PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

i. To prepare the students for successful career in power electronic industry, research and teaching institutions.

ii. To analyze, design and develop the power electronic converter/drive systems.

iii. To develop the ability to analyze the dynamics in power electronic converters/drives systems and design various controllers to meet the performance criteria.

iv. To design power electronic systems and special electrical machines for efficient extraction and utilization of various renewable energy sources.

v. To promote student awareness for the lifelong learning and to introduce them to professional ethics.

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<th>PO#</th>
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<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems.</td>
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<td>2</td>
<td>An ability to write and present a substantial technical report/document.</td>
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<td>3</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.</td>
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<td>Apply knowledge of basic science and engineering in design and testing of power electronic systems and drives.</td>
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<td>Interact with Industry in a professional and ethical manner to meet the requirements of societal needs and to contribute sustainable development of the society.</td>
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<td>Implement cost effective and cutting edge technologies in power electronics and drives system.</td>
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PEO/PO Mapping:

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### Notes
- PO1, PO2, PO3, PO4, PO5, PO6 represent different performance objectives.
- The numbers in the table represent the credit hours for each course.
- Audit Courses are marked with an asterisk (*) for reference.
- Open Electives provide flexibility in the curriculum.
- Project Work assignments are included for practical application.
ANNA UNIVERSITY: CHENNAI 600 025
NON AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
M.E. POWER ELECTRONICS AND DRIVES (FULL TIME)
I TO IV SEMESTERS CURRICULUM AND SYLLABUS

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THEORY

1. MA4106 Applied Mathematics for Power Electronics Engineers FC 3 1 0 4 4
2. PX4101 Analysis of Electrical Machines PCC 3 1 0 4 4
3. PX4151 Analysis of Power Converters PCC 3 1 0 4 4
4. PX4102 Modeling and Design of SMPS PCC 3 0 0 3 3
5. RM4151 Research Methodology and IPR RMC 2 0 0 2 2
6. Professional Elective I PEC 3 0 0 3 3
7. Audit Course I* AC 2 0 0 2 0

PRACTICALS

8. PX4161 Power Converters Laboratory PCC 0 0 3 3 1.5
9. PX4111 Analog and Digital Controllers for PE Converters Laboratory PCC 1 0 3 4 2.5

TOTAL 20 3 6 29 24

* Audit Course is optional

SEMMESTER II

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THEORY

1. PX4201 Analysis of Electrical Drives PCC 3 1 0 4 4
2. PX4202 Special Electrical Machines PCC 3 0 0 3 3
3. PX4291 Electric Vehicles and Power Management PCC 3 1 0 4 4
4. Professional Elective II PEC 3 0 0 3 3
5. Professional Elective III PEC 3 0 0 3 3
6. Audit course II* AC 2 0 0 2 0

PRACTICALS

7. PX4211 Power Electronics and Drives Laboratory PCC 0 0 3 3 1.5
8. PX4212 Design Laboratory for Power Electronics Systems PCC 0 0 3 3 1.5

TOTAL 17 2 6 25 20

* Audit Course is optional
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**Total Credits: 29**

### Research Methodology and IPR Courses (RMC)

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### AUDIT COURSES - I

REGISTRATION FOR ANY OF THESE COURSES IS OPTIONAL TO STUDENTS

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### SUMMARY

Name of the Programme: M.E POWER ELECTRONICS AND DRIVES

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OBJECTIVES:
- To develop the ability to apply the concepts of matrix theory in Electrical Engineering problems.
- To familiarize the students in the field of differential equations to solve boundary value problems associated with engineering applications.
- To develop the ability among the students to solve problems using Laplace transform associated with engineering applications.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.
- To develop the ability among the students to solve problems using Fourier series associated with engineering applications.

UNIT I  MATRIX THEORY  12
The Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Singular value decomposition - Pseudo inverses - Least square approximation.

UNIT II  CALCULUS OF VARIATIONS  12
Concept of variations and its properties - Euler's theorem - Functional dependent on first and higher order of derivatives - Functionals dependent on functions of several independent variables - Variational problems with moving boundaries - Isoperimetric problems - Direct methods : Rayleigh Ritz method and Kantorovich problems.

UNIT III  LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS  12

UNIT IV  Z - TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS  12
Z-transforms - Elementary properties - Convergence of Z-transforms - Initial and final value theorems - Inverse Z-transform (using partial fraction and residues) - Convolution theorem - Formation of difference equations - Solution of difference equations using Z-transforms.

UNIT V  FOURIER SERIES  12
Fourier Trigonometric series: Periodic function as power signals - Convergence of series - Even and odd functions - Cosine and sine series - Non periodic function - Extension to other intervals - Power signals: Exponential Fourier series - Parseval's theorem and power spectrum - Eigenvalue problems and orthogonal functions - Regular Sturm–Liouville systems - Generalized Fourier series.

TOTAL : 60 PERIODS

OUTCOMES:
- Able to apply the concepts of matrix theory in Electrical Engineering problems.
- Able to solve boundary value problems associated with engineering applications.
- Able to solve problems using Laplace transform associated with engineering applications.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.
- Able to solve problems using Fourier series associated with engineering applications.
MAPPING OF CO’S WITH PO’S

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REFERENCES:

PX4101 ANALYSIS OF ELECTRICAL MACHINES LT P C

OBJECTIVES:
- To understand the principles of electromechanical energy conversion in electrical machines and to know the dynamic characteristics of DC motors.
- To study the concepts related with AC machines, magnetic noise and harmonics in rotating electrical machines.
- To interpret the principles of reference frame theory.
- To study the principles of three phase, doubly fed and ‘n’ phase induction machine in machine variables and reference variables.
- To understand the principles of three phase, synchronous machine in machine variables and reference variables.

UNIT I ELECTROMECHANICAL ENERGY CONVERSION and DC MACHINES 12

UNIT II AC MACHINES -CONCEPTS 12
UNIT III  REFERENCE FRAME THEORY  12
Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame – transformation of balanced set-variables observed from several frames of reference.

