: Separately excited D.C. motor, Series excited D.C. motor, Ward- Leonard System. machine matrices, system equation, Transient analysis.

Unit-III

Single Phase SCR Drives: One quadrant and two quadrant drive–Continuous current & Discontinuous current mode of operation for separately excited DC motors, Transient performance.

Unit-V

Three Phase SCR Drives: Principle and operation of semi converter, full converter andDual converter drives. Comparison of circulating and non-circulating current dual converter Reversible drives – armature & field current reversal scheme using dual converters.

Unit-IV

Power Factor Improvement: PF improvement of full converter & Semi converter drive circuits – phase angle control, Semi converter operation of full converter. Asymmetrical firing, extinction angle control, Symmetrical angle control, PWM control,sequence control of series converter.

Reference Books:

1. Analysis of thyristor power conditioned Motors: S. K. Pillai, Longman Ltd.
2. Control of Electrical Drives: Werner Leonhard, Electric Energy System & Engg., SeriesSpringer Verlag Berlin Heidelberg, New York.
3. Electrical Drives: Vedam Subramanian.
4. Electrical Motors Drives (Modeling Analysis and Control) by -R. Krishnan, Practice HallIndia.

First Semester M.Tech. IDC

Course Code: 23PID102P **Course: DC Drives**

Credits: 1 **Teaching Scheme: L – T – P : 0-0-2**

Based on the Theory Syllabus practical must be performed in the Drives Lab.
Maximum 8 Experiment in session.

Note : Practical experiments may be adjusted or modified based on the availability of laboratory equipment, software resources, and the specific focus areas of the course.

First Semester M.Tech. IDC

Course Code: 23PID111T **Course: Program Elective – I**

Credits: 3 **Analysis of Electrical Machines**

Teaching Scheme: L – T – P : 3-0-0

Course Objective:

1 To provide knowledge about fundamentals of magnetic circuits, energy, force and torque.
2 To analyze the steady state and dynamic state operation of DC machine throughmathematical modeling and simulation in digital computer.
3 To provide the knowledge of theory of transformation of three phase variables to two phase variables.
4 To analyze the steady state and dynamic state operation of three-phase inductionmachines using transformation.
5 To analyze the steady state and dynamic state operation of synchronous machines using transformation theory

Course Outcome:

After the completion of this course, the students shall be able to:

1 Apply theory of transformation for machine analysis.
2 Obtain state model of electrical machine including mathematical representation for voltage, toque, impedance matrix and flux linkages.
3 Represent synchronous machines by state model using transformations.
4 Simulate synchronous Determine machine parameters from data sheet for single or infinite bus system.
5 Demonstrate synchronous machines with different simplified linear models.

Unit-I

Theory of transformation: Reference frame, electrical network terminology – mesh network – the generalized machine of first kind, impedance matrix, impedance matrix of synchronous machine, the flux linkage and flux density matrix, rotation matrix – electromagnetic torque, performance calculation, elimination of axes, analysis using revolving field theory, transformation from the stationary d-q axes to stationary real axes reference frame.

Unit-II

State Modeling of Electrical Machines: Spring and plunger system – rotational motion – mutually coupled coils – lagrange‟s equation- application of Lagranges Equation – solution of electro-dynamical Equations. Voltage & Torque equation under acceleration – motional impedance matrix of Generalized machines, state model of generalized machine, State modelof Induction motor, Voltage , Flux Linkages & Torque Equation for 3-phase Induction Motor, Dynamics in the machine variables, Mathematical Models of 3-phase Induction Motor in the arbitrary stationary, rotor & synchronous reference frame.

Unit-III

Synchronous Machines: Per unit system and Normalization, Park's Transformation, Flux linkage equations, Voltage & Current equations, Formulation of State –space equations, Equivalent circuit, Sub-transient & Transient inductances and time constants, Simplified models of Synchronous machines.

Unit-IV

Steady state equations and phasor diagram, Single machine, Infinite Bus system, Determination of machine parameters from Manufacturer's data, Analogue and Digitalsimulation of Synchronous machines.

Unit-V

Linear Model of Synchronous Machines: Linearization of 1) Generator state spacecurrent model 2) Load equation for the one machine problem & 3) Flux linkage model, Simplified linear model & its state space representation

Reference Books:

1. Mukhopadhyay A.K.,Matrix Analysis of Electrical Machines, New Age International,1996.
2. Bimbhra P. S.-,Generalized Theory of Electrical Machines, Khanna Publishers,1975
3. S.K.Sen-, Electric Machinery, Khanna Publishers,1998
4. Anderson P. M. & Fouad A. A. –"Power system control & stability" Galgotia Publications1981

First Semester M.Tech. IDC

Course Code: 23PID112T **Course: Program Elective – I**

Credits: 3 **Mathematical Modeling of Electrical Machines**

Teaching Scheme: L – T – P : 3-0-0

Course Objective:

1 Significance of Electrical Machine Modeling
2 Fundamental of D.C. Motor Modeling
3 Elementary theory of Transformation for reference frame for Induction Motor
4 Fundamental of Synchronous Motor Modeling
5 Performance analysis of Synchronous Motor.

Course Outcome:

After the completion of this course, the students shall be able to:

1 Acquire basic concepts of AC/ DC machine modeling.
2 Justify the dynamic modeling and phase transformation
3 Analyze various methodologies in small signal machine modeling.
4 Represent synchronous machine by mathematical modeling in dq0 reference frame
5 Analyze performance and dynamic modeling of synchronous machines

Unit-I

Basic Concepts of Modeling: Basic Two - pole Machine representation of Commutator machines, 3 phase synchronous machine with and without damper bars and 3 - phase induction machine, Kron's primitive Machine - voltage, current and Torque equations.

Unit-II

DC Machine Modeling: Mathematical model of separately excited D.C motor –Steady State analysis - Transient State analysis - Sudden application of Inertia Load - Transfer function of Separately excited D.C Motor - Mathematical model of D.C Series motor, Shunt motor - Linearization Techniques for small perturbations.

Unit-III

Reference Frame Theory: Real time model of a two phase induction machine-Transformation to obtain constant matrices - three phase to two phase transformation - Power equivalence. Dynamic modeling of three phase Induction Machine Generalized model in arbitrary reference frame.

Unit-IV

Modeling of Synchronous Machine: Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame - electromagnetic torque - current in terms of flux linkages - simulation of three phase synchronous machine- modeling of PM Synchronous motor.

Unit-V

Dynamic Analysis of Synchronous Machine: Dynamic performance of synchronous machine, three -phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria

Text Books:

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis& control", Pearson Publications, First edition, 2002.
2. P.C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, "Analysis of Electrical Machinery and Drive systems", IEEE Press, Second Edition.

Reference Books:

1.P.S. Bimbra, "Generalized Theory of Electrical Machines" Khanna publications, Fifth edition - 1995.
2. Chee Mun Ong – "Dynamic simulation of Electric machinery using MATLAB / Simulink", Prentice Hall of India Publications
3. Online courses on Modeling of Electrical Machines -http://nptel.ac.in/courses/108106023/

First Semester M.Tech. IDC

Course Code: 23PID113T **Course: Program Elective – I**

Credits: 3 **Energy Management in Electrical System**

Teaching Scheme: L – T – P : 3-0-0

Course Objective:

1 Necessity of industrial Energy Audit, methodology and various tools and instruments used.
2 Acquire concepts of electrical load management and energy efficiency in electrical systems such as induction motors, transformers etc.
3 Apply concepts of energy efficiency in industrial systems such as pumping system, compressor and fan systems, steam distribution systems, AC systems etc.

