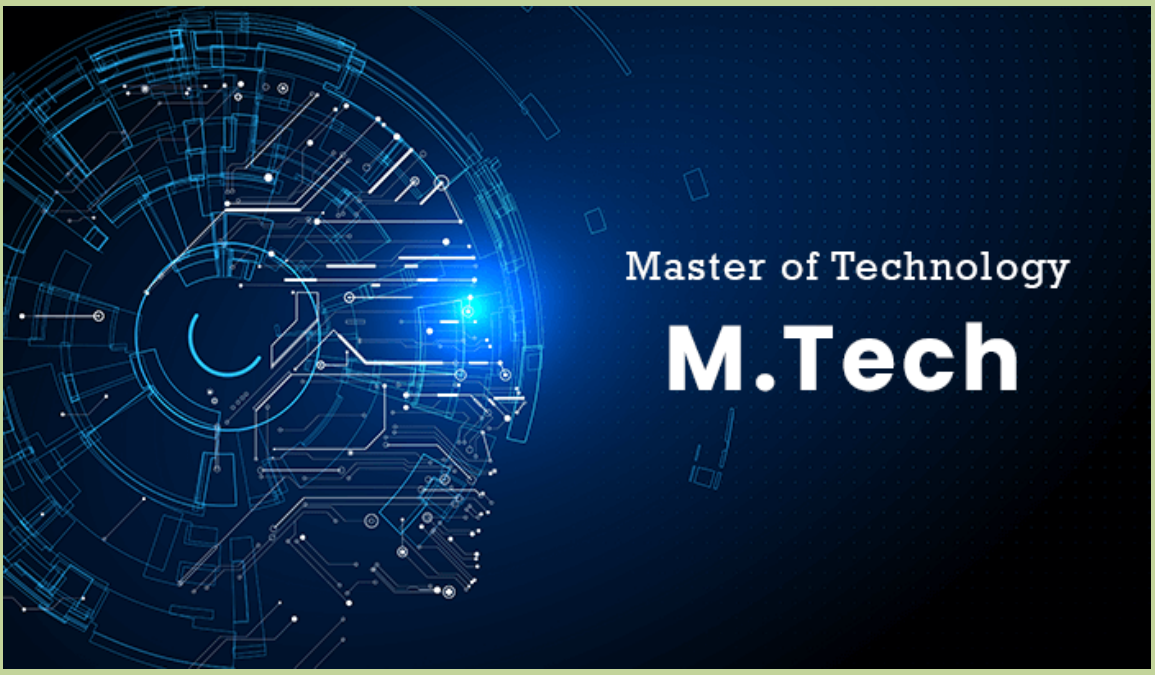
SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION
(DEEMED UNIVERSITY), **Accredited A+ Grade by NAAC**
SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY
Maraluru, Kunigal road, TUMAKURU-572105
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
Accredited by NBA, New Delhi for 3 years (2023-2026)

Scheme and Syllabus for

M.Tech - Computer Applications in Industrial Drives



Department of Electrical and Electronics Engineering

SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY TUMAKURU 572105

CHOICE BASED CREDIT SYSTEM (CBCS)

SCHEME OF TEACHING AND EXAMINATION FOR
M.Tech DEGREE COURSE

I SEMESTER M.Tech.(CAID)

I Semester M.Tech. (C A I D)						Examination				
SI No	Course Code		Course Title	Teaching dept.	Board of Exam.	Credits	CIE	SEE	Total Marks	Exam Hours
01	PC	24CAI11	Applied Mathematics	MA	MA	4	50	50	100	3
02	PC	24CAI12	Electric Vehicle Technology	EE	EE	4	50	50	100	3
03	PC	24CAI13	Special Electrical Machines	EE	EE	4	50	50	100	3
04	PC	24CAI14	DSP Applications to Drives	EE	EE	3	50	50	100	3
05	PC	24CAI15x	1. Dynamics of Control Systems 2. Electro-magnetic Compatibility 3. Embedded Systems	EE	EE	3	50	50	100	3
06	PC	24CAI16x	1. Multilevel Inverters. 2. Fuzzy Logic Control and its Applications 3. Artificial Neural Network	EE	EE	3	50	50	100	3
07	PC	24CAITS1	Technical Seminar -I	EE	EE	1.5	50	-	50	-
08	PC	24CAILB1	Electrical Drives Laboratory-1	EE	EE	1.5	50	--	50	-
Total						24	400	300	700	-
CIE - Continuous Internal Evaluation, SEE-Semester End Examination										

CHOICE BASED CREDIT SYSTEM (CBCS)

SCHEME OF TEACHING AND EXAMINATION FOR
M.Tech DEGREE COURSE

II SEMESTER M.Tech.(CAID)

II Semester M.Tech.(CAID)							Examination			
Sl No	Course Code		Course Title	Teaching dept.	Board of Exam.	Credits	CIE	SEE	Total Marks	Exam Hours
01	PC	24CAI21	AC and DC Drives	EE	EE	4	50	50	100	3
02	PC	24 CAI 22	Advanced Electrical Drives	EE	EE	4	50	50	100	3
03	PC	24 CAI 23	Industrial Automation & Control	EE	EE	4	50	50	100	3
04	PC	24 CAI 24	Hybrid Electric Vehicles	EE	EE	3	50	50	100	3
05	PC	24 CAI 25x	1.Cyber Security in the Electricity Sector 2. FACTS Controllers 3. Power System Harmonics	EE	EE	3	50	50	100	3
06	PC	24 CAI 26x	1. Electrical Power Quality 2. Intelligent Applications to Electric Drives 3. FPGA and Programmable Logic	EE	EE	3	50	50	100	3
07	PC	24 CAI TS2	Technical Seminar -II	EE	EE	1.5	50	-	50	-
08	PC	24 CAI LB2	Electrical Drives Laboratory-II	EE	EE	1.5	50	--	50	-
Total						24	400	300	700	-
CIE - Continuous Internal Evaluation, SEE-Semester End Examination										

CHOICE BASED CREDIT SYSTEM (CBCS)

SCHEME OF TEACHING AND EXAMINATION FOR
M.Tech DEGREE COURSE

III SEMESTER M.Tech.(CAID)

III Semester M.Tech.(CAID)							Examination			
SI No.	Course Code		Course Title	Teaching dept.	Board of Exam.	Credits	CIE	SEE	Total Marks	Exam Hours
01	PC	24CAIIS1	Internship	EE	EE	12	100		100	
02	PC	24CAIPW1	Project Work Phase-I	EE	EE	08	50		50	
Total						20	150		150	

Note:

- **Internship: Report evaluation on Internship (50 Marks) Viva – Voce and Evaluation of Internship(50 Marks)**
- **Project Work Phase-I: Literature Survey/Visit Industry to finalize the project and presentation ofthe same (50 Marks)**

CHOICE BASED CREDIT SYSTEM (CBCS)

SCHEME OF TEACHING AND EXAMINATION FOR
M.Tech DEGREE COURSE

IV SEMESTER M.Tech.(CAID)

IV Semester M.Tech.(CAID)							Examination			
SI No.	Course Code		Course Title	Teaching dept.	Board of Exam.	Credits	CIE	SEE	Total Marks	Exam Hours
01	PC	24CAIPW2	Project Work Phase-II	EE	EE	20	100	200	300	3
Total						20				

Note:

Project Work Phase-II:

1. **Presentation of the project work carried out for the first six weeks (50 Marks)**
2. **Project work Seminar – II:**
   Presentation of the project work carried out for the next eight weeks (50 Marks)
3. Project work evaluation taken up at the end of the IV semester.
4. **Report Evaluation:**
   Average of the marks evaluated by internal and external examiners (125 Marks)
5. Viva- Voce: Conducted and evaluated jointly by internal and external examiners (75 Marks)

Total Credits: 24+24+20+20=88

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: APPLIED MATHEMATICS
Course Code: 24CAI11 **L-P-C: 4-0-4**

Course Objectives:

1. Acquaint with principles of linear algebra, probability theory and Numerical methods.
2. Apply the knowledge of linear algebra, probability theory and random process in the applications of electronics and communication engineering sciences.
3. To understand the concepts of the stochastic process of a statistic and estimation of parameters arising in engineering field.
4. To study the queuing models and sampling distributions.