UNIT IV  INDUCTION MACHINES  12

UNIT V  SYNCHRONOUS MACHINES  12
Three phase synchronous machine and analysis of steady state operation - voltage and torque equations in machine variables and rotor reference frame variables (Park’s equations) – analysis of dynamic performance for load torque variations –Krons primitive machine

TOTAL : 60 PERIODS

OUTCOMES:
After completion of this course, student will be able to

CO1: Understand the principles of electromechanical energy conversion and characteristics of DC motors
CO2: Know the concepts related with AC machines and modeling of ‘n’ phase machines
CO3: Interpret the concepts of reference frame theory.
CO4: Apply procedures to develop induction machine model in both machine variable form and reference variable forms
CO5: Follow the procedures to develop synchronous machine model in machine variables form and reference variable form.

REFERENCES:
5 R. Ramanujam, Modeling and Analysis of Electrical Machines, I.K. International Publishing House Pvt.Ltd, 2018

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OBJECTIVES:
- To provide the mathematical fundamentals necessary for deep understanding of power converter operating modes.
- To introduce the electrical circuit concepts behind the different working modes of power converters so as to enable deep understanding of their operation.
- To impart required skills to formulate and design inverters for generic load and for machine loads.
- To equip with required skills to derive the criteria for the design of power converters starting from basic fundamentals.
- To inculcate knowledge to perform analysis and comprehend the various operating modes of different configurations of power converters.

UNIT I  SINGLE PHASE AC-DC CONVERTER  12

UNIT II  THREE PHASE AC-DC CONVERTER  12

UNIT III  SINGLE PHASE INVERTERS  12
Introduction to self-commutated switches : MOSFET and IGBT - Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques – Design of UPS - VSR operation

UNIT IV  THREE PHASE INVERTERS  12
180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques – VSR operation-Application – Induction heating, AC drive system – Current source inverters.

UNIT V  MODERN INVERTERS  12

OUTCOMES:
After completing the above course, students will be able to
CO1 : Acquire and apply knowledge of mathematics in power converter analysis
CO2:  Model, analyze and understand power electronic systems and equipments.
CO3 :Formulate, design and simulate phase controlled rectifiers for generic load and for machine loads
CO4 : Design and simulate switched mode inverters for generic load and for machine loads
CO5 : Select device and calculate performance parameters of power converters under various operating modes
REFERENCES:

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PX4102 MODELING AND DESIGN OF SMPS LT P C 3 0 0 3

OBJECTIVES:
1. To inculcate knowledge on steady state analysis of Non-Isolated DC-DC converter
2. To perform steady state analysis of Isolated DC-DC converter
3. To educate on different converter dynamics
4. To impart knowledge on the design of controllers for DC-DC converters
5. To familiarize the design magnetics for SMPS applications

UNIT I ANALYSIS OF NON-ISOLATED DC-DC CONVERTERS
Buck, Boost, Buck- Boost and Cuk converters: Principles of operation – Continuous conduction mode– Concepts of volt-sec balance and charge balance – Analysis and design based on steady-state relationships – Introduction to discontinuous conduction mode - SEPIC topology - design examples - Applications to Battery operated vehicle, PV system.

UNIT II ANALYSIS OF ISOLATED DC-DC CONVERTERS
Introduction - classification- forward- flyback- pushpull – half bridge – full bridge topologies-design of SMPS - Applications to Battery operated vehicle.

UNIT III CONVERTER DYNAMICS
UNIT IV CONTROLLER DESIGN
Review of P, PI, and PID control concepts – gain margin and phase margin – Bode plot based analysis – Design of controller for buck, boost, buck-boost and cuk converters

UNIT V DESIGN OF MAGNETICS
Basic magnetic theory revision – Inductor design – Design of mutual inductance – Design of transformer for isolated topologies – Ferrite core table and selection of area product – wire table – selection of wire gauge

OUTCOMES:
After completing the above course, students will be able to
CO1 : Analyse and design Non-Isolated DC-DC converter
CO2:  Analyse and design Isolated DC-DC converter
CO3:  Derive transfer function of different converters
CO4 : Design controllers for DC-DC converters
CO5 : Design magnetics for SMPS application

TEXT BOOKS:
2. John G. Kassakian, Martin F. Schlecht, George C. Verghese, “Principles of Power Electronics”, Pearson, India, New Delhi, 2010
7. V.Ramanarayanan, “Course material on Switched mode power conversion”, 2007

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UNIT I RESEARCH DESIGN
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS

UNIT V PATENTS

TOTAL : 30 PERIODS

REFERENCES

OBJECTIVES:
- To provide the basic understanding of the dynamic behavior of the power electronic switches
- To make the students familiar with the digital processors used in generation of gate pulses for the power electronic switches
- To make the students acquire knowledge on the design of power electronic circuits and implementing the same using simulation tools
- To facilitate the students to design gate drive circuits for power converters
- To provide the fundamentals of DC-AC power converter topologies and analyze the harmonics.
LIST OF EXPERIMENTS:
1. Study of switching characteristics of Power MOSFET & IGBT.
4. Circuit Simulation of Three-phase Voltage Source Inverter in 180 and 120 degree mode of conduction
5. Circuit simulation of Three-phase PWM inverter and study of spectrum analysis for various modulation indices.
6. Simulation of Four quadrant operation of DC Chopper.
10. Simulation of a five-level cascaded multilevel inverter with R load.
11. Simulation of a Flyback DC-DC converter

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Comprehensive understanding on the switching behaviour of Power Electronic Switches
CO2: Comprehensive understanding on mathematical modeling of power electronic system and ability to implement the same using simulation tools
CO3: Ability of the student to use arduino/microcontroller for power electronic applications
CO4: Ability of the student to design and simulate various topologies of inverters and analyze their harmonic spectrum
CO5: Ability to design and fabricate the gate drive power converter circuits. Analyze the three-phase controlled rectifiers and isolated DC-DC converters for designing the power supplies

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OBJECTIVES:
- To understand the concepts related with analog and digital controllers.
- To design and understand the op-amp circuits and microcontroller circuits for power electronics.
- To study and design the driving circuits, sensing circuits, protection circuits for power converters.
- To design and select the appropriate digital controller for power converters along with control strategy