Course Outcome:

After the completion of this course, the students shall be able to:

1 Acquire significance of energy management & audit and will be able to prepare energy audit report.
2 Utilise various measurement techniques and instruments for energy audit.
3 Analyze various electrical parameters required for energy management.
4 Determine efficiency of the motor under various conditions and hence understand energy management.
5 Analyse energy conversation concept in industrial applications.

Unit-I

Importance of energy management – overview of energy conservation act (2001), Energy auditing, objectives, methodology, steps in energy management, types of energy audit, preliminary energy audit, detailed energy audit, Energy audit report writing – analysis of past data, Identification of energy conservation opportunities, mass and energy balances, examples, Simple payback period calculation

Unit-II

Potential energy and cost savings from energy conservation measures, barriers to energy efficiency, Need for measurements during energy audit, various measuring instruments used for energy audit, Energy monitoring & targeting.

Unit-III

Electrical Systems: Tariff systems, billing elements, load curve analysis, load management, power factor correction, electrical demand and load factor improvement, load scheduling / shifting, Demand side management (DSM), case study, Energy efficiency in transformers, Case study.

Unit-IV

Electric motors: Motors efficiency, idle running, factors affecting induction motor, performance, estimation of motor loading, efficiency at low loads, numerical problems, high efficiency induction motors, rewound motors Variable speed drives for induction motors, advantages and applications, different types of VFD.

Unit-V

Energy conservation in industrial systems, pumping systems, fans (flow control), compressed air systems, Refrigeration and air conditioning systems Cogeneration, concept and advantages, options (steam/gas turbines/diesel engine based), selection criteria Heat exchanger networking, pinch analysis, basic concept only.

References:

1. Y. P. Abbi, S. Jain, Handbook of Energy audit and environment Management, The Energy and Resource Institute, New Delhi, 2006.
2. Guide Book for energy managers & Auditors, Book-1,2,3,4,Revision 2, Bureau of Energy Efficiency, India, 2005.
3. L. C. Witte, P. S. Schmidt, D. R. Brown, Industrial Energy Management and Utilization, Hemisphere Publishers, Washington,1988.
4. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982.
5. T.D. Eastop, D.R. Croft, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990.
6. A. Chakrabarti, Energy Engineering and Management, PHI Learning, Delhi, 2013.

First Semester M.Tech. IDC

Course Code: 23PID121T **Course: Program Elective – II**

Credits: 3 **Advanced Control Theory**

Teaching Scheme: L – T – P : 3-0-0

Course Objective:

1 Modeling of electro mechanical systems by mathematical analysis
2 To Determine Transient and Steady State behavior of systems using standard test signals.
3 Introduction of linear & non-linear systems for steady state errors, absolute stability & relative stability
4 To Identify and design a control system satisfying requirements.

Course Outcome:

After the completion of this course, the students shall be able to:

1 Develop mathematical models of physical systems and obtain State variable analysis
2 Acquire basics of digital control and determine stability of the system
3 Judge the controllability and suggest the improvement for stability of the system
4 Analyse the stability of the system
5 Design optimal controllers for physical systems including power electronic and power systems.

Unit-I

State Variable Analysis: Diagonalization of state model, Computation of STM by Laplacetransform, Cayley Hamilton Theorem and Canonical transformation method, Solution ofstate equation. Controllability, Observability and state variable feedback.

Unit-II

Digital Control Systems: Models of Digital control Devices, State description of Digital processors and sampled continuous time plants, discretization of digital continuous time state equations, Solution of state difference equation, Stability By Bilinear Transformation & Jury‟s Test.

Unit-III

Controllability and observability tests for digital control systems, Stability of discrete timeSystems, Pulse transfer function and its realization, Stability improvement by state feedback, Pole-placement design and state observers.

Unit-IV

Lyapunov Stability Analysis: Basic concepts, Limit cycles, Stability definitions, Stability Theorems, Lyapunov functions forlinear and non-linear systems.

Unit-V

Optimal Control: Parameter optimization techniques, Lagrange parameter techniques, Calculus of variations, Unconstrained and Constrained minimization of functional, Two point boundary value problems, Pontrygin's minimum principle, Optimal regulator and tracking problems, Optimaldigital control systems.

Reference Books:

1. M.Gopal.; Digital Control and State Variable Methods; Tata McGraw Hill, New Delhi, 1997.
2. D.E. Kirk.; Optimal Control Theory; Prentice Hall, 1970.
3. M.Gopal.; Digital Control Engineering; Wiley Eastern, 1988.
4. B.C. Kuo.; Digital Control System Engineering; Saunders College publishing, 1992.
5. Advanced Control System, First Edition, M. Rihan

First Semester M.Tech. IDC

Course Code: 23PID122T **Course**: **Program Elective – II**
Credits: 3 **Intelligent Control of Drives**
Teaching Scheme: L – T – P : 3-0-0

Course Objective:

1 Introduction to Microprocessor types and its programming.
2 Applications of various interfacing circuits required for microprocessor & microcontroller.
3 Programming with Microcontroller

Course Outcome:

After the completion of this course, the students shall be able to:

1 Acquire the causes, effects and remedies of power quality problems.
2 Design a system component or process as per needs and specifications
3 Write Assembly language program for8051 Microcontroller to achieve solution to given task
4 To acquire functioning of Signal conditioning using specific circuits/transducers and to measure electrical or non-electrical quantities using processor.
5 Applications of microcontroller in various engineering fields

Unit- I

Review of Microprocessor 8085/8086: Introduction To 16 Bit Microprocessors, 8086/8088 CPU Architecture, Memory Organization, Floating point arithmetic, Bus structure & timings,8086/8088 Instruction Set.

Unit-II

Microcontroller 8031/8051: Microcontroller: 8051 Architecture/ Pin Diagram, Special Function Register (SFR), Internal RAM/ROM, 8051 Instruction Set, Interrupts, Assembly Language Programming and their application, Interfacing to External Memory, Programming Techniques for looping, indexing, counting & bit manipulation.

Unit-III

Basic I/O Interfacing Concept: Memory mapped I/O programmable peripherals, I/Omapped I/O programmable peripherals, Introduction to PPI 8254/8255, Architecture, Modesof operation of 8255, Interfacing of peripherals with 8255, Introduction to PIC 8259, Architecture, Modes of operation of 8259, Interfacing of peripherals with 8259, Interfacing of keyboard & display, ADC/DAC, USART.

Unit-IV

Interfacing of Microcontroller 8031/8051: Interfacing with ADC/DAC display, interfacing with Keyboard, Interfacing with LCD Display & Stepper Motor with 8251, Power factor improvements, Introduction to DSP processor & its application to power system, Generation of PWM signals using Timer/Counter. Harmonics analysis, FFT etc.

Unit-V

Microcontroller dsPIC33EP256MC202: Microcontroller: Architecture/ Pin Diagram, General Input/output ports, Control Registers for PPS, Interrupts, Oscillator, Timer, Generation of High Speed PWM. Applications to Motor Speed Control, AC-DC, DC-AC Conversion, Battery Charger, UPS, INVERTER, and Power factor Correction.

