Syllabus

w.e.f. 2020

M.E.

in

Industrial Systems & Drives (ISD)

Electrical Engineering Department

Madhav Institute of Technology & Science

Gwalior-474005

Computational Techniques (580111)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	03	70	20	10

Course Objective:

- To know about the formulation of L.P.P. & its solution
- To explore the Game theory
- To describe Probability and random Process
- To describe random sampling and hypothetical test
- To perceive the Z-transform techniques

Unit I: Concept of LPP, LPP formulation, Graphical method for solving LPP with two variables, Simplex method, Duality theory, Transportation and Assignment problems. Non Linear Programming Problems (NLPP): Introduction of NLPP, constraints and non constraint problems of maxima and minima, constraints in the form of equations, Dynamic Programming: Basic concepts, Bellman's optimality principle, dynamic programming approach in decision making problems, optimal subdivision problems.

Unit II: Introduction, competitive games, finite and infinite games, two person zero sum game, pure and mixed strategies, saddle point, maximin and minimax principle, solution of a rectangular game in terms of mixed strategies, Graphical method of (2xm) and (nx2) games.

Unit III: Theory of Probability: Concept of probability, Random variable, discrete probability distribution, Continuous probability distribution, Moment generating function, Probability density function, some special distribution, Random Variable: Concept of Random variable, one dimensional Random variable, two dimensional, distribution function, Joint probability distribution function, Marginal probability distribution, cumulative probability distribution.

Unit IV: Testing of Hypothesis, Origin of the theory of sampling, chi-square (χ^2) distribution, the t-distribution, Fisher's Z-distribution, student-distribution, Analysis of variance one way classification, two-way classification.

Unit V: Z-transform and their properties, inverse Z-transform, convolution theorem, solution of difference equations by Z-transform. Basic concept of Bessel's function, Hankel transform and their properties, Parseval's theorem.

Course Outcomes:

After completing this course, the students will be able to:

CO1 Determine the solution of Linear and Non Linear Programming Problems

CO2 Evaluate the problems related to game theory.

CO3 Acquire the knowledge of Probability theory and Random Variable.

CO4 Analyze the test of hypothesis and Analysis of Variance.

CO5 Apply transform for solution og mathematical problems .

Reference & Text Books:

1. Griva, S. G. Nash and A. Sofer: Linear and Non Linear Optimization, Society for Industrial & Applied, U. S. Mathematics , 2012.
2. F. B. Hildebrand: Methods of Applied Mathematics , Prentaince Hall, 1992.
3. H. C. Saxena: Mathematical Statistics, S Chand, 1986.
4. H. K. Dass: Advance Engineering Mathematics, S. Chand, 2018.
5. P. R. Thie and G. E. Keough: An Introduction to Linear Programming & Game Theory, Wiley India Private limited, 2008.

Power Electronics Converters (580112) (Revised syllabus)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	03	70	20	10

Course Objectives

- To introduce students the basic theory of power semiconductor devices and passive components, their practical application in power electronics.
- To familiarize the operation principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications.
- To provide the basis for further study of power electronics circuits and systems.

Unit 1: Power semi-conductor Devices, Characteristics and rating of thyristor, Power Diodes, Power Transistors, TRIAC, MOSFETs ,GTOs, IGBT, MCT Firing circuit, protection scheme and Commutation techniques.

Unit II: Line-commutated rectifiers, single and three-phase rectifiers (controlled/uncontrolled), performance analysis, harmonics, Ripple reduction techniques, Introduction to multi-pulse converters, Dual Converter

Unit III:DC to DC Converters: Study of single and multi-quadrant Chopper, Switch-mode DC-DC Converters, pulse width modulation, Non isolated and isolated Topologies, continuous and discontinuous modes of operations, steady-state analysis, energy storage elements design, higher-order topologies.

Unit IV: Inverters: Inverters, single and three-phase inverter configurations, voltage and current source inverters and their operating modes, voltage control in inverters and harmonic reduction using PWM strategies, Introduction to Multi-level Inverters, Rotary Inverter and their applications.

Unit V: AC-AC voltage controllers, configurations, performance analysis, harmonics, Cyclo-converters, introduction to Matrix converters and their applications.