LIST OF EXPERIMENTS:
1. Amplifiers and buffer design and verification by using Opamp
2. Filter design and verification by using Opamp
3. ON/OFF controller design and verification by using analog circuits
4. Design of Driver Circuit using IR2110
5. Waveform generation by using look up table
6. Generation of PWM gate pulses with duty cycle control using PWM peripheral of microcontroller (TI-C2000 family/ PIC18)
7. Duty cycle control from IDE
8. Duty Cycle control using a POT connected to ADC peripheral in a standalone mode
9. Generation of Sine-PWM pulses for a single and three phase Voltage Source Inverter with control of modulation index using PWM peripheral of microcontroller (TI C2000 family/PIC 18)
10. Design and testing of signal conditioning circuit to interface voltage/current sensor with microcontroller (TI-C2000 family/ PIC18)
11. Interface Hall effect voltage and current sensor with microcontroller and display the current waveform in the IDE and validate with actual waveform in DSO
12. Design of closed loop P, I and PI controllers using OP-AMP

TOTAL : 60 PERIODS

OUTCOMES:
After completing the above course, students will be able to

CO1: Identification of suitable analog and digital controller for the converter design.
CO2: Know the advantages of gate driver, sensing and protection circuits in power converters.
CO3: Hands on with different controller with strategies for design.
CO4: Design and testing the proper driving circuits and protection circuits.
CO5: Fabrication of analog and digital controllers for various real time applications.

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OBJECTIVES:
To understand steady state operation and transient dynamics of a motor load system
- To study and analyze the operation of the converter / chopper fed DC drive, both qualitatively and quantitatively
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drive.
- To understand the drive characteristics for different load torque profiles and quadrants of operation
- To understand the speed control of induction motor drive from stator and rotor sides.
- To study and analyze the operation of VSI &CSI fed induction motor control and pulse width modulation techniques

UNIT I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 12
DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation- Introduction to high speed drives and modern drives. Characteristics of mechanical system– dynamic equations, components of torque, types of load; Requirements of drives characteristics - stability of drives–multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT II CONVERTER AND CHOPPER CONTROL 12
Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters –performance parameters, performance characteristics. Introduction to time ratio control and frequency modulation; chopper controlled DC motor – performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Related problems

UNIT III CLOSED LOOP CONTROL 12
Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed DC drive

UNIT IV VSI AND CSI FED STATOR CONTROLLED INDUCTION MOTOR CONTROL 12
AC voltage controller – six step inverter voltage control-closed loop variable frequency PWM inverter fed induction motor (IM) with braking-CSI fed IM variable frequency motor drives – pulse width modulation techniques – simulation of closed loop operation of stator controlled induction motor drives

UNIT V ROTOR CONTROLLED INDUCTION MOTOR DRIVES 12
Static rotor resistance control - injection of voltage in the rotor circuit – static scherbius drives – static and modified Kramer drives – sub-synchronous and super-synchronous speed operation of induction machines – simulation of closed loop operation of rotor controlled induction motor drives

TOTAL : 60 PERIODS
OUTCOMES:

CO1: Ability to acquire and apply knowledge of mathematics and converter/machine dynamics in Electrical engineering.

CO2: Ability to formulate, design, simulate power supplies for generic load and for machine loads.

CO3: Ability to analyze, comprehend, design and simulate direct current motor based adjustable speed drives.

CO4: Ability to analyze, comprehend, design and simulate induction motor based adjustable speed drives.

CO5: Ability to design a closed loop motor drive system with controllers for the current and speed control operations.

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OBJECTIVES:
- To understand the working, characteristics and speed control principles of stepper motor.
- To study the construction, working, characteristics and speed control methods of switched reluctance motors.
- To know the principle of operation, construction, characteristics and speed control methods for the permanent magnet brushless DC motors.
- To understand the concepts related with permanent magnet synchronous motors and synchronous reluctance motors.
- To know the features of axial flux machines and its working principles

UNIT I  STEPPER MOTORS
9
Constructional features – Principle of operation – Types – Torque predictions – Linear and Non-linear analysis – Characteristics – Drive circuits – Closed loop control – Applications

UNIT II  SWITCHED RELUCTANCE MOTORS
9

UNIT III  PERMANENT MAGNET BRUSHLESS DC MOTORS
9

UNIT IV  PERMANENT MAGNET SYNCHRONOUS MOTORS
9
Permanent Magnet ac Machines, Machine Configurations, PMSM – Principle of operation – EMF and Torque equations – Phasor diagram – Torque speed characteristics – Modeling and small signal equations – evaluation of control characteristics – design of current and speed controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor

UNIT V  AXIAL FLUX MACHINES
9
Axial Flux switched reluctance machine – Topologies and Structures – Operating Principles – Output Equation – Applications

TOTAL : 45 PERIODS

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

CO1: Know the concepts related with stepper motor.
CO2: Understand the working and various characteristics of switched reluctance machines.
CO3: Study the working principle and characteristics of permanent magnet brushless DC motors.
CO4: Know the construction, working principles and characteristics of permanent magnet synchronous motor and synchronous reluctance motor.
CO5: Understand the features of axial flux machines in comparison with radial flux machines and to know the principles of axial flux machines.
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PX4291 ELECTRIC VEHICLES AND POWER MANAGEMENT LT P C 3 1 0 4

OBJECTIVES:
- To understand the concept of electric vehicles and its operations
- To present an overview of Electric Vehicle (EV), Hybrid Electric vehicle (HEV) and their architecture
- To understand the need for energy storage in hybrid vehicles
- To provide knowledge about various possible energy storage technologies that can be used in electric vehicles

UNIT I ELECTRIC VEHICLES AND VEHICLE MECHANICS
Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics.

UNIT II ARCHITECTURE OF EV’s AND POWER TRAIN COMPONENTS
Architecture of EV’s and HEV’s – Plug-n Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT III POWER ELECTRONICS AND MOTOR DRIVES
UNIT IV      BATTERY ENERGY STORAGE SYSTEM

Battery Basics- Different types- Battery Parameters-Battery life & safety impacts -Battery modeling-Design of battery for large vehicles.

UNIT V      ALTERNATIVE ENERGY STORAGE SYSTEMS

Introduction to fuel cell – Types, Operation and characteristics- proton exchange membrane (PEM) fuel cell for E-mobility– hydrogen storage systems –Super capacitors for transportation applications.

TOTAL : 60 PERIODS

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

CO1: Understand the concept of electric vehicle and energy storage systems.
CO2: Describe the working and components of Electric Vehicle and Hybrid Electric Vehicle
CO3: Know the principles of power converters and electrical drives
CO4: Illustrate the operation of storage systems such as battery and super capacitors
CO5: Analyze the various energy storage systems based on fuel cells and hydrogen storage

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OBJECTIVES:

- To control the speed of DC motor-based drive system.
- To conduct load tests in an electrical drive system.
- To conduct experiments to enhance the understanding of different power electronic controller for motor drive applications.
- To control the speed of Stepper motor and BLDC motor-based drive systems.
- To control the speed of an Induction motor and SRM motor-based drive systems.