UNIT	Description	Hours
I	**Linear Algebra-I** Introduction to vector spaces and sub-spaces, definitions, illustrative examples and simple problems. Linearly independent and dependent vectors-definition and problems. Basis of vector space. Linear transformations- definition, properties and problems. Matrix form of linear transformations-Illustrative examples.	**10**
II	**Linear Algebra-II** **System of Linear Algebraic Equations and Eigen Value Problems:** Gauss – Seidal Iterative method. Eigen value problems- Finding all the Eigen values and Eigen vectors, Gerschgorial circle, Computation of Eigen values and Eigen vectors of real symmetric matrices by QR decomposition, singular value decomposition.	**10**
III	**Numerical Methods:** Solution of algebraic and transcendental equations- Newton-Raphson method for simple roots and multiple roots. Rate of convergence of Newton- Raphson method. System of non-linear equations by Newton- Raphson method. Polynomial equations by Birge – Vieta method and Bairstow method.	**10**
IV	**Solution of Simultaneous Linear Algebraic Equations:** Introduction, Engineering Applications, Basic Ill-Conditioned Equations. Graphical Interpretation of the Solution, Solution Using Cramer's Rule, LU Decomposition Method, Relaxation Methods.	**11**
V	**Probability Theory:** Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions-illustrations. Binomial, Poisson, Exponential, Gaussian and Rayleigh distributions.	**11**

Course Outcomes:

1. Acquaint with principles of linear algebra, probability theory and Numerical methods.
2. Adequate exposure to learn alternative methods and analyze mathematical problems to determine the suitable numerical techniques.
3. Use the concepts of interpolation, eigen value problem techniques for mathematical problems arising in various fields.
4. To study the concept of probability distributions with probability generating functions

Reference Books:

Sl.No	Title	Author	Publishers
01	Numerical Solution of Differential Equations	M K Jain	2nd Edition, New Age International, 2008
02	Linear Algebra and its Applications	David C.Lay, Steven R. Lay and J.J.Mc Donald	5th Edition, Pearson Education Ltd., 2015

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: Electric Vehicle Technology
Course Code: 24CAI12 **L-P-C: 4-0-4**

Course Objectives:

1. To explain the basic of Electric vehicles and its major parts.
2. To define the functionality and working principles of different types of Automotive Power trains .
3. To illustrate the working of various automotive transmission systems.
4. To explain vehicle fundamentals of various subsystem and illustrate the working of motors and conversions.

UNIT	Description	Hours
I	**Electric Vehicles**: History, Basics of Electric Vehicles ,Components of Electric Vehicle, General Layout of EV, EV classification : Battery Electric Vehicles (BEVs), Fuel-Cell Electric Vehicles (FCEVs) Comparison with Internal Combustion Engine: Technology, Advantages & Disadvantages of EV, National Policy for adoption of EVs, Overview of Tesla car.	**10**
II	**Vehicle Mechanics**: Vehicle Development, General Configuration of Automobile, Body and Chassis Fundamentals: General Packaging, Types of Structural System, Backbone Construction; Body and Chassis Materials. Automotive Powertrain Mechanical, Suspensions system, Steering System, NVH, Control System Integration and Implementation. Front-Wheel Drive (FWD) Powertrains, Rear-Wheel Drive Powertrains (RWD), Multi-Wheel Drive Powertrains (AWD and 4WD).	**10**
III	**Transmission Systems**: Transmission gears, Manual Transmission (MT), Automatic Transmission (AT), Automated Manual Transmissions (AMT) and Continuously Variable Transmissions (CVT); Manual Transmissions Powertrain Layout and Manual Transmission Structure, Power Flows and Gear Ratios, Manual Transmission Clutch and its structure. Drivetrain and Differential.	**10**
IV	**Vehicle fundamentals**: Vehicle resistance, Types: Rolling Resistance, grading resistance, Aerodynamic drag vehicle performance, Calculating The Acceleration Force, maximum speed, Finding The Total Tractive Effort, Torque Required On The Drive Wheel, Transmission: Differential, clutch &gear box, Braking performance.	**10**
V	**Conversions and motors**: Introduction of DC-DC, AC-AC, AC-DC, DC-AC, four-quadrant operation, Driver circuits. Principle and working of DC motor, Characteristics and Types of DC Motors Overview (Speed torque characteristics) of Permanent Magnet motor, BLDC Motor, Induction motor. Comparison of all motors.	**10**

Course Outcomes:

After completion of course, student will be able to:

1. Explain the basic of Electric vehicles and its major parts.
2. Define the functionality and working principles of different types of Automotive Powertrains .
3. Illustrate the working of various automotive transmission systems .
4. Explain vehicle fundamentals of various subsystem. and illustrate the working of motors and conversions.

Reference Books:

Sl.No	Title	Author	Publishers
01	Electric Vehicle Technology	James Larminie and John Lowry, John Wiley	2003
02	Electric & . Hybrid Vehicles, Design Fundamentals	Iqbal Husain	CRC Press, 2005

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: SPECIAL ELECTRICAL MACHINES
Course Code: 24CAI13 **L-P-C: 4-0-4**

Course Objectives:

1. To explain the types of Stepper Motor, construction and operation of BLDC motor
2. To analyze design aspect of switched Reluctance Motor.
3. To apply the properties of Permanent magnetic materials.
4. To design drive and power circuit for special machines

Unit	Description	Hours
I	**Stepper Motor:** Introduction, types, hybrid stepper motor; construction, principle of operation, two phases energized at a time, conditions for operation, different configurations, VR stepper motor; single stack and multi stack, drive systems and circuit for open loop and closed loop control of stepping motor, dynamic characteristics, single phase stepper motor, expression of voltage,current and torque for stepper motor and criteria for synchronization.	**10**
II	**Switched Reluctance Motor:** Constructional features, principle of operation, Design aspects and profile of the SRM, torque equation, power converters and rotor sensing mechanism, expression of torque and torque – speedcharacteristics.	**10**
III	**Permanent Magnet Materials:** Permanent magnetic materials, properties, Minor hysteresis loop and recoil line, equivalent circuit, stator frames with permanent magnets.	**10**
IV	**Brushless DC Motors:** Construction, operation, sensing and switching logicscheme, drive and power circuit, theoretical analysis and performance prediction, transient analysis.	**10**
V	**Linear Induction Motor:** Construction and principle of operation,calculation of the force on rotor.	**10**

Course Outcomes:

After completion of course, student will be able to:

1. Explain the types of Stepper Motor, construction and operation of BLDC motor
2. Analyze design aspect of switched Reluctance Motor.
3. Apply the properties of Permanent magnetic materials.
4. Design drive and power circuit for special machines.

Reference Books:

Sl.No	Title	Author	Publishers
01	Special Electrical Machines	K Venkataratham	University Press (India), 2009.
02	Brushless Permanent Magnet and Reluctance Motor Drives	T J E Miller	Clerendon Press, Oxford,1989.
03	--	--	IEEE related publications.