Text Books:

1. Hall: Microprocessor & Interfacing: Programming & Hardware; Mc-Graw Hill Books.
2. Gaonkar: Microprocessor Architecture, programming Application with 8085, Penraminternational publishing
3. Bhupendra Singh Chhabra:8086/8088 Microprocessor Architecture Programming, Design& Interfacing, Dhanpat Rai & Sons.
4. Ramakant Gaikwad: Op-amps & Linear IC‟s; Prentice Hall of India
5. Kenneth J. Ayala: The 8051 Microcontroller-Architecture, Programming & Application:penram international publishing (India)
6. Muhammad Ali Mazidi: The 8051 Microcontroller and Embedded Systems Using Assembly& C: Second Edition-Pearson Publication.
7. Data sheets of dspIC33EPMC202.

First Semester M.Tech. IDC

Course Code: 23PID123T **Course: Program Elective – II**

Credits: 3 **Optimization Techniques**

Teaching Scheme: L – T – P : 3-0-0

Course Objective:

To enable the student to apply analysis tools in optimization of power systems and power electronic problems.

Course Outcome:

After the completion of this course, the students shall be able to,

1. Explain and use the basic theoretical principles of optimization and various optimization techniques
2. Develop and select appropriate models corresponding to linear problem descriptions in engineering and solve them
3. Develop and select appropriate models corresponding to non-linear problem descriptions in engineering and solve them
4. Utilise Swarm intelligence for optimization
5. Apply various techniques of optimisation

Unit- I

Introduction to optimization, Statement and Classification of Optimization Problems, Overview of Optimization Techniques, Standard Form of Linear Programming Problems-Definitions and Theorems, Simplex Method-Revised Simplex Method-Duality and Dual Simplex Method-Sensitivity Analysis.

Unit- II

Necessary and Sufficient Conditions-Search Methods (Unrestricted Fibonacci and Golden)-Interpolation Methods (Quadratic, Cubic and Direct Root Method), Direct Search Methods-Random Search-Pattern Search and Rosen Brock's Hill Climbing Method Descent Methods-Steepest Descent, Conjugate Gradient, Quasi Newton and DFE Method

Unit- III

Necessary and Sufficient Conditions-Equality and Inequality Constraints-Kuhn-Tucker Conditions. Gradient Projection Method- Cutting Plane Method-Penalty Function Method (Interior and Exterior). Principle of Optimality-Recurrence Relation-Computation Procedure- Continuous Dynamic Programming

Unit- IV

Swarm Intelligence: Ant Colony Optimization, Swarm intelligence general characteristics, Ant Colony Optimization: Basic Concepts- The Ant Colony System- Ants' Foraging Behavior and Optimization,- The Max-Min Ant System Minimum Cost Paths, Combinatorial Optimization. Major Characteristics of Ant Colony Search Algorithms- Positive Feedback- Rapid Discovery of Good Solution - Use of Greedy Search and Constructive, Heuristic Information- Ant Colony Optimization Algorithms Applications.

Unit- V

Particle swarm optimization: -Fundamentals- Concepts of PSO-Comparison, with Genetic Algorithm-Application and Implementation.

Firefly Algorithm –Basic Concepts-Application in optimization, power electronics and power system problems.

Reference Books:

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

First Semester M.Tech. IDC

Course Code: 23PID103T **Course: Research Methodology and IPR**

Credits: 4 **Teaching Scheme: L – T – P : 4-0-0**

Course Objectives:

The objective of this course is to provide students with:

1. An insight into how scientific research is conducted
2. Knowledge of Research Process, Concepts, diverse research tasks and equip them toundertake research.
3. Understanding the concepts of Data collection, system modeling and reliability.
4. To develop an understanding for the optimization methods in research work.
5. Methods for presentation of research results.

Course Outcomes: By the end of the course, the students shall be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today‟s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. 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 Rightto be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further researchwork 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 agood research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit-II

Effective literature studies approaches, analysis Plagiarism, Research ethics.

Unit-III

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

Unit-IV

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

Unit-V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. ,New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text books:

1. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

Reference Books:

1. Stuart Melville and Wayne Goddard, “Research methodology:an introduction for science& engineering student.
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide forbeginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.

First Semester M.Tech. IDC

Course Code: 23PID131A **Audit Course: English for Research Paper Writing**

Teaching Scheme: L – T – P : 2-0-0

Course objectives:

Students will be able to:

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

Course outcomes: Students will be able to

1. Understand & differentiate between literary piece of writing & Technical Writing.
2. Write technical documents in clear, concise & effective manner
3. Design own style of writing to inform or instruct an audience with a specific goal in mind.
4. Will be able to write proposals.
5. Will be able to design, create and write technical manuals.

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

Key skills needed for writing a Title, Abstract, Introduction, Review of the Literature, methods, Results, Discussion, Conclusions.

Useful phrases, how to ensure paper is as good as it could possibly be the first- timesubmission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)[40] Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.Highman‟sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York DordrechtHeidelberg London, 2011

First Semester M.Tech. IDC

Course Code: 23PID132A **Audit Course: Disaster Management**

Teaching Scheme: L – T – P : 2-0-0

Course Objectives: -Students will be able to:

1. Demonstrate a critical understanding of key concepts in disaster risk reductionand humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practicefrom multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevancein specific types of disasters and conflict situations.
4. 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.

Course outcomes:

Students will be able to

1. To work as a think tank for the society by providing assistance in policy formulation.
2. Develop ability and understanding of disaster mitigation and management.

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 PhenomenaTriggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental And Community Preparedness.

Suggested Readings:

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies ““New Royal book Company. Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies”,Deep &DeepPublication Pvt. Ltd., New Delhi.

First Semester M.Tech. IDC

Course Code: 23PID133A **Audit Course: Value Education**

Teaching Scheme: L – T – P : 2-0-0

Course Objectives:

1. To Understand value of education and self- development
2. To Imbibe good values in students
3. To be aware of importance of character

Course outcomes:

By the end of the course, the students shall be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. 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 judgements

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. 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-IV

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

Suggested reading

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, OxfordUniversity Press, New Delhi
2. Open Verification Methodology Cookbook, Mark Glasser, Springer, 2009
3. Principles of Functional Verification, Andreas S. Meyer, Elsevier Science, 2004
4. Assertion-Based Design, 2nd Edition, Harry D. Foster, Adam C. Krolnik, David J. Lacey,Kluwer Academic Publishers, 2004.

Second Semester M.Tech. IDC

Course Code: 23PID201T **Course: Drives System Design**

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1. Study of instantaneous power in various frames of reference
2. Study of various DC-DC converter in CCM and DCM and the effect of variation of the controller parameters
3. Study on the Sine-triangle PWM scheme for a 3-phase VSI
4. Study on the switching and conduction power losses in generic power electronic converters
5. Analyze the various parameters by modeling

Course Outcomes:

After the completion of this course, the students shall be able to:

1. Implement processes related to the numerical solution used in generic simulators
2. Choose the numerical solver to be used for a given type of analysis
3. Solving convergence problems occurring during simulation and to avoid them
4. Simulate the behavior of Power Converters, DC and AC drive

Unit-I

Systems, Models and the Concept of State: Environment and Variables , The State of a System, Classification of Systems , Mathematical Models of Continuous-time Linear Lumped Parameter Time invariant Systems ,Discrete-time Systems.

Unit-II

Linear Approximation of Nonlinear Systems, Topological Models of Systems, State Diagrams, A Generalized Approach to Modeling-The Principles of Conservation and Analogy, Mechanical Systems, Electrical and Electromechanical Systems.