LIST OF EXPERIMENTS:

1. Simulation of closed loop control of Converter fed DC drive.
2. Speed control of Converter fed DC motor.
3. Speed control of Chopper fed DC motor.
4. Simulation of VSI fed three phase Induction motor drive.
5. V/f control of Three-Phase Induction motor.
7. Speed control of BLDC motor.
8. DSP based speed control of SRM motor.
10. Voltage Regulation of three-phase Synchronous Generator.
11. AC voltage Controller based speed control of induction motor.

TOTAL : 45 PERIODS

OUTCOMES:

CO1: Ability to construct the simulation circuit for the closed loop control of drive systems
CO2: Ability to formulate, design the speed controller for DC motor-based drive system.
CO3: Ability to conduct load tests in an electrical drive system.
CO4: Ability to formulate, design the speed controller for AC motor-based drive system.
CO5: Ability to design the control algorithm for the control of an electrical drive using Microcontroller and Digital signal processor.

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OBJECTIVES:
- To design power converter after selecting the suitable component for typical applications
- To design non-isolated and isolated switching mode regulators
- To simulate analyse and test different switching mode regulators

LIST OF EXPERIMENTS:
1. Selection and Design of components (Inductor, Capacitor, transformers and devices) for power converters
2. Design and testing of Isolated converter design and verification (100 W)
3. Design and testing of Non-isolated converter design and verification (100 W)
4. Mini Project Demonstration with applications

TOTAL : 45 PERIODS

OUTCOMES:
CO1: Ability to independently carry out research and development work in power converters
CO2: Ability to demonstrate a degree of mastery over the design and fabrication of switching regulators.
CO3: Ability to apply conceptual basis required for design and testing of various
CO4: Ability to interact with industry to take up problem of societal importance as miniproject designed.
CO5: Ability to compare different possible solution to the same practical problem.

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OBJECTIVES:
- To understand the concepts related with power switches and its requirements.
- To know about the developments and characteristics of Silicon Carbide (SiC) and Galium Nitride (GaN) devices.
- To understand the working, steady state and switching characteristics of current controlled and voltage controlled silicon devices.
- To study the working of driving circuits, protection circuits for power devices.
- To understand the thermal characteristics of power devices and the ability to design heat sink for the power devices.

UNIT I  INTRODUCTION
Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Power diodes - Types, forward and reverse characteristics, switching characteristics – rating. Features and Brief History of Silicon Carbide-Promise and Demonstration of SiC Power Devices- Physical Properties of Silicon Carbide devices -Unipolar and Bipolar Diodes- GaN Technology Overview

UNIT II  CURRENT CONTROLLED DEVICES
BJT’s – Construction, static characteristics, switching characteristics; Negative temperature coefficient and second breakdown; - Thyristors – Construction, working, static and transient characteristics, types, series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT &Thyristor- Basics of GTO, SiC based Bipolar devices- Applications- Building a GaN Transistor -GaN Transistor Electrical Characteristics

UNIT III  VOLTAGE CONTROLLED DEVICES
Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - and IGCT. New semiconductor materials for devices – Intelligent power modules- study of modules like APTGT100TL170G, MSCSM70TAM05TPAG. Integrated gate commutated thyristor (IGCT) -SiC based unipolar devices-applications

UNIT IV  DEVICE SELECTION, DRIVING and PROTECTING CIRCUITS
Device selection strategy – On-state and switching losses – EMI due to switching. Necessity of isolation, pulse transformer, optocoupler – Gate drive integrated circuit: Study of Driver IC – IRS2110/2113. SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers

UNIT V  THERMAL PROTECTION
Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for heat sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types- switching loss calculation for power device

TOTAL : 45 PERIODS

OUTCOMES:
After completing the above course, students will be able to

CO1: Identification of suitable device for the application.
CO2: Know the advantages of Silicon Carbide devices and Galium Nitride devices.
CO3: Understand the principles and characteristics of Silicon devices, Silicon Carbide devices
and Galium Nitride devices.

CO4: Design proper driving circuits and protection circuits.

CO5: Construct a proper thermal protective devices for power semiconductor devices.

REFERENCES:
5. Biswanath Paul, Power Electronics, Universities Press 2019

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PX4002 SYSTEM DESIGN USING MICROCONTROLLER L T P C
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OBJECTIVES:
- To get introduce the fundamentals of microcontroller based system design.
- To learn I/O and other built in features available in microcontroller.
- To know Microcontroller based system design, applications.
- To learn I/O interface in system Design
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired for improved employability skills

UNIT I 8051 ARCHITECTURE

UNIT II 8051 PROGRAMMING

UNIT III PIC 16 MICROCONTROLLER
UNIT IV PERIPHERAL OF PIC 16 MICROCONTROLLER

Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPRO Memories

UNIT V SYSTEM DESIGN –CASE STUDY

Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency- Stand alone Data Acquisition System

TOTAL :45 PERIODS

OUTCOMES:
CO1: Ability to understand the features of microcontroller 8051
CO2: Ability to write programs using 8051 assemble language, utilizing its build in features
CO3: Ability to understand the features of PIC microcontroller.
CO4: Ability to use the peripherals builtin the PIC microcontroller through programming
CO5: Ability to grasp the interfacing concepts involving in the design of microcontroller based systems.