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: DSP APPLICATIONS TO DRIVES
Course Code: 24CAI14 **L-P-C: 3-0-3**

Course Objectives:

1. To explain the concept of LTI systems, DFT and its properties.
2. To apply the knowledge of DFT in designing FIR and IIR filters.
3. To analyze the SVPWM technique for AC drives.
4. To demonstrate the concept of DSP controller for DC drives

UNIT	Description	Hours
I	**Introduction:** Linear Time-invariant system as frequency selective filter, Properties of discrete Fourier transform, Linear filtering methods based on DFT.	**08**
II	**Design of FIR Filters:** Design of linear phase FIR filters using windows, Design of optimum equi-ripple Linear phase FIR filters, Design of FIR differentiators, Hilbert Transforms.	**08**
III	**Design of IIR Filters:** Design of IIR filters by approximation of derivatives, Impulse invariance bilinear transformation, Design of IIR filters by frequency transformations in analog and digital domain.	**08**
IV	**TMS320LF2407 DSP controller**: Introduction, peripherals, C2xx DSP CPU architecture and instruction set (brief), addressing modes, overview of system configuration registers. **Space Vector Pulse Width Modulation**: Introduction, Principle of Constant V/Hz Control for Induction Motors, Space Vector PWM Technique, DSP Implementation.	**08**
V	**DSP-Based Implementation of DC-DC Buck-Boost Converters:** Introduction,Converter Structure, Continuous Conduction Mode, Discontinuous Conduction Mode, Connecting the DSP to the Buck-Boost Converter, Controlling the Buck-Boost Converter.	**08**

Course Outcomes:

After completion of course, student will be able to:

1. Explain the concept of LTI systems, DFT and its properties.
2. Apply the knowledge of DFT in designing FIR and IIR filters.
3. Analyze the SVPWM technique for AC drives.
4. Demonstrate the concept of DSP controller for DC drives.

Reference Books:

Sl.No	Title	Author	Publishers
01	Digital Signal Processing: Principles, algorithms and Applications	J.G. Proakis & D G Monolikis	Pearson Education, 4th Edition, 2009.
02	Power Electronics: Circuits, Devices and Applications	M. H. Rashid	Third Edition,PHI,2005
03	Discrete Time Signal Processing	A V Oppenheim & R W Schafer	Pearson Education,2002.
04	DSP-Based Electro mechanical Motion Control	Hamid A. Toliyat	CRC Press, 2004
05	--	--	IEEE related publications.

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: DYNAMICS OF CONTROL SYSTEMS
Course Code: 24CAI151 **L-P-C: 3-0-3**

Course Objectives:

1. To explain and solve state space equations for continuous systems.
2. To apply knowledge of control systems through pole placement for continuous system
3. To analyze steady state equations for discrete system.
4. To design control systems through pole placement for discrete systems.

UNIT	Description	Hours
I	**State variable description of linear systems:** State space representation of electrical, mechanical and electro mechanical systems. Derivation of transfer functions from state model. State transition matrix, computation of state transition matrix by series expansion method, Laplace transform approach and Cayley Hamilton theorem.	08
II	**Controllability and Observability :** State space representation using canonical forms and phase variables. Transformation to phase variable canonical form, similarity transformations. State variable equations of composite systems, effect of pole zero cancellation, Controllability and observability.	08
III	**Design of control system by state space methods:** Control system design viapole placement techniques, Design of state observer - full order and minimum order observer, effects of addition of the observer on a closed loop system,transfer function of observer based control system.	08
IV	**Linear, discrete, dynamic systems analysis:** The z–transform, properties of the z- transform, inverse z-transform, solutionof difference equations by z-transform, Impulse sampling and data hold circuits, transfer function of ZOH.	08
V	**State space analysis of discrete time systems :** State space representation of discrete –time systems, controllable canonical form, observable canonical form and diagonal form. Solution of discrete time state space equations, pulse transfer function matrix, Discretization of continuous time state space equations. Transformations.	08

Course Outcomes:

After completion of course, student will be able to:

1. Explain and solve state space equations for continuous systems.
2. Apply knowledge of control systems through pole placement for continuous system
3. Analyze steady state equations for discrete system.
4. Design control systems through pole placement for discrete systems.

Reference Books:

Sl.No	Title	Author	Publishers
01	Modern Control Engineering	Katsuhiko Ogata	PHI, 4th edition, 2002.
02	Control System Engineering'	I.J.Nagrath, M.Gopal	New Age International Publishers, 3rdEdition,1999
03	Discrete Time Control Systems'	Katsuhiko Ogata	Pearson education, 2nd edition, 1995
04	--	--	IEEE related publications.

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: ELECTRO-MAGNETIC COMPATIBILITY
Course Code: 24CAI152 **L-P-C: 3-0-3**

Course Objectives:

1. To explain different electromagnetic disturbances, classification and applications.
2. To analyze suppression of noise in electronic systems.
3. To apply the concept of EMI filters for conduction of test as per IEC specifications and reducing internal EMI.
4. To design and analysis of EMI filters

UNIT	Description	Hours
I	**Introduction**: Designing of electromagnetic compatibility, EMC regulation, typical noise path, and use of network theory, method of noise coupling, miscellaneous noise sources, and method of eliminating interference.	08
II	**Cabling**: Capacitive coupling, effect of shield on magnetic coupling, mutual inductancecalculations, magnetic coupling between shield and inner conductor, shielding to prevent magnetic radiation, shielding a receptor against magnetic fields, shield transfer impedance, example of selective shielding, co-axial cable versus shielded twisted pair braided shields	08
III	**Grounding**: Safety grounds, signal grounds, single point ground systems, hybrid grounds, multi-point ground systems, functional ground layout, practical low frequency grounding, hardware grounds, single ground reference for a circuit amplifier shields, grounding of cable shields, ground loops, low frequency analysis of common mode choke, high frequency analysis of common mode choke, differential amplifiers, shields grounding at high frequencies.	08
IV	**Balancing, Filtering & Shielding**: Balancing, power supply decoupling, decoupling filters, amplifier decoupling driving capacitive loads, system bandwidth, and modulation coding. Near field and far fields, characteristic and wave impedances shielding effectiveness, absorption loss, reflection loss, composite adsorption and reflection loss, summary of shielding equation, shielding with magnetic material.	08
V	**EMC applications** : Supply decoupling, Transient power supply currents, Decouplingcapacitors, Effective decoupling strategies- Multiple decoupling capacitors, multiple capacitors of the same value, two different values and many different values, Powersupply isolation.	08

Course Outcomes:

After completion of course, student will be able to:

1. Explain different electromagnetic disturbances, classification and applications.
2. Analyze the suppression of noise in electronic systems.
3. Apply the concept of EMI filters for conduction of test as per IEC specifications andreducing internal EMI.
4. Design and analysis of EMI filters.

Reference Books:

Sl.No	Title	Author	Publishers
01	Introduction To Electromagnetic Compatibility (With Cd)	Clayton r. Paul	Wiley India Pvt. Ltd.
02	Noise reduction techniques in electronic systems	Henry W. Ott, JohnWiley	2nd edition, 1988
03	--	--	IEEE related publications

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: EMBEDDED SYSTEMS
Course Code: 24CAI153 **L-P-C: 3-0-3**

Course Objectives:

1. To explain the concept of embedded system design, architectures of 6808 and 6811Embedded Memories and applications of embedded systems.
2. To analyze the concept of Issues in embedded system design, design challenge, design technology.
3. To apply Software aspects of Embedded Systems.
4. To design subsystem interfacing with external systems.