Recommended Books:

1. Power Electronics by P.C. Sen, McGrawHill, 1st Ed., 2001
2. Power Electronics by P.S. Bimbhra, Khanna Publishers, 5th ed., 2012
3. Power Electronics: Circuits, Devices & Applications by MH Rashid, Pearson, 5th ed., 2012
4. Power Electronics by Cyril W. Lander , McGraw-Hill; 2nd edition,1987
5. Power Electronics Principles and Applications by Josheph Vidyathil, TMH,2010

Course Outcomes:

After completing this course the student will be able to:

CO 1. **Explain** the fundamental concepts of power electronics devices and their characteristics.
CO 2. **Explain** the configuration of different Converter circuits.
CO 3. **Analyze** the performance parameters of various converter circuits.
CO 4. **Design** the converters under various loads.
CO 5. **Solve the** problems and limitations of power electronics devices, converters and suggest solution.

Intelligent Control Techniques (580113)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	03	70	20	10

Objective:
To introduce soft computing and intelligent control techniques and to apply these techniques to solve real-world modelling and control problems

Unit I:Fuzzy Logic Systems: Fuzzy sets, operations on fuzzy sets, fuzzy relations, operations on fuzzy relation, linguistic variables, fuzzy if-then rules, compositional rule of inference, fuzzy reasoning.

Unit II: Fuzzy Logic Control: Basic concept of fuzzy logic control, reasoning with an FLC, relationship to PI, PD and PID control, design of FLC: determination of linguistic values, construction of knowledge base, inference engine, tuning, fuzzification and defuzzification, Mamdani type models, Takagi-Sugeno-Kang (TSK) fuzzy models

Unit III: Artificial Neural Networks: Perceptrons, perceptron training rule, gradient descent rule, multilayer networks and backpropagation algorithm, convergence and local minima, regularization methods, radial basis function networks, alternative error functions, alternative error minimization procedures, recurrent networks, extreme learning machines, unsupervised networks.

Unit IV: Neural Networks for feedback Control: Identification of system models using neural networks, Model predictive control, feedback linearization and model reference control using neural networks, Neural Network Reinforcement Learning Controller, Adaptive Reinforcement Learning Using Fuzzy Logic Critic, Optimal Control Using NN

Unit V: Hybrid algorithms: Neuro fuzzy systems, ANFIS and extreme- ANFIS, derivative free optimization methods, genetic algorithm, particle swarm optimization, Solution of typical control problems derivative free optimization.

Recommended Books:
1. S. Haykin, “Neural Networks and Learning Machines” (3rd Edition), Prentice Hall, **2009**
2. Driankov, Hellendoorn, Reinfrank, “An Introduction to Fuzzy Control”, Narosa Publishing House. **1993**
3. Timothy J. Ross., “Fuzzy Logic with Engineering Applications”, 3rd edition, John Wiley and Sons 2011
4. Timothy J. Ross., “Fuzzy Logic with Engineering Applications”, 3rd edition, John Wiley and Sons 2011
5. SR Jang, CT Sun, E Mizutani “Neuro-fuzzy and soft computing: a computational approach to learning and machine intelligence”, Prentice-Hall of India **2004**

Course Outcomes:
After completing the course, the students will be able to-
CO1 **Define** the concepts of Fuzzy sets, relation and rule of inference
CO2 **Describe** the concept of fuzzy logic control, linguistic value , different fuzzy model, and its importance to handle uncertainty
CO3 **Compare** various neural networks training rule, neural model
CO4 **Analyze** various neural model with different **Control** techniques
CO5 **Solve** engineering problems using various neural networks, fuzzy logic, GA and PSO

Elective-IA: Power Quality and FACTS Controllers (580114)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	03	70	20	10

Course Objectives:

- To provide detailed knowledge of power quality, series and shunt compensation, various types of FACTS controllers, their Applications and placement and sizing.
- To introduce the concepts of Distributed Generation, its impact on Power quality, smart grid and microgrid.

Unit I: Power Quality: Overview and definition of power quality, Sources of pollution, concepts of linear and nonlinear loads. International power quality/EMC standards and regulations. Power quality problems: Sag and Swells, rapid voltage fluctuations, voltage unbalances, transient over-voltages, short and long duration interruptions etc.