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OBJECTIVES:

- To refresh the fundamentals of Electromagnetic Field Theory
- To provide foundation in formulation and computation of electromagnetic field equations using analytical methods
- To impart knowledge in the concept of problem formulation and computation of electromagnetic field equations using numerical methods.
- To compute and analyze the field quantities using FEM.
- To formulate, solve, analyze and optimize the design of electrical components

UNIT I INTRODUCTION

Review of basic field theory – Maxwell’s equations – Constitutive relationships and Continuity equations – Laplace, Poisson and Helmholtz equation – principle of energy conversion – force/torque calculation

UNIT II BASIC SOLUTION METHODS FOR FIELD EQUATIONS

Limitations of the conventional design procedure need for the field analysis based design, problem definition, boundary conditions, solution by analytical methods - direct integration method – variable separable method – method of images

UNIT III SOLUTION BY NUMERICAL METHODS


UNIT IV COMPUTATION OF BASIC QUANTITIES USING FEM PACKAGES


UNIT V DESIGN APPLICATIONS


TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the students will be able to

CO1: Explain and interpret the concept of Electromagnetic Field Theory.
CO2: Formulate the field problem and apply analytical and numerical method for solving Electromagnetic field problems.
CO3: Formulate Finite Element Methodology for solving electro Magnetic field problem
CO4: Estimate the basic Electromagnetic field quantities using FEM.
CO5: Design electrical apparatus using FEM

REFERENCES:


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### PX4004 SOFT COMPUTING TECHNIQUES

**OBJECTIVES**

- Design of ANN and fuzzy set theory.
- Analysis and implementation of ANN and Fuzzy logic for modeling and control of Non-linear system and to get familiarized with the Matlab toolbox.
- Impart the knowledge of various optimization techniques and hybrid schemes with the ANFIS tool box.

### UNIT I INTRODUCTION AND ARTIFICIAL NEURAL NETWORKS


### UNIT II ARTIFICIAL NEURAL NETWORKS AND ASSOCIATIVE MEMORY


### UNIT III FUZZY LOGIC SYSTEM

Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control- Fuzzification inferencing and defuzzification-Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system.
UNIT IV GENETIC ALGORITHM
Evolutionary programs – Genetic algorithms, genetic programming and evolutionary programming - Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators - Optimization problems using GA-discrete and continuous - Single objective and multi-objective problems - Procedures in evolutionary programming.

UNIT V HYBRID CONTROL SCHEMES

TOTAL : 45 PERIODS

OUTCOMES:
Ability to
CO1: Understand the basic architectures of NN and Fuzzy sets
CO2: Design and implement ANN architectures, algorithms and know their limitations
CO3: Identify and work with different operations on the fuzzy sets.
CO4: Develop ANN and fuzzy logic based models and control schemes for non-linear systems.
CO5: Understand and explore hybrid control schemes and PSO

TEXT BOOKS:

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OBJECTIVES:
1. To educate on modeling and representing systems in state variable form.
2. To train on solving linear and non-linear state equations.
3. To illustrate the properties of control system.
4. To classify non-linearities and examine stability of systems in the sense of Lyapunov’s theory.
5. To educate on modal concepts, design of state, output feedback controllers and estimators.

UNIT I  STATE VARIABLE REPRESENTATION

UNIT II  SOLUTION OF STATE EQUATIONS

UNIT III  PROPERTIES OF THE CONTROL SYSTEM
Controllability and Observability-Stabilizability and Detectability-Test for Continuous time Systems-Time varying and Time invariant case-Output Controllability-Reducibility-System Realizations.

UNIT IV  NON-LINEARITIES AND STABILITY ANALYSIS

UNIT IV  MODAL ANALYSIS
Controllable and Observable Companion Forms - SISO and MIMO Systems – Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.

TOTAL: 45 PERIODS

OUTCOMES:
Students able to
CO1 Understand the concept of State-State representation for Dynamic Systems
CO2 Explain the solution techniques of state equations
CO3 Realize the properties of control systems in state space form
CO4 Identify non-linearities and evaluate the stability of the system using Lyapunov notion
CO5 Perform Modal analysis and design controller and observer in state space form

REFERENCES:
2. Z. Bubnicki, "Modern Control Theory", Springer, 2005
3. K. Ogatta, “Modern Control Engineering”, PHI, 2002
OBJECTIVES:
- To provide knowledge about different types of renewable energy systems.
- To analyze the various electrical Generators used for the Wind Energy Conversion Systems.
- To design a power converter used in renewable energy systems such as AC-DC, DC-DC, and AC-AC converters.
- To understand the importance of standalone, grid-connected, and hybrid operation in renewable energy systems.
- To analyze various maximum power point tracking algorithms

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS
Classification of Energy Sources – Importance of Non-conventional energy sources – Advantages and disadvantages of conventional energy sources - Environmental aspects of energy - Impacts of renewable energy generation on the environment - Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, - Solar Photovoltaic (PV), Fuel cells: Operating principles and characteristics, Wind Energy: Nature of wind, Types, control strategy, operating area

UNIT II ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS (WECS)
Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT III POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS

UNIT IV POWER CONVERTERS AND ANALYSIS OF WIND SYSTEMS
OUTCOMES:
Upon completion of the course, students will be able to:

CO1: Analyze the impacts of renewable energy technologies on the environment and demonstrate them to harness electrical power.

CO2: Select a suitable Electrical machine for Wind Energy Conversion Systems.

CO3: Design the power converters such as AC-DC, DC-DC, and AC-AC converters for Solar energy systems.

CO4: Design the power converters such as AC-DC, DC-DC, and AC-AC converters for Wind energy systems.

CO5: Interpret the stand-alone, grid-connected, and hybrid renewable energy systems with MPPT.

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OBJECTIVES:
- To inculcate knowledge on harmonics standards.
- To impart knowledge on the design power factor correction rectifiers for UPS applications.
- To familiarize the design resonant converters for SMPS applications.
- To provide knowledge on dynamic analysis of DC to DC Converters.
- To introduce the control techniques for control of resonant converters.

UNIT I  POWER SYSTEM HARMONICS & LINE COMMUTATED RECTIFIERS  

UNIT II  PULSE WIDTH MODULATED RECTIFIERS  

UNIT III  RESONANT CONVERTERS  

UNIT IV  DYNAMIC ANALYSIS OF SWITCHING CONVERTERS  
Review of linear system analysis-State Space Averaging-Basic State Space Average Model- State Space Averaged model for Buck Converter, Boost Converter, Buck Boost Converter and Cuk Converter.

UNIT V  CONTROL OF PWM RECTIFIERS  
Pulse Width Modulation-Voltage Mode PWM Scheme-Current Mode PWM Scheme- Average current control-Current programmed Control- Hysteresis control- Nonlinear carrier control -Design of Controllers: PI Controller, Variable Structure Controller for source current shaping of PWM rectifiers.

TOTAL : 45 PERIODS

OUTCOMES:
CO1: To understand the standards for supply current harmonics and its significance.
CO2: To design power factor correction rectifiers for UPS applications.
CO3: To analyze and design the resonant converters.
CO4: To derive the state space model of basic and derived DC-DC converters.
CO5: To design an appropriate controller for PWM rectifiers.