UNIT	Description	Hours
I	**Introduction to Embedded System:** An embedded system, processor, hardware unit, software embedded into a system, Example of an embedded system, OS services, 1/O,N/W, O/S. Real time and embedded OS.	08
II	**Processor and Memory Organization:** Structural unit in a processor, processor selection for an embedded systems. Memory devices, memory selection for an embedded system, allocation of memory to program statements and blocks and memory map of a system. Direct memory accesses.	09
III	**Microchip PIC Microcontroller**: Introduction to 16fxx controller, CPU Architecture, Addressing modes, Instruction set, Assembly level programming.	08
IV	Timers, I/O port expansion, Interrupts, ITC Bus operation, Serial EEPROM, ADC,UART, DAC using PWM	08
V	Serial Programming/Parallel slave port, I2C Bus for Peripheral Chip Access	07

Course Outcomes:

After completion of course, student will be able to:

1. Explain the concept of embedded system design, architectures of 6808 and 6811 Embedded Memories and applications of embedded systems.
2. Analyze the concept of Issues in embedded system design, design challenge, designtechnology.
3. Apply Software aspects of Embedded Systems .
4. Design subsystem interfacing with external systems .

Reference Books:

Sl.No	Title	Author	Publishers
01	Embedded System Architecture-Programming & Design	Rajkamal	TMH 2004
02	Design with PIC Microcontrollers	J.B.Peatman	---
03	Embedded Microcomputer System	J.W.Valvano	---
04	Real Time Systems	Jane W.S. Liu	IEEE related publications.

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: MULTI-LEVEL INVERTERS
Course Code: 24CAI161 **L-P-C: 3-0-3**

Course Objectives:

1. To explain the concept of multilevel inverters.
2. To apply PWM techniques for different Multilevel Inverter topologies.
3. To analyze multilevel inverter based drives for induction motors andsynchronous motors
4. To design and analyze high power converters.

UNIT	Description	Hours
I	Introduction, Conventional two-level inverters for single and three phase applications. Gate drive circuits for devices. Ratings and device stress. Harmonics.	08
II	Concept of multilevel inverters. Its effect on switch stress and harmonics and EMC. Topologies and waveforms. Effect of multilevel inverters on AC motors.SPWM and SVPWM techniques.	08
III	Neutral point clamped (NPC) inverters: 3-level, and 5-level, features, advantages and disadvantages. Cascaded H-bridge inverter. Higher levels attained using asymmetrical DC sources, and employing capacitors instead of DC sources. Requirements of number of devices, cost and reliability aspects for Different configurations.	08
IV	Generalized multilevel inverter topology with self-voltage balancing. Multilevel inverters with Flying capacitor topology. Cascading two level inverters. Higher level inverter by using an open end induction machine with multilevel inverters on each side.	08
V	Issues of capacitor balancing and common mode voltage elimination. 12 and 18sided Polygonal voltage space vector generation, hybrid inverters and recent trends in multilevel inverters.	08

Course Outcomes:

After completion of course, student will be able to:

1. Explain the concept of multilevel inverters.
2. Apply PWM techniques for different Multilevel Inverter topologies.
3. Analyze multilevel inverter based drives for induction motors and synchronous motors.
4. Design and analyze high power converters.

Reference Books:

Sl. No	Title	Author	Publishers
01	High Power Converters and AC drives	Bin Wu, John Wiley and Sons	IEEE press, Inc. 2006
02	Operation and Design of Multilevel Inverters	Keith Corzine	Developed for the office of Naval Research, Dec 2003, Revised June 2005
03	IEEE related publications.	---	----

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: FUZZY LOGIC CONTROL AND ITS APPLICATIONS
Course Code: 24CAI162 **L-P-C: 3-0-3**

Course Objectives:

1. To explain the basics of Fuzzy rule.
2. To apply the concept of membership functions.
3. To analyze the Fuzzy rule based system.
4. To design a the control system using Fuzzy rule for different application.

UNIT	Description	Hours
I	**Introduction:** Background, Uncertainty and imprecision, statistics and random processes, Uncertainty in information, Fuzzy sets and membership, chance versus ambiguity. **Classical Sets:** Operations on classical sets, properties of classical sets, Mappingof classical sets to functions, Fuzzy sets, Fuzzy set operations, Properties of Fuzzy sets.	08
II	**Classical relations and fuzzy relations**: Cartesian product, **Classical Relations:** Cardinality of Crisp Relation, Operations on Crisp Relation,Properties of Crisp Relations, Composition. **Fuzzy relations**-cardinality of fuzzy relations, operations on fuzzy relations, propertiesof fuzzy relations, Fuzzy Cartesian product and composition. **Tolerance and equivalence relations**-crisp equivalence relation, crisp tolerancerelation, fuzzy tolerance, value assignments-Cosine amplitude, Max-min Method.	08
III	**Membership functions:** Introduction, Features of Membership Function, Classification of Fuzzy Sets Fuzzification, Membership Value Assignments- Intuition, Inference, Rank Ordering, and Angular Fuzzy Sets. **De-fuzzification:** Introduction, Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods.	08
IV	**Fuzzy rule based system:** Introduction, Formation of Rules, Decomposition of Rules, Aggregation of Fuzzy Rules, Properties of Set of Rules, Fuzzy InferenceSystem. **Fuzzy arithmetic:** Functions of fuzzy sets-extension principle, fuzzy transform(Mapping), practical considerations, and fuzzy numbers, interval analysis in arithmetic, Approximate methods of extension-vertex method, DSW algorithm, Restricted DSW algorithm, Comparisons, Fuzzy vectors.	08
V	**Fuzzy Control Systems:** Review of control systems theory, simple fuzzy logic controllers, general fuzzy logic controllers, special form of fuzzy logic control system models, **Applications of Fuzzy Logic: Fuzzy Logic in Control**- Fuzzy Logic Controller, Automatic Generation Control Using Fuzzy Logic Controllers **Fuzzy Logic Applications in Power Systems**-Introduction to Power System Control **Fuzzy Logic in Power Plants**-Fuzzy Logic Supervisory Control for Coal Power Plant. **Fuzzy Logic in Industrial and Control Applications**- Fuzzy Logic Enhanced Control of an AC Induction Motor with a DSP, Analysis of Environmental Data for Traffic Control, Application of Fuzzy Control for Optimal Operation of Complex Chilling Systems **Fuzzy Logic in Automotive Applications**-Fuzzy Anti-lock Brake System, Anti- lock-Braking System and Vehicle Speed Estimation Using Fuzzy Logic.	08

Course Outcomes:

After completion of course, student will be able to:

1. Explain the basics of Fuzzy rule.
2. Apply the concept of membership functions.
3. Analyze the Fuzzy rule based system.
4. Design the control system using Fuzzy rule for different application.

Reference Books:

Sl. No	Title	Author	Publishers
01	Introduction to Fuzzy Logic using MATLAB	S. N. Sivanandam, S. Sumathi and S. N. Deepa	Springer Berlin Heidelberg 2007
02	Fuzzy Logic with Engineering Applications	Timothy J. Ross B	3rd Edition, JohnWiley and Sons, Ltd., Publication 2010
03	An introduction to fuzzy logic for practical applications	Kazao Tanaka, Springer-verlag	New York,1997
04	IEEE related publications	--	---

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: ARTIFICIAL NEURAL NETWORKS
Course Code: 24CAI163 **L-P-C: 3-0-3**

Course Objectives:

1. To explain basic knowledge of logic gates and circuits using Perceptron, Hebbi analgorithm and Mc.Culloch -Pitts models.
2. To analyze models for classification of patterns, identifications of patterns based onperceptron and Hebbian algorithms.
3. To apply ANN model to solve problems associated with electrical drives.
4. To design ANN model in MATLAB.