Unit-III

Linear Approximation of Nonlinear Systems, Topological Models of Systems, State Diagrams, A Generalized Approach to Modeling-The Principles of Conservation and Analogy, Mechanical Systems, Electrical and Electromechanical Systems.

Unit-IV

Time-domain Analysis: State Variable Approach, The Solution of State Equations-Discrete-time Systems, Computation of State Transition Matrix by Canonical Transformation, Computation of State Transition Matrix by Technique based on Cayley-Hamilton Theorem, The Solution of State Equations-Continuous time Systems, Numerical Method for Solution of Continuous-time State.

UNIT-V

Modeling & Analysis of D.C. Machines: Modeling and Analysis of Permanent-Magnet Direct-Current Generators driven by Permanent-Magnet Direct-Current Motors. Model Development and Analysis of Ward-Leonard Systems with Direct-Current Electric Machines.

Reference Books:

1) System Modeling & Analysis By I .J. Nagrath & M. Gopal :Tata Macgraw Hill.
2) Electromechanical System, Electric Machines,& Applied Mechatronics : Sergey E. Lyshevski.

Second Semester M.Tech. IDC

Course Code: 23PID202T **Course: AC Drives**

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1. Study of torque produced in an induction machine in 'abc' and 'qd0' frames of reference with sinusoidal source and with a 3-Ph VSI with V/f control.
2. Study on the switching and conduction power losses in generic power electronic converters
3. Study on the design of controllers for a V/f controlled induction motor drive with slip compensation technique
4. Study of a vector controlled 3-Ph induction motor drive with three-level inverters
5. Study of State Space Averaging Technique.

Course Outcomes:

1. Design a V/Hz controller with sine-triangle modulation for a VSI driven 3-Ph induction motor drive
2. To model existing and modified power converters under small signal and steady state condition
3. Develop power converters with better performance for challenging applications
4. Analyze and design power converters and feedback loops

Unit – I

Brief review of DC to AC inverter circuit, single phase and 3 phase current inverter, Load commutated inverter , AC to AC cyclo-converter.

Unit – II

Speed control of 3 phase Induction Motors by AC Power controllers : Static Rotor Resistance Control Slip energy recovery schemes – Static Kramer Drive – Static Scherbius drive – closed loop control schemes using the above special control techniques.

Unit – III

Speed control of 3 phase Induction motors using Voltage source inverters, Current source Inverters.

Unit – IV

Voltage / Frequency Controller: Open loop speed control, closed loop speed control , low frequency performance with Increased Volts/ Hz , optimum efficiency operation.

Unit – V

Speed control of 3- phase Induction motor By Vector Control methods – Basic concepts of Direct and Indirect methods of control performance and analysis of Induction motors with non – sinusoidal supply sources.

Reference Books:

1.S. B. Devan, G. R. Slemon , A .Straughen : Power semiconductor Drives, Wiley Interscience, 1984.
2.V. Subramanian: Thyristor control of Electric Drives, Tata Mc Graw Hill, 1988
3.B. K. Bose: Power Electronics and AC Drives, Prentice Hall,1986
4.Thyristor Control of AC Motors By J.M. D. Murphy, Pargamm Press, New York
5.Control Of Electrical Drives: W. Leonhard Springer-Verlag.
6.Electrical Motors Drives (Modeling Analysis and Control) by -R. Krishnan, Practice Hall

Course Code: 23PID203T **Course: Electrical Transportation**
Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1. To make students understand the importance and various modes of electric transportation systems such as electric traction, hybrid vehicle and elevators etc.
2. To differentiate various source of energy used in transportation and their performance characteristics.
3. To impart knowledge about different power and energy converters.
4. To classify the different controls used in electric vehicles.
5. To demonstrate the knowledge about electric cars and elevators.

Course Outcomes:

After the completion of this course, the students shall be able to:

1. Select between alternative modes for electric transportation system.
2. Explain various types of energy storage devices and their impact on electrified transportation.
3. Explain various power and energy converters in transportation system.
4. Analyze different control systems used in electric vehicles.
5. Describe different characteristics of electric car and elevators

Unit-I

General Review of Transportation : Need and importance of mobility, various modes of transportation, evolution of transportation system, Horse carriages to steam engines to internal combustion engines to electric vehicles, advantages and disadvantages of electric mobility, various application of electric mobility such as electrical traction, hybrid electric and electric vehicles, elevators, personal mobility and special applications such as wheel chairs, future concepts.

Unit-II

EV- Basic Building Blocks: Various sources of energy used in transportation and their characteristics, Conventional vehicle power transmission systems. Energy conversions module integrations and their operation. Different types of Batteries & their operation. Types of batteries, their characteristics, charging and discharging of batteries, round trip efficiency, ability to deliver instantaneous power, load cycle and its effect on battery performance, environmental impact of batteries, power quality issues related to charging of batteries. Different load characteristics (Specifically road characteristics)

Unit-III

Power module & Energy converters: Need for power converters, basic power electronic blocks, AC/DC, DC/DC, DC/AC modules. Types of mechanical drives, conversion of electrical energy into mechanical energy, characteristics of various types of drives, BLDC machines, AC machines, DC machines, mechanical drive / power train

Unit-IV

Control system and instrumentation: Function of instrumentation and control system, speed control, acceleration characteristics, mechanical steering versus electric steering, motion control, driverless vehicles, road safety and traffic control and monitoring, emerging trends

Unit-V

Electric cars: Emerging trend, typical power train architecture, hybrid cars, acceleration and speed characteristics, Traction Introduction to Modern AC traction for high-speed rail application, their control and performance under different operating conditions. Comparison of AC/DC traction. Elevators Load characteristics of elevator systems, Introduction to control schemes in elevators with new power electronic controlled drives, considerations for energy efficient systems. Special vehicles, basic concepts and emerging trend.

Text Books:

1. James Larminie and John Lowry, “Electrical Vehicle” John Wiley & Sons, 2012.
2. Mark Warner, “The Electric Vehicle Conversion handbook” –HP Books, 2011.
3. Iqbal Husain, “Electric & Hybrid Vehicles-Design Fundamentals”, Second edition, CRC press
4. D. A. J. Rand, R. Woods R. M. Dell, “Batteries for Electric Vehicles”, New York, John Wiley and Sons.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao and Ali Emadi, “Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and Design”, CRC Press, 2009.
2. Burch Edward P., “Electric Traction for Railway Trains” McGraw Hill, 1911.
3. H.Partab, “Modern Electric Traction”–Dhanpat Rai & Sons, 1973.
4. Barney, George C., “Elevators Technology” international Association of Elevator Engineers by Ellis Harwood, 1986.

Second Semester M.Tech. IDC

Course Code: 23PID211T **Course: Program Elective III**
Design of Synchronous and Asynchronous Machines

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1 To give exposure to the students about the concepts of alternating current machines
2 To learn the characteristics of induction machines and to learn how it can be employed for various applications.

Course Outcomes:

After the completion of this course, the students shall be able to:

1. Identify alternator types, and appreciate their performance
2. Determine the voltage regulation and analyse the performance of alternators
3. Describe the principle of operation of synchronous motor and different applications
4. Analyze the performance of 3-phase induction motors
5. Describe the principle of operation of 3-phase induction motors and select appropriate motor types for different applications.

Unit-I

Alternators - basic principle, constructional features of salient pole type and cylindrical type alternators, advantages of stationary armature, turbo-alternator. Armature winding – types of armature winding, Effect of pitch factor on harmonics – advantages of short chorded winding, EMF Equation – numerical problems. Harmonics in generated EMF – suppression of harmonics.