REFERENCES:
1. John G. Kassakian, Martin F. Schlecht, George C. Verghese, “Principles of Power Electronics”, Pearson, India, New Delhi, 2010
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PX4007 ADVANCED POWER CONVERTERS

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Objectives:
- To study the operation of voltage lift circuits
- To impart knowledge on the working of super lift circuits
- To learn the operation of ultra lift converters and multiple quadrant converters.
- To provide knowledge on the principle of bidirectional dual active bridge converters
- To educate on the working principle of impedance source converter

Unit I Voltage-Lift Converters
Introduction- Self-lift and reverse self-lift circuits- Cuk converter, Luo converter and SEPIC converter- continuous and discontinuous conduction mode.-Applications

Unit II Positive Output & Negative Output Super-Lift Luo-Converters
Main series, -Elementary Circuit, Re-Lift Circuit, Triple-Lift Circuit, Higher-Order Lift Circuit- Continuous and discontinuous conduction modes- Applications

Unit III Ultra Lift Converters and Multiple-Quadrant Operating Luo-Converters
Ultra-Lift Luo- Converter- Operation - Continuous and discontinuous conduction Modes of Ultra-Lift Luo-Converter-Instantaneous Values- Multiple quadrant operating Luo Converters- Circuit explanations-Modes of operation- Applications

Unit IV Bidirectional Dual Active Bridge DC-DC Converters
Application of Bidirectional DC–DC Converter-Classification of Bidirectional DC–DC Converter - Working Principle of Hybrid-Bridge-Based Dual active bridge (DAB) converter- Performance-Voltage mode control- Principle of Dual-Transformer based DAB converter- Three-Level bidirectional DC–DC converter- Applications

Unit V Impedance Source Converter

Total :45 Periods

Outcomes:
After completing the above course, students will be able to
CO1 : Understand the working of voltage lift circuits
CO2: Design the super lift converters
CO3 : Understand the working and applications of ultra-lift converters
CO4 : Acquire knowledge on working and design of bi-directional DC-DC converters

CO5 : Understand the concepts related with impedance source converter

TEXT BOOKS
3. Deshang Sha, Guo Xu, “High-Frequency Isolated Bidirectional Dual Active Bridge DC–DC Converters with Wide Voltage Gain”, Springer 2019

REFERENCE BOOKS

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PX4009 CONTROL OF POWER ELECTRONIC CIRCUITS

OBJECTIVES:
- To inculcate knowledge on the basics of control for power electronic circuits
- To illustrate the concepts of feedback controllers for DC-DC converters
- To learn about the controller design for AC-DC converter circuits
- To impart knowledge on sliding mode control
- To equip with required skills to design flatness-based controllers

UNIT I CONTROLLER DESIGN FOR BASIC DC-DC CONVERTERS- PART I 9
Introduction, Review of Linear Control Theory, Linearization of Various Transfer Function Blocks, Feedback Controller Design in Voltage-Mode Control, Peak-Current Mode Control, Feedback Controller Design in DCM

UNIT II CONTROLLER DESIGN FOR BASIC DC-DC CONVERTERS- PART II 9
Introduction, Linear Feedback Control- Pole Placement by Full State Feedback, Pole Placement Based on Observer Design, Reduced Order Observers, Generalized Proportional Integral Controllers-Hamiltonian Systems Viewpoint - Application to power converters

UNIT III CONTROLLER DESIGN FOR BASIC AC-DC CONVERTER CIRCUITS 9
Introduction, Operating Principle of Single-Phase PFCs, Control of PFCs, Designing the Inner Average-Current-Control Loop, Designing the Outer Voltage-Control Loop, Example of Single-Phase PFC Systems
UNIT IV  SLIDING MODE CONTROL

UNIT V  FLATNESS BASED CONTROL
Flatness, the use of the differential flatness property, Controller development using flatness- Application to power converters

OUTCOMES:
After completing the above course, students will be able to
CO1: Design controller for front end power factor corrector circuits.
CO2: Design controllers for UPS application.
CO3: Design controllers for AC-DC converters.
CO4: Design sliding mode control for power converters.
CO5: Design flatness based control for power converters.

TEXT BOOKS:

REFERENCE BOOKS:
1. Farzin Asadi and Kei Eguchi, Morgan & Claypool, "Dynamics and Control of DC-DC Converters", 2018

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TOTAL : 45 PERIODS
PS4072 ENERGY STORAGE TECHNOLOGIES LT P C 3 0 0 3

COURSE OBJECTIVES:
- To understand the various types of energy storage Technologies
- To analyze thermal storage system
- To analyze different battery storage technologies
- To analyze the thermodynamics of Fuel Cell
- To study the various applications of energy storage systems

UNIT I INTRODUCTION 9
Necessity of energy storage – types of energy storage – energy storage technologies – Applications.

UNIT II THERMAL STORAGE SYSTEM 9
Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – Pressurized water storage system – Modelling of phase change storage system – Simple units, Packed bed storage units - Modelling using porous medium approach,

UNIT III ELECTRICAL ENERGY STORAGE 9

UNIT IV FUEL CELL 9

UNIT V ALTERNATE ENERGY STORAGE TECHNOLOGIES 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of this course, the students will be able to
CO1: Understand the physics of energy storage
CO2: Model the different energy technologies.
CO3: Recognize the applications of various techniques.
CO4: Design and analyze the energy storage technologies.
CO5: Select and apply the appropriate technique based on the application.

REFERENCES
3. Jiujun Zhang (Editor), Lei Zhang (Editor), Hansan Liu (Editor), Andy Sun (Editor), Ru-Shi Liu (Editor), “Electrochemical technologies for energy storage and conversion”, Two Volume Set, Wiley publications, 2012
OBJECTIVES:

- To provide knowledge about various power quality issues.
- To understand the concept of power and power factor in single phase and three phase systems supplying nonlinear loads.
- To equip with required skills to design conventional compensation techniques for power factor correction and load voltage regulation.
- To introduce the control techniques for the active compensation.
- To understand the mitigation techniques using custom power devices such as DSTATCOM, DVR & UPQC

UNIT I INTRODUCTION


UNIT II ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM


UNIT III CONVENTIONAL LOAD COMPENSATION METHODS

UNIT IV LOAD COMPENSATION USING DSTATCOM

Compensating single-phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode

UNIT V SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM


TOTAL : 45 PERIODS

OUTCOMES:
After completing the above course, students will be able to
CO1: comprehend the consequences of Power Quality issues.
CO2: conduct harmonic analysis of single phase and three phase systems supplying non-linear loads.
CO3: design passive filter for load compensation.
CO4: design active filters for load compensation.
CO5: understand the mitigation techniques using custom power devices such as distribution static compensator (DSTATCOM), dynamic voltage restorer (DVR) & UPQC.