UNIT	Description	Hours
I	Introduction, Fundamental concepts and Models of Artificial Neural systems, Biological Neural Networks, Where Are Neural Nets Being Used, How Are Neural Networks Used, Typical Architectures, Setting the Weights, Common Activation Functions, Mc Culloch –Pitts model- AND gate, OR gate, AND-NOT gate, XOR gate. Application of MATLAB in Neural Networks	09
II	Simple neural nets for Pattern Classification, Hebb net, examples, Single Layer Perceptron Classifiers, Single Layer Feedback Networks, examples, Perceptron learning Pattern associations, applications, Training algorithm, Hebb rule &Delta rule, Classification of associative memory. Practical applications of pattern associations in Electrical systems.	08
III	Hetero associative neural net architecture, examples, Examples with missing and mistake data, Auto associative net architecture, Examples with missing and mistake data, Storage capacity. Recurrent linear auto associator, Examples.	08
IV	Discrete Hopfield net, Examples with missing and mistake data, Bidirectional associative net, architecture, Examples with missing and mistake data, Hamming distance, Fixed weight competitive nets, Architecture, applications. Constrained optimization examples.	08
V	Self-organizing maps, architecture, applications, examples, back propagationneural net, architecture, Application, Example, Applications of neural nets in different fields. Application of neural net in industrial drives. V/f control.	07

Course Outcomes:

After completion of course, student will be able to:

1. Explain basic knowledge of logic gates and circuits using Perceptron, Hebbianalgorithm and McCulloch -Pitt‟ s models.
2. Analyze models for classification of patterns, identifications of patterns based onperceptron and Hebbian algorithms.
3. Apply ANN model to solve problems associated with electrical drives.
4. Design ANN model in MATLAB.

Reference Books:

Sl. No	Title	Author	Publishers
01	Fundamentals of Neural Networks: Architecture, Algorithms and Applications	Laurene Fausett	Person Education, 2004
02	Neural Networks	Simon Hayking	A Comprehensive Foundation,2nd Ed., PHI
03	Introduction to Neural Net using Matlab 6.0	S.N Sivanandam, S Sumathi & S.N Deepa	TMH, 2008
04	IEEE related publications	-----	-----

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: I
Course Name: Electrical Drives Laboratory-I
Course Code: 24CAILB1 **L-P-C: 0-3-1.5**

Course Objectives:

1. To explain and apply PWM techniques in converters.
2. To design converters for power supplies
3. To demonstrate their ability to use software tools to simulate various types of powerelectronic converters.

SL.	Description
I	Simulation of single phase inverter using MATLAB/ SIMULINK package. i) Perform FFT analysis to determine THD. ii) Perform FFT analysis to determine THD with SPWM iii) Perform FFT analysis to determine THD with SVPWM
II	Simulations of three phase Inverter using MATLAB/SIMULINK package. i) Perform FFT analysis to determine THD. ii) Perform FFT analysis to determine THD with SPWM iii) Perform FFT analysis to determine THD with SVPWM
III	Simulation of BUCK converter using MATLAB/ SIMULINK package.
IV	Simulation of BOOST converter MATLAB/ SIMULINK package.
V	Simulation of BUCK- BOOST converter MATLAB/ SIMULINK package.
VI	Simulation of CUK converter MATLAB/ SIMULINK package.
VII	Simulation of single phase rectifier with and without filter.
VIII	Simulation of Three phase rectifier with and without filter.
IX	Conduct a suitable experiment to match grid and generator parameters.
X	Conduct a suitable experiment to achieve power quality by electrical characterization.

Course Outcomes:

After completion of course, student will be able to:

1. Analyze and apply PWM techniques in converters.
2. Design converters for power supplies
3. Demonstrate their ability to use software tools to simulate various types of power electronic converters.

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: II
Course Name: AC & DC DRIVES
Course Code: 24CAI21 **L-P-C: 4-0-4**

Course Objectives:

1. To explain the basics of an electrical drive system.
2. To apply the concept of PWM converters for AC and C drive systems.
3. To analyze mathematical models of AC and DC drive system.
4. To design and analyze simple drive systems.

UNIT	Description	Hours
I	**Basic elements of drives:** classification of drives, fundamental torque equations, speed torque conventions and multi-quadrant operation, components of load torques, nature and classification of load torques.	10
II	**DC motor and their performance:** starting, braking, methods of speedcontrol, transfer functions of motors.	10
III	**Rectifier control of DC motors:** Controlled rectifier circuits review, braking operation of rectifier controlled motor, single phase full/half controlled rectifier-fed separately excited motor, pulse width modulated rectifiers, multi-quadrant operation of fully controlled rectifier fed DC motors	10
IV	**Chopper Control of DC motors:** Chopper circuits review, control techniques, regenerative braking of DC motors, dynamic braking of DC motors, current control, multi-quadrant control of chopper fed motors.	10
V	**Induction motors:** Speed-torque characteristics, starting, braking, speed control Methods Scalar Control, Vector (field oriented) Control. Slip power recovery drives.	10

Course Outcomes:

After completion of course, student will be able to:

1. Explain the basics of an electrical drive system .
2. Apply the concept of PWM converters for AC and C drive systems.
3. Analyze mathematical models of AC and DC drive system .
4. Design and analyze simple drive systems .

Reference Books:

Sl. No	Title	Author	Publishers
01	Power Semiconductor Controlled Drives	Gopal. K Dubey,	Prentice Hall, 1989.
02	Power Electronics: Devices, converters, applications.	Vedam Subrahmanyam	New Age,revised2nd Edition, 2006
03	Principles of Electric Machines and Power Electronics	P.C.Sen	John Wiley & Sons, 2ndEdition,1996.
04	IEEE related publications	--	--

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: II
Course Name: ADVANCED ELECTRICAL DRIVES
Course Code: 24CAI22 **L-P-C: 4-0-4**

Course Objectives:

1. To explain different control & feedback signal estimation techniques forinduction motor & synchronous motor drives.
2. To apply control techniques for Special machines.
3. To analyze Synchronous reluctance machine drives.
4. To design and analyze Stepper motors- applications.

UNIT	Description	Hours
I	Dynamic DQ model, Krons and Stanley's equations, scalar control of induction motors, v/f control, Energy conservation effect, speed control with slip regulation, torque & flux control, vector control-DC drive analogy,equivalent circuit & phasor diagram.	**10**
II	Principles of vector control, direct vector control, flux vector estimation, indirect vector control, stator flux oriented vector control, direct torque & flux control, control strategy of Direct Torque Control.	**10**
III	Equivalent circuit, salient pole m/c characteristics, Park model, control & estimation of synchronous m/c drives – introduction, sinusoidal SPM (surface permanent magnet) machine drives, open loop Volts/Hertz control, self- control model, absolute position encoder, vector control, field weakening mode.	**10**
IV	PM machines, materials, SPM, IPM, Trapezoidal SM machines, VRM, Synchronous reluctance m/c drives, IPM m/c drives, Synchronous Reluctance Machine drives	**10**
V	Trapezoidal SPM machines drives, Drive operation with inverter, 120 degree angle switch-on mode, wound-field synchronous machine drives. Brush and Brushless dc excitation	**10**

Course Outcomes:

After completion of course, student will be able to:

1. Explain different control & feedback signal estimation techniques forinduction motor & synchronous motor drives.
2. Apply control techniques for Special machines.
3. Analyze Synchronous reluctance machine drives.
4. Design and analyze Stepper motors- applications