Unit-II

Theory of salient pole machine – Blondel's two reaction theory – direct axis and quadrature axis synchronous reactances – phasor diagram and determination of Xd and Xq by slip test. Parallel operation of alternators – necessity of parallel operation of alternators, methods of synchronization– dark lamp method and bright lamp method, synchroscope, Synchronizing current, synchronizing power, synchronizing torque. Effects of changing excitation of alternators, load sharing of two alternators in parallel operation.

Unit-III

Synchronous motor – construction and principle of synchronous motor, methods of starting. Effects of excitation on armature current and power factor, v-curve and inverter v-curve, load angle, torque and power relationship, phasor diagram, losses and efficiency calculations.

Unit-IV

Circle diagrams – tests on induction motors for determination of equivalent circuit and circle diagram. Starting of induction motors – types of starters – DOL starter, autotransformer starter, star-delta starter, rotor resistance starter – starting torque and starting current numerical problems.

Unit-V

Induction generator – principle of operation, grid connected and self excited operation, comparison of induction generator with synchronous generators. Synchronous induction motor – principle of operation.

Text Books:

1) Bimbra P. S., Electrical Machinery, 7/e, Khanna Publishers, 2011.
2) Nagrath J. and D. P. Kothari, Theory of AC Machines, Tata McGraw Hill, 2006.

Reference Books:

1) Say M. G., The Performance and Design of A. C. Machines, C B S Publishers, New Delhi, 2002.
2) Fitzgerald A. E., C. Kingsley and S. Umans, Electric Machinery, 6/e, McGraw Hill, 2003.
3) Langsdorf M. N., Theory of Alternating Current Machinery, Tata McGraw Hill, 2001.
4) Deshpande M. V., Electrical Machines, Prentice Hall India, New Delhi, 2011.

Second Semester M.Tech. IDC

Course Code: 23PID212T **Course: Program Elective III Switch Mode Power Converter and Applications**

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1 To impart knowledge of Modern power electronic converters and its applications in electric power utility.

Course Outcomes:

After the completion of this course, the students shall be able to:

1 Analyze the PWM techniques for DC-AC converters

2 Acquire knowledge on modern power electronic converters and its applications in electric power utility.

3 Acquire knowledge on filters and UPS

Unit-I

Introduction to Switched mode power converters (SMPC),Advantages over linear Power converters, Several Application of SMPC, a brief Survey of power Semiconductor devices, ideal switching characteristics, Switching losses, Single quadrant switches, current bidirectional two quadrant switches, Voltage bidirectional two quadrant switches, Four quadrant switches.

Unit-II

Analysis of Switching Power converters in steady state, Inductor Volt-Second Balance, Capacitor Charge Balance, and the Small-Ripple Approximation. Pulse width Modulation (PWM), Buck Converter, Boost Converter, Buck-Boost Converter, Cuk Converters analysis and Design in CCM and DCM.

Unit-III

Isolated Power converters, Forward converter, fly-back converter, Push Pull, half-bridge and full bridge converter, Isolated version of cuk converter and their analysis and design.

Unit-IV

Basic Magnetic Theory, Transformer modeling, Skin and Proximity effects, Design of high frequency Inductor for Power converters, Design example with basic converter topologies like (boost, buck etc.), Design of high frequency transformer for power converters and their design examples.

Unit-V

Closed loop control of power converters, dynamic modeling by state space averaging, Transfer function and frequency analysis of the converter, Stability analysis.

Reference / Text Books:

1) Robert. W. Erickson and Dragan Maksimovic, “Fundamentals of Power Electronics” Second Edition, Springer (India).

2) V. Ramanarayanan “Course Material on Switched Mode Power Conversion”, Department of Electrical Engineering, Indian Institute of Science-Bangalore.

3) Ned Mohan, T. M. Undeland “Power Electronics: Converters, applications and Design” Third Edition, Wiley-India.

4) Daniel W Hart “Power Electronics ” McGraw-Hill Education; 1st edition.

Second Semester M.Tech. IDC

Course Code: 23PID213T **Course: Program Elective III**
Converter for Renewable Energy

Credits: 3 **Sources Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1 To introduce to students the importance of Advanced Power for conversion of power in various forms
2 To understand basic operation and control of pulse-width modulated inverters (PWM).

Course Outcomes:

After the completion of this course, the students shall be able to:
1 An ability to develop in depth knowledge for WEC and PV based system.
2 An ability to develop in depth knowledge for analysis of grid connected WEC and PV system.
3 Use the basics of various converter topologies in the photovoltaic system operation
4 Use the basics of various converter topologies in the wind energy conversion system.

UNIT- I

Introduction Wind Energy Conversion (WEC) system, Photovoltaic (PV) based Power conversion system. Introduction to converter in WEC and PV system. Modes of Operation of Converters; Grid Connection Mode, Stand-Alone Mode, Battery Charging Mode.

UNIT-II

Analysis of Wind and PV Systems: Standalone operation of fixed and variable speed wind energy conversion systems and solar PV system. Grid connection Issues, operation of Grid integrated PMSG, SCIG and DFIG Based WECS. Grid Integrated solar PV system.

UNIT-III

Converter Topologies for two-Level Converter and three level converters. Modulation Strategies-Pulse Width Modulation, Carrier-Based Strategies, Space Vector Strategies.

UNIT-IV

Photovoltaic Inverter Structures Inverter Structures Derived from H-Bridge Topology; Basic Full-Bridge Inverter, H5 Inverter (SMA), HERIC Inverter (Sunways), REFU Inverter Summary of H-Bridge Derived Topologies. Inverter Structures Derived from NPC Topology Neutral Point Clamped (NPC) Half-Bridge Inverter; NPC Inverter, Summary of NPC Derived Inverter Topologies, Three-Phase PV Inverters, Control Structures, Conclusions and Future Trends.

UNIT-V

Converter Structures for Wind Turbine Systems Introduction, WTS Power Configurations, Grid Power Converter Topologies; Single-Cell Voltage source converters, Multicell (Interleaved or Cascaded) converters and back to back converters, WTS Control; Generator-Side Control Grid side Control, Future trends in wind conversion system converters.

Text Books:

1. Modern Power Electronics by P.C. Sen AH Wheeler Publication
2. Power Electronics hand book By Rashid M.H. Academic Press
3. Non-conventional Energy Sources by G.D. Rai Khanna Publishers.
4. Grid Converter for Photovoltaic and Wind Power Systems by Remus Teodorescu, Marco Liserre, Pedro Rodrıguez IEEE Press John Viley and Sons
5. Power Electronics Converter for Microgrids by Suleiman M. Sharkh, Mohammad A. Abusara, Georgios I. Orfanoudakis IEEE Press John Wiley and Sons
6. Power Electronics by Ned Mohan, Tora M. Udeland, William P. Robbins John Wiley and Sons.

Second Semester M.Tech. IDC

Course Code: 23PID221T **Course: Program Elective IV**
Advance Electrical Drives

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1 To impart knowledge about fundamentals of Electric drives and control.
2 Operational strategies of dc and ac motor drives as per different quadrant operations

Course Outcomes:

After the completion of this course, the students shall be able to:
1 Acquire the knowledge of selection of drives as per practical operational industrial requirement.
2 Apply their knowledge to prepare control schemes as per different types of motors used in industries
3 Estimate & solve harmonic and power factor related problems in controlling AC and DC drives.