Unit II: Power System Harmonics: Overview of sources of harmonic, Harmonic analysis, Effects of Harmonic on power system devices. Distributed Generation: Introduction and general impact of distributed generation on Power quality. Harmonic mitigation techniques.

Unit III: Compensation in power systems: Introduction, Fundamental concepts in Reactive Power, requirement for compensation: load compensation and line compensation, Reactive Power Compensation Principles**:** Shunt Compensation, Series Compensation, Traditional Var Generators: Fixed or mechanically switched capacitors and Synchronous Condensers, Thyristorized Var Compensators.

Unit IV: Flexible AC Transmission System: Introduction, Shunt FACTS Controllers: Static Var Compensator (SVC), Static Synchronous Compensator (STATCOM), Series FACTS Controllers : Thyristor Controlled Series Compensator (TCSC), Thyristor Controlled Phase Shifting Transformer (TCPS), Synchronous Series Compensator (SSSC), Unified Power Flow Controller (UPFC).

Unit V: Placement and Applications of FACTS Controllers : Placement of FACTS Controllers, Sizing of FACTS Controllers, Steady State Applications: Voltage Control, Increase Thermal Loading, Post Contingency Voltage Control, Loop Flows, Short-Circuit Level and Power Flow Control, Dynamic Applications: Transient Stability Improvement, Oscillation Damping and Voltage Stability Enhancement, Technical Benefits of FACTS Controllers.

Recommended Books:

1. Electrical Power System Quality: R. C. Dugan, McGraw Hill Publication
2. Power Electronics Handbook: Devices, Circuits and Applications, M.H. Rashid, Butterworth-Heinemann, 3rd Edition, 2011
3. Understanding FACTS: Concepts and Technologies of Flexible AC Transmission System- N.G. Hingorani, L. Gyugyi, IEEE Press, 2001
4. Thyristor-Based FACTS controllers for Electrical Transmission systems- R.M.Mathur, R.K. Verma, Wiley Interscience, 2002
5. Power Quality: C. Sankaran, CRC Press
6. Power System Operation and Control- N. V. Ramana, Pearson Education India

Course Outcomes:

After completing the course, the students will be able to-

CO1 Describe Power Quality issues, their origin, monitoring and mitigation methods, Distributed Generation.
CO2 Analyze the effects of various power quality phenomenon in various equipments and impact of DG on power quality.
CO3 Describe the significance of shunt, series compensation and role of FACTS devices on power system control.
CO4 Classify various types of VAR generators and FACTS controllers.
CO5 Describe Steady State & Dynamic Applications of FACTS Controllers, Smart grid and microgrid.
CO6 Solve Placement & Sizing problem of FACTS Controllers

Elective-IB: Smart Grid Technology (580115)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	03	70	20	10

Course Objectives:

- To familiarize the students with the smart grid technology aspects of planning, operation, controlling power generation and transmission systems.
- To provide the understanding for the need of information and Communication Technology in smart Grid.

Unit I: Introduction to Smart Grid Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.

Unit II: Smart Grid Technologies: 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, Phase Shifting Transformers.
Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System, Phase Measurement Unit.

Unit III: Microgrids and Distributed Energy Resources Concept of microgrid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. 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 Management in Smart Grid 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: Information and Communication Technology for Smart Grid 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.

Recommended Books:

1. J. Ekanayake, N. Jenkins, K. Liyanage, J. Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley.
2. S. Chowdhury, S. P. Chowdhury, P. Crossley, “Microgrids and Active Distribution Networks”, Institution of Engineering and Technology.
3. S. Borlase, “Smart Grids (Power Engineering)”, CRC Press.
4. Keyhani, M. N. Marwali, M. Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley
5. W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press
6. Carvallo, J. Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability: 1”, Artech House Publishers.
7. M. Kezunovic, M. G. Adamiak, A. P. Apostolov, J. G. Gilbert, “Substation Automation (Power Electronics and Power Systems)”, Springer

Course Outcomes:

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

CO1: Describe Concept of Smart Grid, Opportunities & Barriers
CO2: Explain the role of Smart Sensors, Automation techniques, WAMS and PMU.
CO3: Explain the concepts of DER like fuel cell, captive power plant, RES, protection & control techniques of micro-grid.
CO4: Solve the problem related power quality issues and its management.
CO5: Explain the communication technology and standards of Smart Grid

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OC-1A: Industrial Instrumentation (800100)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	03	70	20	10

Course Objectives
Review of different transducers, their characteristics, displacement, force, torque and speed measurement, measurement of different industrial processes, pressure measurement, flow measurement, temperature measurement.