Reference Books:

Sl. No	Title	Author	Publishers
01	Modern Power Electronics and AC Drives	Bimal K. Bose	Pearson Education, 2002
02	Generalized theory of Electrical Machines	Dr. P. S. Bimbhra	Khanna Publishers
03	IEEE related publications	--	--

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: II
Course Name: Industrial Automation & Control
Course Code: 24CAI23 **L-P-C: 4-0-4**

Course Objectives:

1. To explain architecture and hardware of PLC
2. To apply ladder programming using basic control elements to solve controlproblems using classical PID control strategies.
3. To analyze the interface for a variety of input and output devices for PLC and SCADA.
4. To design of automation applications

UNIT	Description	Hours
I	**Introduction to PLC**: Programming logic controller hardware and internal architecture, PLC systems Basic configuration and development, desktop and PC configured system, I/O devices, mechanical switches, proximity switches, Photo Electric sensors and switches, temperature sensors, position sensors, pressuresensors and smart sensors.	**10**
II	**Programming methods:** Ladder programming, ladder diagrams, logic functions, latching multiple outputs, entering programs, function blocks, programming with examples, instruction list(IL), sequential function charts(SFC), structured text example with programs.	**10**
III	**Extended Programming methods:** Ladder program development examples withjump and call subroutines, timers, programming timers, off-delay timers, pulse timers, counters, forms of counter, up and down counting, timer with counters, and programming with examples. **Data handling:** Registers and bits, data movement, moving number to timer, data comparison, sequential switching on arithmetic and BCD, PLC for closed loop control, PID control with PLC, examples with programs, Development of temperature control, valve sequencing.	**10**
IV	**SCADA:** Introduction to Supervisory control & data Acquisitions, distributed Control System (DCS): computer networks and communication in DCS. different BUS configurations used for industrial automation – GPIB, HART and OLE protocol, Industrial field bus – FIP (Factory Instrumentation Protocol), PROFIBUS (Process field bus), Bit bus. Interfacing of SCADA with controllers, Basic programming of SCADA, SCADA in PC based Controller.	**10**
V	**Introduction to Industry 4.0**: History of industrial revolutions, Concept of IR4.0, Typical architecture of IR4.0, Design principles and major role players in IR4.0, Advantages and Challenges.	**10**

Course Outcomes:

After completion of course, student will be able to:

1. To explain architecture and hardware of PLC
2. To apply ladder programming using basic control elements to solve control problems using classical P ID control strategies.
3. To analyze the interface for a variety of input and output devices for PLC and SCADA.
4. To design of automation applications.

Reference Books:

Sl. No	Title	Author	Publishers
01	Programming Logic Controllers	W. Bolten	Elsevier Publication, Oxford UK
02	Programmable logic controllers principle and application	John W Webb, Ronald Reis	Pearson publication.
03	IEEE related publications.	---	---

M.Tech. in Computer Applications in Industrial Drives
Syllabus for the Academic Year – 2024 – 2025

Semester: II
Course Name: HYBRID ELECTRIC VEHICLES
Course Code: 24CAI24 **L-P-C: 3-0-3**

Course Objectives:

1. To explain plug – in hybrid electric vehicle architecture, design and componentsizing.
2. To apply different power electronics devices in hybrid electric vehicles .
3. To analyze electric drive for a specific type of hybrid electric vehicle .
4. To design and analyze different energy storage devices used for hybrid electric vehicles, their technologies and control.

UNIT	Description	Hours
I	**Introduction**: Architectures of HEVs , Basics of the EV, Basics of the HEV. HEV Fundamentals: Introduction, Vehicle Model, Vehicle Performance, EV Powertrain Component Sizing, Series Hybrid Vehicle, Parallel Hybrid Vehicle, Wheel Slip Dynamics.	08
II	**Plug-in Hybrid Electric Vehicles:** Introduction, Architectures, Design and Component Sizing, , HEV to PHEV Conversions, Vehicle-to-Grid Technology. **Power Electronics in HEVs:** Rectifiers Used in HEVs, Buck Converter Usedin HEVs, Non-isolated Bidirectional DC–DC Converter, Voltage Source Inverter, Current Source Inverter, Isolated Bidirectional DC–DC Converter, PWM Rectifier in HEVs.	**08**
III	**Electric Machines and Drives in HEVs:** Introduction, Induction Motor Drives, Permanent Magnet Motor Drives, Switched Reluctance Motors, Design and Sizing of Traction Motors, Thermal Analysis and Modeling of Traction Motors.	**08**
IV	**Batteries, Ultra capacitors, Fuel Cells, and Controls:** Introduction, Battery Characterization, Comparison of Different Energy Storage Technologies for HEVs, Battery Charging Control, Charge Management of Storage Devices, Flywheel Energy Storage System, Fuel Cells and Hybrid Fuel Cell Energy Storage System.	**08**
V	**HEV Component Sizing and Design Optimization:** Introduction, Design Optimization Process, Parallel HEV Design Optimization Example, Series HEV Design Optimization Example. Vehicular Power Control Strategy.	**08**

Course Outcomes:

After completion of course, student will be able to:

1. Explain plug – in hybrid electric vehicle architecture, design and component sizing.
2. Apply different power electronics devices in hybrid electric vehicles .
3. Analyze electric drive for a specific type of hybrid electric vehicle .
4. Design and analyze different energy storage devices used for hybrid electric vehicles,their technologies and control.

Reference Books:

Sl. No	Title	Author	Publishers
01	Hybrid Electric Vehicles principles andApplications with Practical Perspectives	Chris Mi,M, Abul Masrur, David Wenzhong Gao	Newnes, Wiley, 2011
02	IEEE related publications	--	--

Syllabus for the Academic Year – 2024 – 2025

Semester: II
Course Name: CYBER SECURITY IN THE ELECTRICITY SECTOR
Course Code: 24CAI251 **L-P-C: 3-0-3**

Course Objectives:

1. To explain the current cyber security situation in the electricity sector and the relevantstandards that can be employed for cyber security.
2. To analyze available solutions that support the cost-benefit analyses involved in cybersecurity management and cyber security assessment approach.
3. To apply cyber security management approach and the methods for the electricity sector.
4. To design cyber security controls, for reducing cyber risks.

UNIT	Description	Hours
I	**Introduction:** Transformation, Dependence on the ICT, 8Cybersecurity, Priority Critical Infrastructure. State of Cyber security in the Electricity Sector: Introduction, Vulnerabilities, Threats, Challenges, Initiatives, Future Directions.	08
II	**Cyber security Standards Applicable to the Electricity Sector:** Introduction, Literature Search, Literature Analysis, Standards‟ Selection and Evaluation Criteria, Results, Most Relevant Standards, Standards‟ Limitations, Standards‟ Implementation and Awareness	08
III	**A Systematic Approach to Cyber security Management:** Introduction, Cyber security Management Approaches in Standards, The Systematic Approach to Cyber security Management in the Electricity Sector.	08
IV	**Cost of Cyber security Management:** Introduction, Economic Studies, Organization Management Studies, Cost Benefit Analysis, Cost Calculators, Costing Metrics, CAsPeA. Cyber security Assessment: Introduction, Security Assessment Methods for the Electricity Sector, Cyber security Test beds for Power Systems, JRC Cyber security Assessment Method, Laboratory Infrastructure, Mal Sim	08
V	**Cyber security Controls:** Introduction, Standard Technical Solutions, Information Sharing Platform on Cyber security Incidents for the Energy Sector, Situation Awareness Network.	08

Course Outcomes:

After completion of course, student will be able to:

1. Explain the current cyber security situation in the electricity sector and the relevant standards that can be employed for cyber security.
2. Analyze available solutions that support the cost-benefit analyses involved in cyber security management and cyber security assessment approach.
3. Apply cyber security management approach and the methods for the electricity sector.
4. Design cyber security controls, for reducing cyber risks.