UNIT-I

Review of introductory concepts of drives , DC Motor Drive and its Operational Strategies: Dynamic model of machine with armature voltage control only and converters with continuous conduction only; Closed loop control using single (speed) and two loops (speed, current), Implementation using circulating current type three phase dual converter and four quadrant transistorized chopper

UNIT- II

Open-loop Dynamic Performance of AC & DC Drives: Starting & reversal time, Energy consumption & energy savings principle. Drives Application Engineering for Fan, Pump, Compressor, Lift-Elevator, Kiln, Winder-Un-Winder, Traction application. Synchronization and master-slave configuration.

UNIT- III

AC Drives and its Operational Strategies: Variable frequency operation of three induction machine, Scalar control methods for constant power an constant torque modes, Vector control of induction machine, Methods of field sensing and estimation, Field orientation methods: Implementation of IRFO scheme using current controlled PWM, VSI and implementation of DSFO scheme using CSI, Performance of vector controlled permanent magnet machine.

UNIT- IV

Control and Estimation of Ac Drives: Introduction to speed control of Switched Reluctance Machine, Induction motor drive, basic of Scalar & Vector control V/f Control, Sensorless vector control, Field Oriented Control, Direct torque control and flux observation, Speed control of wound rotor induction motors: Converter based static rotor resistance control, Static scherbius drive using line commutated converter cascade, Analysis and estimation of harmonics and power factor, Vector control of wound rotor induction machine using self-commutated converter cascade and improvement in power factor, Variable speed constant frequency (VSCF) generation.

UNIT-IV

Compatibility of Motor & Drives: Effects of drives on motor - dV/dt, THD, Common Mode Voltage, Shaft Voltage and Bearing Current, Sound & Vibration

Text Books:

1. Mohan, N., Electric Drives: An Integrative Approach, MNPERE (2001).
2. Mohan, N., Advanced Electric Drives: Analysis, Control, and Modeling Using Simulink, MNPERE (2001).
3. Krishnan, R., Electric Motor & Drives: Modeling, Analysis & Control, PHI Pvt. Ltd. (2001).
4. Bose B.K., Modern Power Electronics & AC Drives, PHI Pvt. Ltd., (2001).

Second Semester M.Tech. IDC

Course Code: 23PID222T **Course: Program Elective IV**
Digital Control System

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1 Develop the capability of analyzing the stability of a system and of designing simple controllers to regulate system behavior.
2 Introduce different optimization techniques to achieve desired performance.
3 Introduction to digital controller and technique for stability analysis of Digital Control System.

Course Outcomes: After the completion of this course, the students shall be able to:

1 Analyze discrete time control system and signals
2 Derive and design various stability techniques for improving performance of the system
3 Analyze continuous time system using state space technique.
4 Deal with various Digital control system applications
5 Derive and describe pole placement by state variable technique and condition for controllability and observability of the system.

UNIT- I

Discrete systems and Signals: Standard discrete test signals, Basic operations on signals. Classification of discrete systems. Detail analysis of frequency aliasing & quantization, Brief review of Sampling theorem, Ideal low pass filter. Transfer function of ZOH, Frequency domain characteristics of ZOH, First order hold, frequency domain characteristics of first order hold.

UNIT-II

Stability Analysis: Brief review of pulse transfer function, mapping between S-plane and Z plane, constant frequency loci and constant damping ratio loci. Stability analysis of closed loop system in the ZPlane. Jury‟s stability test, Stability analysis by use of Bilinear transformation & Routh Stability Criterion. Digital compensator design using frequency response (Bode plot).

UNIT- III

State - Space analysis: Conversion of Pulse transfer functions to State space model and vice a versa. Solution of LTI Discrete –time state equation; State Transition Matrix (STM) and properties of STM; Computation of STM by Z-transform method, by power series expansion method, by Cayley Hamilton theorem, by Similarity transformation method, Discretization of continuous time state space equation

UNIT- IV

Design using state space : Controllability and observability of linear time invariant discrete data system, Tests for Controllability and observability; Principal of Duality; Effect of pole- zero cancellation; Relationship between controllability, observability and stability. Pole placement design using linear state-feedback. State estimation and full order observer design. Ackermanns formula.

UNIT-V

Digital control system applications: Hybrid system simulation, Computer program structure for simulation of discrete time control of continuous time plant. Digital temperature control, position control, Stepper motor control, Block diagram presentation and control algorithms.

Text Books:

1. K. Ogata, “Discrete Time Control System”, 2nd Edition, PHI Learning Pvt. Ltd. 2009
2. B. C. Kuo, “Digital Control Systems”, 2nd Edition, Oxford University Press
3. M. Gopal, “Digital Control Engineering”, New Age International Publishers
4. M. Gopal, “Digital Control and State Variable Methods”, 3rd Edition The McGraw Hill Co.

Reference books:

1. Load D. Landau, Gianluca Zito, „Digital Control Systems: design, Identification and Implementation‟ Springer.

Second Semester M.Tech. IDC

Course Code: 23PID223T **Course: Program Elective IV**
Industrial Automation

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:
To make the aspiring engineers acquainted with the conceptual as well as practical knowledge of the PLC programming & latest technologies being used to achieve PLC Industrial Automation.

Course Outcomes:
After the completion of this course, the students shall be able to:
1 Draw block diagram of industrial automation and control system
2 Explain architecture of industrial automation system
3 Draw block diagram of supervisory control and data acquisition (SCADA)
4 Integrate SCADA with PLC systems
5 Use Internet of Things for industrial automation

UNIT-I
Introduction: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & profibus

UNIT- II
Automation components: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT- III
Computer aided measurement and control systems: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation

UNIT- IV
Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT- V
Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Text Books:
1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI
3. Industrial control handbook, Parr, Newnem
4. Programmable logic controller, Dunning, Delmar

Second Semester M.Tech. IDC

Course Code: 23PID231A **Audit Course**: **Pedagogy Studies**

Teaching Scheme: L – T – P : 2-0-0

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

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 institute 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-III

Research Gaps and Future Directions Research design – Contexts – Pedagogy – Teacher education – Curriculum and assessment -Dissemination and research impact.

Text Books/ Research Paper / Reference :

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. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

Second Semester M.Tech. IDC

Course Code: 23PID232A **Audit Course**: **Pedagogy Studies**

Teaching Scheme: L – T – P : 2-0-0

Unit I

Meaning and Definition of Stress. Types: Eutress, Distress, Anticipatory Anxiety, Intense Anxiety and Depression. Meaning of Management – Stress Management.

Unit II

Physiology of Stress on: Autonomic Nervous System (ANS), Endocrine System, Hypothalamus, Cerebral Cortex and Neurohumours. Mechanism of Stress related diseases: Psychic, Psychosomatic, Somatic and Organic phase. Role of Meditation & Pranayama on stress – physiological aspect of Meditation. Constant stress & strain, anxiety, conflicts resulting in fatigue among Executive. Contribution of Yoga to solve the stress related problems of Executive.

Unit III

Meaning and definition of Health – various dimensions of health (Physical, Mental, Social and Spiritual) – Yoga and health – Yoga as therapy. Physical fitness. Stress control exercise – Sitting meditation, Walking meditation, Progressive muscular relaxation, Gentle stretches and Massage.