Unit I: Pressure Measurement: Different type of manometers, diaphragm gauges, bellow and force balance type sensors, bourdern gauge, piezoelectric, capacitive and inductive pressure pickups. Vacuum pressure measurements: Mcleod gauge, pirani gauge, thermocouple gauge, knudsen gauge, ionization calibration procedures.

Unit II Flow Measurement: Differential pressure flow meters, pitat tube, orifice, vanturi flow nozzle, hot wire flow meter, constant pressure drop, variable area meters (rotameter), turbine meters. Electromagnetic flow meters, ultrasonic flowmeters, measurement of level, differiential pressure method, conductive and capacitive method, electrochemical method, use of radioscope for level measurement.

Unit III: Temperature Measurements: Different types of temperature transducers, RTDS, industrial type RTD sensor, laboratory grade platinum temperature thermometer, thermo resistance thermometer, thermisters temperature detectors, digital quartz crystal thermometer.

Unit IV: Displacement Measurement: Linear variable displacement transducer, capacitive transducer. Force measurement: Hydraulic force meter, pneumatic force meter, electric force transducers, strain gauge load cell, inductor load cells. Torque Measurement: In-line rotating torque sensor, in-line stationary torque sensor, proximity torque sensors. Speed Measurement: Variable reluctance speed transducer, d.c. techometer generator, a.c. techometer generator, revolution counter, resonance techometer, magnetic pick up sensors.

Unit V: Measurement of Density: Measurement of density in solids, liquids and gases, Magnetic vibrational methods, Vibrating tube densitometer, vibrating cylinder densitometer, tuning fork and coriolis densitometer, hydrostatic weighing densitometer and balance type densitometer, hydrometers, radiation and refractometric densitometer. Viscosity Measurement: Rotational viscometers, capillary viscometers, industrial viscosity meters.

Recommended Books:

1. Instrumentation Measurement and Analysis by B.C. Nakra & K.K. Chaudhary (VII Edition), Tata McGraw Hill Publishing Ltd., New Delhi.
2. Electrical Measurement and Measuring Instruments by A K sawhney (VII Edition), Dhanpat Rai & Co.
3. Industrial Instrumentation & Control, II edition by S.K. Singh, TMH, New Delhi
4. Industrial Control & Instrumentation by W. Bolton, Orient Longman Ltd. Hyderabad.
5. Principle of Industrial Instrumentation by D. Patranabis , TMH , New Delhi.
6. Measurement Systems & Applications by Doebelin (III Edition), McGraw Hill Book Co.

Course Outcomes:
After Completion of course student should be able to:

CO1 Names and classify different types of transducers
CO2 Describe constructional details & characteristics of different transducers
CO3 Illustrate principle of operation of different transducers
CO4 Figure out advantages and shortcomings of different transducers
CO5 Recognize appropriate applications of transducers
CO6 Explain and compute the various parameters of transducers

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OC-1B: Industrial Process Control (800101)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	03	70	20	10

UNIT I: Industrial Sensors: Sensors and transducers for different industrial variables like pressure, torque, speed, temperature**,** Humidity, Toxic Gas etc.; Important Characteristics of Sensors; Selection of Sensors for Practical Applications; Smarts Sensors: Component of smart sensor, General architecture of smart sensor, Industrial application of smart sensor.

UNIT II: Process Modeling for Industrial Process control: Process model, Physical model, Control Model, Process modeling. Modeling Procedure: Goals Definition, Information, Preparation, Model Formulation, Solution Finding, Results Analysis, and Model Validation.

UNIT III: Advanced Strategies for Industrial Process Control: Economics of Industrial Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control, Standard Interfaces

UNIT IV: Industrial Signal Conditioning Systems: Amplifiers, Filters, A/D converters for industrial measurements systems. I/P and P/I converters, pneumatic and electric actuators, valve positioned, control valves, actuators.

UNIT V: Case Study of Industrial Process Control: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal, Rolling, Control of Electric Power Generation Plant. Pressure & Flow control of industrial processes.