Reference Books:

Sl. No	Title	Author	Publishers
01	Cyber security in the Electricity Sector	Rafal Leszczyna	Springer, 2019
02	--	--	IEEE related publications.

Semester: II
Course Name: FACTS CONTROLLERS
Course Code: 24CAI252 **L-P-C: 3-0-3**

Course Objectives:
1. To explain FACTS concept and general system considerations
2. To analyze the static Voltage and Phase Angle Regulations
3. To apply the concept FACTS Controllers for combined compensation
4. To design FACTS Controllers for series and shunt compensation

UNIT	Description	Hours
I	**FACTS concept and general system considerations** Transmission line Interconnections, Flow of power in an AC System, loadinglimit, Power flow and Dynamic stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters, Brief Description and Definitions of Basic Types of FACTS controllers.	**09**
II	**Static Voltage and Phase Angle Regulations:** Objective of Voltage and Phase Angle Regulators, Approaches to Thyristor-Controlled Voltage and Phase Angle Regulators (TCVRs and TCPARs), Switching Converter- Based Voltage and Phase Angle Regulators; Hybrid Phase Angle Regulator	**08**
III	**Combined Compensations:** Introduction, Unified Power Flow Controller, Interline Power Flow Controller (IPFC), Generalized and MultifunctionalFACTS Controllers	**08**
IV	**Special Purpose Facts Controllers:** NGH-SSR Damping Scheme and Thyristor-Controlled Breaking Resistor	**08**
V	Sub synchronous Resource; NGH-SSR Damping Scheme, Thyristor-Controlled Breaking Resistor (TCBR)	**07**

Course Outcomes:

After completion of course, student will be able to:

1. Explain FACTS concept and general system considerations
2. Analyze the static Voltage and Phase Angle Regulations
3. Apply the concept FACTS Controllers for combined compensation
4. Design FACTS Controllers for series and shunt compensation.

Reference Books:

Sl. No	Title	Author	Publishers
01	Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems	Narain G. Hingorani and Laszlo Gyugyi	IEEE Press, Standard Publishers Distributors, Delhi,1st Edition,2001,
02	Static Controllers for Electrical Transmission Systems	R. Mohan Mathur	IEEE Pressand JohnWiley & Sons, Inc.
03	Thyristor-Based FACTS Controllers for Electrical Transmission Systems	R. Mohan Mathur and Rajiv K. Varma	IEEE Press and John Wiley & Sons, Inc.
04	--	--	IEEE related publications.

Semester: II
Course Name: POWER SYSTEM HARMONICS
Course Code: 24CAI253 **L-P-C: 3-0-3**

Course Objectives:

1. To explain the effects of harmonics distortion on power system equipment and loads.
2. To apply the methods used to suppress the harmonics in power systems.
3. To analyze harmonic distortion and modelling of power system components forharmonic analysis study.
4. To design transmission lines and cables for harmonic analysis.

UNIT	Description	Hours
I	**Fundamentals of Harmonics**: Introduction, Examples of harmonic wave forms, characteristics of harmonics in power systems, measurement of harmonic distortion, power in passive elements, calculation of passive elements, resonance, capacitor banks and reactive power supply, capacitor banks and power factor correction, bus voltage rise and resonance, harmonics in transformers. **Harmonics in Power system**: Introduction, sources of harmonics, transformers, rotatingmachines, fluorescent lights, static var compensators, cyclo-converters. Single phase controlled rectifiers, three phase converters.	09
II	**Effects of Harmonic Distortion on Power System**: Introduction, thermal losses in a harmonic environment, harmonic effects on power system equipment, capacitor banks, transformers, rotating machines, protection, communication and electronic equipment. Mitigation of Power system Harmonics: Introduction, harmonic filters, power converters, transformers, rotating machines, capacitor banks, harmonic filter design, active filters.	08
III	**Limits of Harmonic Distortion:** Introduction, voltage harmonic distortion limits, current harmonic distortion limits. Harmonic studies – Modeling of System Components: Introduction, impedance in the presence of harmonics, skin effect, modeling of the high voltage grid, generator modeling, modeling of shunt capacitor banks, series capacitor banks, load models, induction motor modeling. **Transformer Modeling:** Introduction, modeling of two winding transformers, phase sequence admittance matrices, transmission of voltage and current across two winding transformers, transmission matrices and phase admittance matrix, modeling of three and four winding transformers.	08
IV	**Modeling of Transmission lines/Cables:** Introduction, skin effect, modeling of powerlines, Lines series impedance, mutual coupling between conductors, mutually coupled lines, lines shunt capacitance, surge impedance and velocity of propagation, lines series impedance and shunt capacitance – single phase equivalents, the transmission (ABCD) matrix, the admittance matrix, conversion between the transmission and admittance matrices, the nominal pi model – single phase equivalent, the equivalent pi model – voltage and current the line, line losses, the equivalent pi model – single phase equivalent, variations in the networks short circuit capacity, examples – the nominal and equivalent models.	08
V	**Power System Harmonic Studies:** Introduction, harmonic analysis using a computer program, harmonic analysis using spread sheet, harmonic distortion limits, harmonic filter rating, and practical considerations. Harmonic study of simple system, 300 -22 kV power system and low voltage system	07

Course Outcomes:

After completion of course, student will be able to:

1. Explain the effects of harmonics distortion on power system equipment and loads.
2. Apply the methods used to suppress the harmonics in power systems.
3. Analyze harmonic distortion and modelling of power system components for harmonicanalysis study.
4. Design transmission lines and cables for harmonic analysis.

Reference Books:

Sl. No	Title	Author	Publishers
01	Power System Harmonics	George J Wakileh	Springer, Reprint, 2014
02	Power System Harmonic Analysis	Jos Arrillaga etal	Wiley, Reprint, 2014
03	--	--	IEEE related publications.

Semester: II
Course Name: ELECTRICAL POWER QUALITY
Course Code: 24CAI261 **L-P-C: 3-0-3**

Course Objectives:

1. To explain the passive shunt and series compensation using lossless passivecomponents.
2. To apply the concept of series and shunt compensation to improve power quality.
3. To analyze mitigation of power quality problems due to nonlinear loads.
4. To design series and shunt filters to improve power quality.

UNIT	Description	Hours
I	**Power Quality**: Introduction, State of the Art on Power Quality, Classification of Power Quality, Causes of Power Quality, Effects of Power Quality on Users, Classification of Mitigation Techniques for Power QualityProblems. **Power Quality Standards and Monitoring**: Introduction, State of the Arton Power Quality Standards and Monitoring, Power Quality Terminologies, Power Quality Definitions, Power Quality Standards, Power Quality Monitoring, Numerical Examples. **Passive Shunt and Series Compensation:** Introduction, State of the Art on Passive Shunt and Series Compensators, Classification of Passive Shunt and Series Compensators, Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators, Modeling, Simulation, and Performance of Passive Shunt and Series Compensators, Numerical Examples.	09
II	**Active Shunt Compensation:** Introduction, State of the Art on DSTATCOMs, Classification of DSTATCOMs, Principle of Operation and Control of DSTATCOMs, Analysis and Design of DSTATCOMs, Modeling, Simulation, and Performance of DSTATCOMs, Numerical Examples.	07
III	**Active Series Compensation:** Introduction, State of the Art on Active Series Compensators, Classification of Active Series Compensators, Principle of Operation and Control of Active Series Compensators, Analysis and Design of Active Series Compensators, Modeling, Simulation, and Performance of ActiveSeries Compensators, Numerical Examples.	08
IV	**Unified Power Quality Compensators:** Introduction, State of the Art on Unified Power Quality Compensators, Classification of Unified Power Quality Compensators, Principle of Operation and Control of Unified Power Quality Compensators, Analysis and Design of Unified Power Quality Compensators, Modeling, Simulation, and Performance of UPQCs, Numerical Examples	08
V	Unified Power Quality Compensators (continued): Numerical Examples (from6.11to 20). Loads That Cause Power Quality Problems: Introduction, State of the Art on Nonlinear Loads, Classification of Nonlinear Loads, Power Quality Problems Caused by Nonlinear Loads, Analysis of Nonlinear Loads, Modeling, Simulation, and Performance of Nonlinear Loads, Numerical Examples	08