Reference:

1) Andrews, Linda Wasmer., (2005). Stress Control for peace of Mind. London: Greenwich Editions
2) Lalvani, Vimla., (1998). Yoga for stress. London:
3) Hamlyn Nagendra, H.R., and Nagarathana, R., (2004). Yoga perspective in stress management. Bangalore: Swami Vivekananda Yoga Prakashana.
4) Nagendra, H.R., and Nagarathana, R., (2004). Yoga practices for anxiety & depression. Bangalore:
5) Swami Sukhabodhanandha Yoga Prakashana. Sukhabodhanandha, Swami., (2002). Stress Management. Banglore: Prasanna trust. Udupa, K.N., (1996).
6) Stress management by Yoga. NewDelhi: Motilal Banaridass Publishers Private Limited.

Second Semester M.Tech. IDC

Course Code: 23PID233A **Audit Course: Personality Development through Life Enlightenment Skills**

Teaching Scheme: L – T – P : 2-0-0

Course Objectives:

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

Course Outcomes:

Students will be able to Study of

1. 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
2. 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. Shrimad Bhagwad Geeta:

- 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.

Text Books/ References:

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.

Third Semester M.Tech. IDC

Course Code: 23PID311T **Course: Program Elective-V: Controllers for Electrical Drives**

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1 To develop an understanding of the fundamental principles and characteristics of electrical drives, including their classification, applications, and torque-speed characteristics.

2 To study the construction, operation, and control methods for various types of electric motors, such as DC motors, induction motors, and synchronous motors.

3 To gain knowledge of power electronic converters and their applications in electrical drive systems, including rectifiers, DC-DC converters, inverters, and pulse width modulation (PWM) techniques

4 To explore different control strategies for electrical drives, including open-loop and closedloop control techniques, sensor-based and sensorless control methods, and field-oriented control (FOC).

5 To develop the ability to model and simulate electrical drive systems using mathematical modeling techniques and simulation tools like MATLAB/Simulink, PSIM, or other relevant software packages.

Course Outcomes:

On successful completion of this course, students will be able to:

1 Differentiate between various types of electrical drives and their applications, and understand the fundamental torque-speed characteristics.

2 Analyze the construction, operation, and torque-speed characteristics of DC motors and induction motors, and design appropriate converters and control methods for their speed control.

3 Understand the principles of power electronic converters, including rectifiers, DC-DC converters, inverters, and PWM techniques, and their applications in electrical drive systems.

4 Apply various control strategies for electrical drives, such as open-loop control, closedloop control, sensor-based and sensorless control techniques, and field-oriented control (FOC).

5 Develop mathematical models for DC, induction, and synchronous motors, and simulate their performance using appropriate software tools like MATLAB/Simulink or PSIM.

6 Analyze and design electrical drive systems for specific applications, considering factors like motor characteristics, power electronic converters, and control strategies.

Unit-I

Introduction to Electrical Drives: Definition and classification of electrical drives, Fundamental torque-speed characteristics, Applications of electrical drives

Unit-II

DC Motor Drives: Construction and principle of operation of DC motors, Torque-speed characteristics and speed control methods, Converters for DC motor drives (single-phase, three-phase), Closed-loop control of DC motor drives

Unit-III

Induction Motor Drives: Construction and principle of operation of induction motors Torque-speed characteristics and speed control methods, Voltage source inverters for induction motor drives , Scalar control and vector control techniques, Direct torque control (DTC)

Unit-IV

Power Electronic Converters for Drives : Rectifiers (controlled and uncontrolled) , DC-DC converters (buck, boost, buck-boost) , Inverters (voltage source and current source), Pulse Width Modulation (PWM) techniques.

Unit-V Control Strategies for Electrical Drives : Open-loop control (Volts/Hz control) , Closed-loop control (speed, torque, and position control) , Sensor-based and sensorless control techniques, Field-oriented control (FOC)

Text Books:

1. Gopal K. Dubey, "Fundamentals of Electrical Drives," CRC Press, 2nd Edition, 2009.
2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis, and Control," Prentice Hall, 2001.
3. Bimal K. Bose, "Modern Power Electronics and AC Drives," Prentice Hall, 2002.
4. Ned Mohan, Tore M. Undeland, and William P. Robbins, "Power Electronics: Converters, Applications, and Design," John Wiley & Sons, 3rd Edition, 2003.

Reference Books:

1. Mukherjee, D., and Chakrabarti, S., "Fundamentals of Renewable Energy Systems," New Age International Publishers, 2005.
2. Rashid, M.H., "Power Electronics Handbook," Academic Press, 2001.
3. Bose, B.K., "Power Electronics and Motor Drives: Advances and Trends," Academic Press, 2006.
4. Vas, P., "Vector Control of AC Drives," Oxford University Press, 1998.

Third Semester M.Tech. IDC

Course Code: 23PID312T **Course: Program Elective-V: Special Electric Machines & Drives**

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1 To introduce students to the principles, construction, and operation of various special electric machines, including stepper motors, switched reluctance machines, permanent magnet brushless DC machines, and linear electric machines.
2 To provide an understanding of the characteristics, performance analysis, and control strategies of these machines.
3 To familiarize students with the drive circuits and power converters used in conjunction with special electric machines.
4 To explore the applications of special electric machines in various industries, such as robotics, CNC machines, aerospace, automotive, transportation, and material handling.
5 To develop an appreciation for the advantages and limitations of special electric machines compared to conventional machines.

Course Outcomes:

Upon successful completion of this course, students will be able to:
1 Classify and differentiate various types of special electric machines based on their construction and operating principles.
2 Analyze the performance characteristics and torque production mechanisms of stepper motors, switched reluctance machines, and permanent magnet brushless DC machines.
3 Design and select appropriate drive circuits and control techniques for special electric machines based on application requirements.
4 Evaluate and choose suitable power converters and drive circuits for efficient operation of special electric machines
5 Identify and recommend appropriate special electric machines for specific applications in robotics, CNC machines, aerospace, automotive, transportation, and material handling industries.

Unit-I

Introduction to Special Electric Machines: Classification of special electric machines, Principles of operation and applications, - Comparison with conventional machines.

Unit-II

Stepper Motors: Construction and working principle, Types of stepper motors (variable reluctance, permanent magnet, hybrid) ,- Characteristics and performance analysis , Drive circuits and control techniques.

Unit-III

Switched Reluctance Machines: Construction and operating principle, Torque production and control strategies, Power converters and drive circuits, Applications and advantages.

Unit-IV

Permanent Magnet Brushless DC Machines: Construction and operating principle - Torque and speed characteristics, Control techniques (brushless DC, brushless AC), Applications and advantages.

Unit-V

Linear Electric Machines: Principles of linear electric machines, Linear induction motors, Linear synchronous motors, Applications in transportation and material handling.

Textbooks:

1. "Special Electrical Machines" by E.G. Janardanan, PHI Learning Pvt. Ltd.
2. "Special Electrical Machines" by K. Venkataratnam, Universities Press.
3. "Special Electrical Machines" by A.K. Sawhney, Dhanpat Rai & Co.

Reference Books:

1. "Linear Electric Machines and Drives" by Ion Boldea and Syed A. Nasar, CRC Press.
2. "Permanent Magnet Brushless DC Motor Drives and Controls" by T.J.E. Miller, Clarendon Press.
3. "Switched Reluctance Motor Drives" by R. Krishnan, CRC Press.
4. "Stepper Motors: Fundamentals, Applications and Design" by V.V. Rama Rao, Universities Press.
5. "Electrical Machines and Drives: Fundamentals and Advanced Modelling Techniques" by N.A. Al-Achmad and T.S. Radwan, CRC Press.
6. "Handbook of Electric Motors" by Hamid A. Toliyat and Gerald B. Kliman, CRC Press.
7. "Electrical Machine Analysis Using Finite Elements" by A. Arkkio, Springer.