Recommended Books:

1. Computer Aided Process control by Singh S.K , PHI – 2007
2. Process Control Instrumentation Technology (III Edition 2005), by Curtis D. Johnson, PHI
3. Digital computer Process Control by C.L Smith , Ident Educational Publishers
4. Instrumentation and Process Measurements by W. Bolton, Orient Longman Limited

Course Outcomes:

After the completion of this course the student will be able to:

CO1 **Compare** the application of Sensors and transducers

CO2 **Describe** Process model, Physical model, Control model

CO3 **Analyze** the Economics aspect of Industrial Process control

CO4 **Explain** the proper signal conditioning System for Process Control

CO5 **Perform** Case Study of Industrial Process Control

Systems & Drives Lab I (580118)

P	Total Credits	End Sem	Lab work / Sessional
04	04	90	60

List of Experiments:-

1. To perform and analyse the effect of SCR firing angle control of SCR using different firing circuit.
2. To observe and analyse the effect of firing angle on output voltage and current of a single phase AC voltage controller with lamp load.
3. Perform, analyse and compare the performance of single phase half wave and full wave controlled rectifier controlled rectifier with inductive Load.
4. To observe the performance of Half- Controlled bridge (semi-converter) with reactive load and analyse effect of freewheeling diode
5. Analyse the performance of MOSFET based Chopper (Buck Conversion)
6. analyze the performance by variation in firing angle (output voltage and current) of a SCR based Bridge Inverter with inductive load.
7. To observe the performance of single phase step down Cyclo-converter
8. Perform speed control operation of a DC motor using single phase full wave fully converter, analyse effect of soft start and field failure.
9. Perform forward and reverse motoring operation of DC motor using dual converter and analyse the affect of circulating current and its elimination by intergroup reactor.
10. Analyse the Speed control of single phase Induction motor (A) With PWM inverter based control (B) AC regulator based control
11. To observe the performance of 3 phase rectifier with inductive load.
12. To observe the performance of three phase full wave uncontrolled rectifier with R and RL-Load.
13. To observe the performance of three phase full wave half controlled rectifier with R, RL-Load and freewheeling Diode
14. To performance braking and motoring operation four quadrant operation of a PMDC motor using Dual Converter

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Semiconductor Controlled Drive (580211)

(Revised in BOS held on 07/07/2019)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	03	70	20	10

Course Objective: This course is an extension of power electronics application to advanced Electrical drives. It covers the detailed the advanced control of AC and DC drives that are used in industry.

UNIT-I: Converter Fed DC Drives: Single-phase and Three-phase drives – Separately excited and series motor drives – Semi converter and full converter fed drives – General analysis –Evaluation of performance parameters – Dual converter fed drives.

Unit II: Chopper Fed DC Drives: Single – quadrant chopper controlled drives – Evaluation of Performance parameters for separately excited and series motor drives – Two quadrants and four quadrant chopper controlled drives.

Unit III: Induction Motor Drives: *Stator control:* Stator voltage control of 3-Phase induction motors: control by AC voltage controllers – Variable frequency square wave VSI drives – PWM Drives –CSI drives – closed loop control. ***Rotor Control:*** Static rotor resistance control – Slip power recovery: Static Kramer drive – Static Scherbius drive.

Unit IV: Vector Control, Sensor less and Direct Torque Control of Induction Motors: Principle of vector – Rotor flux – Oriented control, Stator Flux-oriented control, Magnetizing flux-oriented control of Induction Machines. Basic types of torque controlled drive scheme: vector drives –direct torque controlled drives, microcontroller fed drives.

Unit V: Synchronous motor Drives: Need for leading PF operation - open loop VSI fed drive - group drive applications. Self control - margin angle control - torque angle control - power factor control - V curves -simple design examples - Closed loop speed control scheme with various power controllers - starting methods - brush less excitation systems.

Recommended Books:

1. Gopal K Dubey, "Fundamentals Of Electric Drives", Narosa Publishing House, New Delhi, 2005.
2. Pillai S.K., "Analysis Of Thyristor Power Conditioned Motors", University Press, 1992.
3. Bimal K Bose, "Power Electronics And Variable Frequency Drives – Technology And Application", IEEE Press, New York, 1997.
4. Peter Vas, "Vector Control Of AC Machines", Oxford University Press, 1990.
5. Krishnan R, "Electric Motor Drives: Modeling, Analysis And Control, Prentice Hall Of India, Pvt. Ltd., New Delhi, 2002.