Course Outcomes:

After completion of course, student will be able to:

1. To explain the passive shunt and series compensation using lossless passive components.
2. To apply the concept of series and shunt compensation to improve power quality.
3. To analyze mitigation of power quality problems due to nonlinear loads.
4. To design series and shunt filters to improve power quality.

Reference Books:

Sl. No	Title	Author	Publishers
01	Power Quality Problems and MitigationTechniques	Bhim Singh, Ambrish Chandra, Kamal Al-Haddad	Wiley, 2015
02	--	--	IEEE related publications.

Semester: II
Course Name: INTELLIGENT APPLICATIONS IN ELECTRIC DRIVES
Course Code: 24CAI262 **L-P-C: 3-0-3**

Course Objectives:

1. To explain the basics of physical structure and scarcity.
2. To analyze the Expert systems.
3. To apply basics AI applications to Power Systems.
4. To design the structure of Electrical Systems using Artificial Intelligence.

UNIT	Description	Hours
I	**Artificial Intelligence:** Introduction**,** definitions, history and evolution,essential abilities of intelligence, AI applications; Problem solving: problem characteristics, problem search strategies, forward and backward reasoning, AND-OR graphs, game trees, search methods- informed and uninformed search, breadth first search and depth first search methods.	08
II	**Artificial Neural Network:** difference between human machine and intelligence, biological neural network, artificial neuron model, Concept of Perceptron, ADALINE, Feedback in Neural Network, Neural Network Architectures: Neural Learning, Application of Neural Network in Power System.	08
III	**Knowledge representation**: logical formalisms, propositional and predicate logic, syntax and semantics, wffs, clause form expressions, resolution- use of RRTs for proofs and answers, examples from electric power systems. Non-monotonic logic- TMS, modal, temporal and fuzzy logic.	08
IV	**Structured representation** of knowledge: ISA/ISPART trees, semantic nets, frame sand scripts, examples from electric systems.	08
V	**Expert systems:** Basic components, forward and backward chaining, ES features, ES development, ES categories, ES tools and examples from electric drive systems. AI languages: LisP and Prolog - Introduction, sample segments, LisP primitives, list manipulation functions, function predicates, variables, iteration and recursion, property lists, sample programs for examples from electric power systems.	08

Course Outcomes:

After completion of course, student will be able to:

1. Explain the basics of physical structure and scarcity.
2. Analyze the Expert systems.
3. Apply basics AI applications to Power Systems.
4. Design the structure of Electrical Systems using Artificial Intelligence.

Reference Books:

Sl. No	Title	Author	Publishers
01	Introduction to Artificial Intelligence and Expert Systems"	D.W.Patterson	Prentice-Hall ofIndia, 1992.
02	Computer Methods for Circuit Analysis and Design'	J.Vlach and Singhal,	CBSPublishers,1986
03	Artificial Intelligence"	Rich, Elaine, Kevin Knight	Tata McGraw-Hill, 1991.
04	Introduction to AI"	Charniak E. and Mcdermott D	Addison-Wesley, 1985
05	Problem Solving Methods in AI"	Nils J.Nilson	McGraw-Hill, 1971
06	Principles of AI"	Nils J.Nilson	Berlin Springer-Verlag, 1980
07	--	--	IEEE related publications.

Semester: II
Course Name: FPGA AND PROGRAMMABLE LOGIC
Course Code: 24CAI263 **L-P-C: 3-0-3**

Course Objectives:

1. To explain basics of FPGA.
2. To analyze FPGA by using VHDL hardware description language for electronicapplication
3. To apply concept of reverse engineering of a product by using alternative FPGAsolutions.
4. To design state machines using HDL and come up with an integrated chip (IC)solution in the form of a FPGA to be used in the area of drives.

UNIT	Description	Hours
I	Recapitulation of combinational logic circuits. Timing hazards in combinational circuits. Introduction to the history and development of programmable logic. Birth of hardware description languages. Types of programmable logic devices, simple PLDs and CPLDs.	08
II	Architecture of FPGA - generic features. Definition and construction of FPGA. Architecting an FPGA. Performance, density and capacity of an FPGA. Programmability issues. A study of the XC4000 configurable logic block. Introduction to major FPGA families, Xilinx, Altera and Cypress.	08
III	Programming of FPGAs. Introduction to VHDL hardware description language. Programming elements, constructs and syntax. Entities and architecture, Creating combinational and synchronous logic. Details of function and procedures. Topics on identifiers, data objects, data types and attributes. Synthesis and fitting of designs.	08
IV	Simulation and verification of the programs. Considerations of area, speed and device resource utilization in FPGA technology. Creating test benches. Systematic study of implementing state machines using VHDL. Unit	08
V	FPGA versus CPLD and case studies. Pipe lining and resource sharing concepts. Applications of FPGA in electric drives and communication devices. Future advances in FPGA technology	08

Course Outcomes:

After completion of course, student will be able to:

1. Explain basics of FPGA.
2. Analyze FPGA by using VHDL hardware description language for electronicapplication
3. Apply concept of reverse engineering of a product by using alternative FPGAsolutions.
4. Design state machines using HDL and come up with an integrated chip (IC) solutionin the form of a FPGA to be used in the area of drives

Reference Books:

Sl. No	Title	Author	Publishers
01	VHDL for Programmable logic	Kevin Skahill	Pearson Education, 2004
02	Digital Design, Principles and Practices	John F. Wakerly	Pearson Prentice Hall
03	--	--	IEEE related publications.

Semester: II
Course Name: ELECTRICAL DRIVES LABORATORY
Course Code: 24CAILB2 **L-P-C: 0-3-1.5**

Course Objectives:

1. To apply basic logic gates using ladder logic.
2. To analyse PWM techniques for control of AC and DC motors.
3. To design Power, Torque, RPM, Velocity, Efficiency using AC and DC emulator.

SL.	Description
I	Construct and develop PLC ladder diagram to control lamp.
II	Construct and develop PLC ladder diagram to control motor.
III	Demonstration of water bottle filler using PLC.
IV	Demonstration of elevator using PLC.
V	Realization of basic logic gates.
VI	Simulation of single phase AC voltage controller.
VII	Simulation of phase control and on-off control for AC voltage controller.
VIII	Conduct a suitable experiment to study charging and discharging operation of bidirectional converter.
IX	Power, Torque, RPM, Velocity, Efficiency analysis using wind emulator.
X	Power, Torque, RPM, Velocity, Efficiency analysis using DC emulator.

Course Outcomes:

After completion of course, student will be able to:

1. To apply basic logic gates using ladder logic.
2. To analyse PWM techniques for control of AC and DC motors.
3. To design Power, Torque, RPM, Velocity, Efficiency using AC and DC emulator.