TEXTBOOKS:

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COURSE OBJECTIVES:
1. To understand various representation methods of DSP system
2. To provide insight about different DSP algorithms
3. To familiarize the various architectures of DSP system
4. To perform analysis of DSP architectures and to learn the implementation of DSP system in programmable hardware
5. To learn the details of DSP system interfacing with other peripherals

UNIT I REPRESENTATION OF DSP SYSTEM

UNIT II DSP ALGORITHMS
DSP algorithms - Convolution, Correlation, FIR/IIR filters, FFT, adaptive filters, sampling rate converters, DCT, Decimator, Expander and Filter Banks. DSP applications. Computational characteristics of DSP algorithms and applications, Numerical representation of signals-word length effect and its impact, Carry free adders, Multiplier.

UNIT III SYSTEM ARCHITECTURE
Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing. VLIW architecture. Basic performance issue in pipelining, Simple implementation of MIPS, Instruction Level Parallelism, Dynamic Scheduling, Dynamic Hardware Prediction, Memory hierarchy. Study of Fixed point and floating point DSP architectures

UNIT IV ARCHITECTURE ANALYSIS ON PROGRAMMABLE HARDWARE
Analysis of basic DSP Architectures on programmable hardwares. Algorithms for FIR, IIR, Lattice filter structures, architectures for real and complex fast Fourier transforms, 1D/2D Convolutions, Winograd minimal filtering algorithm. FPGA: Architecture, different sub-systems, design flow for DSP system design, mapping of DSP algorithms onto FPGA.

UNIT V SYSTEM INTERFACING
Examples of digital signal processing algorithms suitable for parallel architectures such as GPUs and multiGPUs. Interfacing: Introduction, Synchronous Serial Interface CODE, A CODEC Interface Circuit, ADC interface.

COURSE OUTCOMES:
At the end of this course, the students will have the ability in
CO 1: Evaluate the DSP system using various methods.
CO 2: Design algorithm suitable for different DSP applications.
CO 3: Explain various architectures of DSP system.
CO 4: Implement DSP system in programmable hardware.
CO 5: Build interfacing of DSP system with various peripherals.
## Course Objectives:
The course is aimed at:
1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

## Unit I: Learning Problems and Algorithms
Various paradigms of learning problems: Supervised, Semi-supervised and Unsupervised algorithms.

## Unit II: Neural Networks

## Unit III: Machine Learning – Fundamentals & Feature Selections & Classifications
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1-score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality.
reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS 9
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS 9
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1 : Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

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REFERENCES:
COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

UNIT I  INTRODUCTION TO INTERNET OF THINGS  9
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II  IOT ARCHITECTURE  9

UNIT III  PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT  9
PROTOCOLS:
NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV  IOT PROCESSORS  9
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.

Embedded processors for IOT: Introduction to Python programming - Building IOT with RASPBERRY PI and Arduino.

UNIT V  CASE STUDIES  9
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT
CO3: Explain different protocols and communication technologies used in IoT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications
REFERENCES:


ET4018 MEMS DESIGN: SENSORS AND ACTUATORS

OBJECTIVES:
- To analyse the properties of materials, microstructure and fabrication methods.
- To design and modeling of Electrostatic sensors and actuators.
- To teach the characterizing thermal sensors and actuators through design and modeling.
- To understand the fundamentals of piezoelectric sensors and actuators through exposure to different MEMS and NEMS devices

UNIT I MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONCEPTS
Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain-flexural beam bending analysis- torsional deflections-Intrinsic stress- resonant frequency and quality factor.
UNIT II  ELECTROSTATIC SENSORS AND ACTUATION  
Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications

UNIT III  THERMAL SENSING AND ACTUATION  
Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors-Applications.

UNIT IV  PIEZOELECTRIC SENSING AND ACTUATION  
Piezoelectric effect-cantilever piezo electric actuator model-properties of piezoelectric materials Applications.

UNIT V  CASE STUDIES  
Piezoresistive sensors, Magnetic actuation, Micro fluidics applications, Medical applications, Optical MEMS.-NEMS Devices

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course, the students will demonstrate the ability

CO1: To analyse the learning process to design of micro sensors, embedded sensors & actuators
CO2: To analyse the electrostatic sensors and actuators through MEMS and NEMS devices
CO3: To analyse the thermal sensors and actuators through MEMS and NEMS devices
CO4: To analyse the piezoelectric sensors and actuators through MEMS and NEMS
CO5: Design of piezoresistive sensors for biomedical and micro fluidic applications

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OBJECTIVES:

- To understand the non linear behavior of power electronic converters.
- To understand the techniques for investigation on non linear behavior of power electronic converters.
- To analyse the nonlinear phenomena in DC to DC converters.
- To analyse the nonlinear phenomena in AC and DC Drives.
- To introduce the control techniques for control of non linear behavior in power electronic systems.

UNIT I Basics of Nonlinear Dynamics

UNIT II Techniques for Investigation of Nonlinear Phenomena
Techniques for experimental investigation, Techniques for numerical investigation, Computation of averages under chaos, Computations of spectral peaks, Computation of the bifurcation and analyzing stability.

UNIT III Nonlinear Phenomena in DC-DC Converters
Border collision in the Current Mode controlled Boost Converter, Bifurcation and chaos in the Voltage controlled Buck Converter with latch, Bifurcation and chaos in the Voltage controlled Buck Converter without latch, Bifurcation and chaos in Cuk Converter. Nonlinear phenomenon in the inverter under tolerance band control.

UNIT IV Nonlinear Phenomena in Drives
Nonlinear Phenomenon in Current controlled and voltage controlled DC Drives, Nonlinear Phenomenon in PMSM Drives.