Course Outcomes:

After Completion of course student should be able to:

- CO1 Analyze the performance of Power Electronics converters like chopper, rectifiers etc, closed loop operation and different operating modes of DC drives.
- CO2 **Explain** the modeling and performance of different solid state AC and DC drives
- CO3 **Describe** the basic operation and constructional behavior of AC, DC and Traction drive.
- CO4 **Analyze** the concept of modeling and closed loop control to derive the transfer function of DC and AC drives.
- CO5 **Formulate** and solved engineering problems in drives.
- CO6 **Justify** the need and choice for variable drives.

Electrical Machine Modeling and Drives (580212)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	04	70	20	10

Course Objectives:

- To provide knowledge about the fundamentals of steady state and dynamic state operation of DC machine through mathematical modeling and simulation in digital computer.
- To expose the students to steady state and dynamic state operation of three-phase synchronous machines using transformation theory based mathematical modeling and digital computer simulation.

Unit-I Review of Electrical Drive: Dynamics of Electrical drive, Conventions and multi-quadrant operation, Transient and steady state stability of Electrical drive, Control of Electrical drive.

Unit-II Modeling of DC Machine: Theory of operation, Induced EMF, Equivalent circuit and Electromagnetic torque, electromechanical modeling, State-space model ling, Block diagram and Transfer functions. DC motor drives: DC motor and their performance, starting, braking, transient analysis, speed control, Ward-Leonard drives, controlled rectifier fed DC drives, control of fractional HP motors, Chopper controlled DC drives.

Unit-III Dynamic Modeling of Induction Machine: Real-Time model of a two-phase induction machine, Transformation to obtain constant matrices, Three-phase to two phase transformation, Generalized model in arbitrary reference frames, Derivation of commonly used induction motor models, Per unit model. Induction motor drives: Three-phase I.M. braking, transient operation, variable frequency control from voltage and current source.

Unit-IV Synchronous Machine : Transformation equations for rotating three phase windings, Voltage and power equation for salient and non salient alternator, their phasor diagrams, Simplified equations of a synchronous machine with two damper coils.

Unit-V Principle of operation of BLDCM ,Trapezoid ally excited BLDCM drive with current control, Permanent Magnet synchronous motor(PMSM) drive ,Stepper motor-Variable reluctance stepper motor ,Permanent Magnet stepper motor, Hybrid stepper motor, Introduction to vector control scheme and Switch Reluctance motor.

Recommended Books:

1. J.M.D. Murphy & F.G. Turnbull, “Power Electronic control of AC Motors”, Pergamon Press.
2. P. Lloyed & Conard, “Alternating Current Machines”, IEEE Press.
3. S.K.Pillai, “A First Course in Electrical Drives”, II Edition, New Age International (P) Ltd.
4. G.K.Dubey, “Fundamentals of Electrical Drives”, Narosa Publication (P) Ltd.
5. R.Krishnan, “Electric Motor Drives: Modeling, Analysis & Control”, Prentice-Hall.
6. B.K. Bose, “Modern Power Electronics & AC Drives”, Prentice- Hall.
7. V. Subrahmanyam, “Electrical Drives Concept & Application”, Tata McGraw Hill

Course Outcomes:

After completion of course student should able to:

CO1 Explain the constructional behavior and understand the operation of AC and DC drives
CO2 Analyze the model and derive the transfer function of different drives
CO3 Perform the modeling, control & different modes of operation of AC and DC drives.
CO4 Analyze the Power Electronics converters like Choppers, Rectifiers , Inverters fed AC & DC drives
CO5 Apply the concept of modeling to develop block diagram of AC and DC drives
CO6 Compare the choice for variable drives

Microcontroller and Its Applications to Power Converters (580213)

L	Total Credits	End Sem	Mid Sem	Quiz/Assignment
03	03	70	20	10

Course Objective: To provide knowledge of architecture, interfacing and programming of microcontroller and its applications on generation of firing signals for power electronic converters

Introduction : Review of 8-bit microprocessor and peripheral devices; Review of power electronic converters; Overview of microcomputer control of power electronic systems; Intel 8051/8052 Microcontroller: Introduction, architecture, functional diagram, pin description, CMOS and HMOS microcontrollers and their difference, oscillator, CPU Timing, Intel 8031 and 8751