Third Semester M.Tech. IDC

Course Code: 23PID312T **Course: Program Elective-V: Excitation of Synchronous Machines and their control**

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1 To provide an understanding of the construction, operating principles, and types of synchronous machines.
2 To introduce the concepts of excitation systems, automatic voltage regulators (AVRs), and voltage regulation methods for synchronous machines
3 To explore the role of excitation control in power system stability, including steady-state and transient stability concepts, and the application of power system stabilizers (PSS).
4 To study mathematical models, transfer functions, and frequency response analysis of excitation systems for synchronous machines.
5 To examine advanced excitation control techniques, such as digital control, adaptive and self-tuning control, fuzzy logic, and neural network-based control, with a focus on renewable energy integration

Course Outcomes:

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

1 Explain the construction, operating principles, and equivalent circuit representation of synchronous machines, including cylindrical and salient pole types.
2 Analyze and design excitation systems, including static, brushless, and rotating types, and understand their role in voltage regulation.
3 Evaluate power system stability using synchronizing power and torque equations, and propose excitation control strategies for improving stability, including the application of power system stabilizers (PSS).
4 Develop mathematical models and transfer function representations of excitation systems, and perform frequency response analysis and tuning of automatic voltage regulators (AVRs).
5 Investigate and apply advanced excitation control techniques, such as digital control, adaptive and self-tuning control, fuzzy logic, and neural network-based control, with a focus on renewable energy integration

Unit-I

Introduction to Synchronous Machines: Construction and operating principle of synchronous machines, Types of synchronous machines (cylindrical, salient pole) , Equivalent circuit representation and phasor diagrams , Steady-state performance characteristics.

Unit-II

Excitation Systems and Voltage Regulation: Principle of excitation and excitation systems , Types of excitation systems (static, brushless, rotating) , Automatic voltage regulators (AVRs) , Voltage regulation characteristics and methods.

Unit-III

Power System Stability and Excitation Control : Steady-state and transient stability concepts , Synchronizing power and torque equations , Excitation control for improving stability, Power system stabilizers (PSS).

Unit-IV

Excitation System Models and Analysis : Mathematical models of excitation systems ,- Transfer function representation and block diagrams , Frequency response analysis and tuning of AVRs , Excitation system limitations and constraints.

Unit-V

Advanced Excitation Control Techniques : Digital excitation control systems , Adaptive and self-tuning excitation control , Fuzzy logic and neural network-based control , Excitation control for renewable energy integration.

Textbooks:

1. "Excitation Control Systems for Synchronous Generators" by A.M. El-Serafi and J.S. Thorp, IEEE Press.
2. "Synchronous Machines" by P.M. Anderson and A.A. Fouad, CRC Press.
3. "Electric Machines and Power Systems" by M.A. El-Sharkawi, CRC Press.

Reference Books:

1. "Power System Stability and Control" by P. Kundur, McGraw-Hill Education.
2. "Synchronous Generators" by J.H. Walker and N. Jenkins, Pergamon Press.
3. "Synchronous Machines" by G.R. Slemon and A. Straughen, CRC Press.
4. "Electric Power System Dynamics" by D.J. Hill and I.M. Ginarakis, Springer.
5. "Power System Analysis and Design" by J.D. Glover, T.J. Overbye, and M.S. Sarma, Cengage Learning.
6. "Advanced Power System Analysis and Dynamics" by L.P. Singh, Wiley.

Third Semester M.Tech. IDC

Course Code: 23PID321P
Credits: 1

Course: Program Elective-V: Controllers for Electrical Drives
Teaching Scheme: L – T – P : 0-0-2

Based on the Theory Syllabus practical must be performed in the Drives Lab.
Maximum 8 Experiment in session.

Note : Practical experiments may be adjusted or modified based on the availability of laboratory equipment, software resources, and the specific focus areas of the course.

Third Semester M.Tech. IDC

Course Code: 23PID322P **Course: Program Elective-V: Special Electric Machines & Drives**

Credits: 1 **Teaching Scheme: L – T – P : 0-0-2**

Based on the Theory Syllabus practical must be performed in the Drives Lab.
Maximum 8 Experiment in session.

Note : Practical experiments may be adjusted or modified based on the availability of laboratory equipment, software resources, and the specific focus areas of the course.

Third Semester M.Tech. IDC

Course Code: 23PID312T **Course: Program Elective-V: Special Electric Machines & Drives**

Credits: 3 **Teaching Scheme: L – T – P : 3-0-0**

Course Objectives:

1 Understand the importance of industrial safety and the historical context of safety practices.
2 Develop skills in identifying hazards, assessing risks, and implementing appropriate control measures.
3 Gain knowledge of safety management systems, including elements, implementation, and continuous improvement.
4 Learn about fire safety and emergency response procedures, including prevention, detection, and evacuation drills.
5 Acquire knowledge of electrical safety principles, lockout/tagout procedures, and safety equipment.

Course Outcomes:

1 Students will be able to explain the significance of industrial safety and the role of regulatory bodies and legislation.
2 . Students will be able to identify various types of hazards and apply appropriate risk assessment methodologies.
3 Students will have the ability to develop and implement effective safety management systems within an organization.
4 Students will be proficient in fire safety practices, emergency planning, and conducting evacuation drills.
5 Students will demonstrate an understanding of electrical safety hazards, lockout/tagout procedures, and the use of safety equipment.

Unit-I

Introduction to Industrial Safety: Importance of safety in the workplace , Historical perspective and evolution of safety practices , Regulatory bodies and safety legislation

Unit-II

Hazard Identification and Risk Assessment: Types of hazards (physical, chemical, biological, ergonomic), Hazard identification techniques (inspections, audits, job safety analysis), Risk assessment methodologies (qualitative and quantitative), Hierarchy of controls (elimination, substitution, engineering controls, administrative controls, personal protective equipment)

Unit-III

Safety Management Systems: Elements of a safety management system (policy, planning, implementation, measurement, and improvement), Safety culture and employee involvement, Safety training and awareness programs, Incident investigation and root cause analysis

Unit-IV

Fire Safety and Emergency Response: Fire prevention and protection measures , Fire detection and suppression systems, Emergency planning and response procedures , Evacuation drills and fire safety training

Unit-V

Electrical Safety: Electrical hazards and safety practices, Lockout/Tagout procedures, Grounding and bonding techniques, Electrical safety equipment and personal protective equipment.

Textbooks:

1. "Occupational Safety and Health for Technologists, Engineers, and Managers" by David L. Goetsch.
2. "Safety and Health for Engineers" by Roger L. Brauer.
3. "Fundamentals of Industrial Safety and Health" by Mark A. Friend and James P. Kohn.

Reference Books:

1. "Safety Professional's Reference and Study Guide" by W. David Yates.
2. "Handbook of OSHA Construction Safety and Health" by Charles D. Reese and James V. Eidson.
3. "Electrical Safety Handbook" by John Cadick, Mary Capelli-Schellpfeffer, and Dennis Neitzel.
4. "Fire Protection Handbook" by the National Fire Protection Association (NFPA).
5. "Occupational Safety and Health Simplified for the Industrial Workplace" by Frank R. Spellman and Nancy E. Whiting.
6. "Safety Management: A Human Approach" by Daniel E. Della-Giustina.
7. "Machine Guarding Handbook" by Dennis J. Crisp and Robert B. Ouellette.