Memory Organization: Accessing external program and data memory, internal data memory, special function registers, hardware interfacing, timing diagrams, I/O expansion, I/O Ports and Timer: Internal structure of ports P0, P1, P2 and P3, alternative functions of port P3; Timer and counter operation, TM0, TM1 and TM2, modes of operation; Applications

Programming: Addressing modes; Instruction set: Data transfer group, arithmetic group, logical group, control group and Boolean processing capability; Programming and erasing EPROM; Interrupts: Types of interrupts, interrupt priority and interrupt enable registers, processing of interrupt, single-step operation.

Microprocessor Controlled Converters and Choppers: Firing pulse generation of single-phase and three-phase converters, dual converter, PWM converter; Control techniques, Firing pulse generation of single-quadrant and multi-quadrant choppers; Control techniques

Microprocessor Controlled Inverters: Firing pulse generation of voltage source square wave and PWM inverters, three-timer and four-timer methods, foreground and back ground calculation; Firing pulse generation for PWM current source inverter

Recommended Books:

1. Dubey G. K., "Power Semiconductor Controlled Drives", Prentice Hall International Editions
2. Bose B. K., "Power Electronics and Variable Frequency Drives", IEEE Press, Standard Publisher Distributors
3. Intel Manual on 8-bit Microcontroller
4. Ayala K. J.," The 8051 Microcontroller- Architecture, Programming and Applications", 3rd 2008 Ed, Cengage Learning
5. Hall D.V., "Microprocessor and Interfacing –Programming and Hardware", 2nd 2008 Ed., Tata McGraw-Hill Publishing Company Limited
6. Mazidi M.A. and Mazidi J.G., "The 8051 Microcontroller and Embedded Systems", 2nd 2008 Ed., Pearson Education.

Course Outcomes:

At the completion of this course, the student will be able to:

CO1 Describe the architecture of a 8051/8052 microprocessor
CO2 Write assembly level programming for particular application
CO3 Configure the interrupt structures and to use interrupt sub routines to implement real-time control
CO4 Interface Microcontroller with memory and I/O subsystems
CO5 Solve the practical optimization problems of Power Electronics fed drives
CO6 Evaluate the problems related to control power Electronics converters

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Systems & Drives Lab II (580216)

P	Total Credits	End Sem	Lab work / Sessional
04	04	90	60

List of Experiments:

1. Perform and analyze Breakdown, flash point, fire point and tanδ test for transformer oil.
2. Perform turn ratio test of a power transformer, and analyze the effect of tap changing.
3. Perform and analyze the role of P, PI and PID controller for close loop speed control operation of DC motor.
4. Realize the impact position control and velocity feedback on stability for close loop speed control operation of DC motor.
5. Perform close loop speed control of DC motor using analog and digital interface approach.
6. Perform Experimental control of 3Φ induction machine using ladder logic programming in PLC (Allen Bradley Micrologix 1000).
7. Perform virtual experimentation for automatic bottle filling and mixing raw material in a tank by ladder logic programming in PLC.
8. Design a Single phase full bridge rectifier with RLE load ,analyse output voltage current and harmonics by varying firing angle and plot the waveform of output voltage and current using Simulink model.
9. Design a Single phase full bridge rectifier using with and without C –Filter with RLE load and analyze its performance parameters by Simulink.
10. Develop a simulation model of a single phase semi controlled converter feeding RL load and show the waveforms of output voltage, output current, input current and voltage across any one thyristor and diode for a firing angle of 30°
11. Draw the simulink model of a Single phase full bridge Inverter with inductive load with Bipolar switching scheme and analyse the impact of variation in firing angle.
12. Develop a simulation model for the Simulation of a three phase bridge VSI using 150° conduction mode and compare it with 120° and 180° mode of conduction.
13. Write a program in MATLAB to generate Bus Admittance Matrix (Ybus) of a given electrical network
14. Develop a MATLAB based code to determine the Bus Impedance Matrix (Zbus) of a given electrical network
15. To observe Total Harmonic distortion (THD) in 6-pulse, 12-pulse and multi-pulse converter using MATLAB/Simulink.