UNIT V Control of Chaos
Hysteresis control, Sliding mode and switching surface control, OGY Method, Pyragas method, Time Delay control. Application of the techniques to the Power electronics circuit and drives.

TOTAL : 45 PERIODS

OUTCOMES:

CO1 Ability to understand, model and simulate chaotic behavior in power electronic systems.
CO2 Ability to investigate the various techniques of non linear phenomena
CO3 Ability to analyze the nonlinear phenomena in DC-DC converter
CO4 Ability to analyze the non linear phenomena in Drives
CO5 Ability to mitigate chaotic behavior noticed in power system.

TEXT BOOKS:
2. Steven H Strogatz, Nonlinear Dynamics and Chaos, Westview Press
REFERENCES:

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PX4011 GRID INTEGRATION OF RENEWABLE ENERGY SOURCES L T P C 3 0 0 3

OBJECTIVES:
- To study about the integration of various renewable energy sources into the grid.
- To analyse various grid issues due to renewable energy sources.
- To analyse the dynamics of network due to wind farm
- To provide knowledge about power system stabilizers.
- To provide knowledge about grid connected and standalone PV system

UNIT I INTRODUCTION
Introduction to renewable energy grid integration - Concept of mini/micro grids and Smart grids - Different types of grid interfaces - Issues related to grid integration of small and large scale of synchronous generator based - induction generator based and converter based sources together - Network voltage management - Power quality management (voltage dips, harmonics, flickers, and reactive power control) - Frequency management - Influence of WECS on system transient response - Interconnection standards and grid code requirements for integration.

UNIT II NETWORK INFLUENCE OF GENERATION TYPE

UNIT III INFLUENCE OF WIND FARMS ON NETWORK DYNAMIC PERFORMANCE
UNIT IV  POWER SYSTEM STABILIZERS AND NETWORK DAMPING  9
CAPABILITY OF WIND
A Power System Stabilizer for a Synchronous Generator - A Power System Stabilizer for a DFIG - A Power System Stabilizer for a FRC Wind Farm.

UNIT V  STAND ALONE AND GRID CONNECTED PV SYSTEM  9
TOTAL:  45 PERIODS

OUTCOMES:
CO1: Know about the integration of various renewable energy sources into the grid.
CO2: Able to analyze various grid issues due to renewable energy sources.
CO3: Able to analyze the dynamics of network due to windfarm
CO4: Know about power system stabilizers.
CO5: Able to design the grid connected and standalone PV system.

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OBJECTIVES:
To impart knowledge on
- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT I INTRODUCTION
Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS

UNIT III PHOTOVOLTAIC SYSTEM DESIGN
Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS

UNIT V OTHER RENEWABLE ENERGY SOURCES
Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

OUTCOMES:
After completion of this course, the student will be able to:
CO1: Demonstrate the need for renewable energy sources.
CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.
CO3: Design a stand-alone and Grid connected PV system.
CO4: Analyze the different configurations of the wind energy conversion systems.
CO5: Realize the basic of various available renewable energy sources

TOTAL: 45 PERIODS
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PX4013 WIND ENERGY CONVERSION SYSTEM

OBJECTIVES:
- To learn about the basic concepts of wind energy conversion system
- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed wind energy conversion systems.
- To understand the concepts of Variable speed wind energy conversion systems.
- To analyze the grid integration issues.

UNIT I INTRODUCTION
Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory- Power coefficient-Sabinin’s theory-Aerodynamics of Wind turbine

UNIT II WINDTURBINES
HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations- Tip speed ratio-No. Of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control- stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS
Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS
Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modelling - Variable speed variable frequency schemes.
UNIT V GRIDCONNECTED SYSTEMS

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to:
CO1: Attain knowledge on the basic concepts of Wind energy conversion system.
CO2: Attain the knowledge of the mathematical modelling and control of the Wind turbine.
CO3: Develop more understanding on the design of Fixed speed system.
CO4: Study about the need of Variable speed system and its modelling.
CO5: Learn about Grid integration issues and current practices of wind interconnections with power system.

REFERENCES:
5. N. Jenkins, "Wind Energy Technology" John Wiley & Sons, 1997

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OBJECTIVES:
Students will be able to:
- understand the classification of optimization
- study the linear programming models and solution techniques
- study the different non-linear programming problem solution techniques
- understand the concept of dynamic programming
- study the fundamentals genetic algorithm and its applications.

UNIT I INTRODUCTION 9
Definition, Classification of optimization problems, Classical Optimization Techniques, Single and Multiple Optimization with and without inequality constraints.

UNIT II LINEAR PROGRAMMING (LP) 9
Simplex method of solving LPP, revised simplex method, duality, Constrained optimization, Theorems and procedure, Linear programming, mathematical model, solution technique, duality.

UNIT III NON LINEAR PROGRAMMING 9

UNIT IV DYNAMIC PROGRAMMING (DP) 9
Multistage decision processes, concept of sub-optimization and principle of optimality, Recursive relations, Integer Linear programming, Branch and bound algorithm.

UNIT V GENETIC ALGORITHM 9
Introduction to genetic Algorithm, working principle, coding of variables, fitness function, GA operators; Similarities and differences between Gas and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded gas, Advanced Gas, global optimization using GA, Applications to power system.

OUTCOMES:
Students will be able to:
CO1: learn about different classifications of optimization problems and techniques.
CO2: attain knowledge on linear programming concepts
CO3: understand the application of non-linear programming in optimization techniques
CO4: understand the fundamental concepts of dynamic programming
CO5: gain knowledge about Genetic algorithm and its application to power system optimization.

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PS4091 DISTRIBUTED GENERATION AND MICRO GRID

COURSE OBJECTIVES:
- To familiarize with the concept of Distributed Generation
- To expose the various distributed energy resources
- To focus on the planning and protection of Distributed Generation
- To study the concept of MicroGrid and to analyze the impact of MicroGrid
- To understand the major issues on MicroGrid economics

UNIT I INTRODUCTION TO DISTRIBUTED GENERATION
DG definition - Reasons for distributed generation-Benefits of integration - Distributed generation and the distribution system - Technical, Environmental and Economic impacts of distributed generation on the distribution system - Impact of distributed generation on the transmission system-Impact of distributed generation on central generation

UNIT II DISTRIBUTED ENERGY RESOURCES
Combined heat and power (CHP) systems-Wind energy conversion systems (WECS)- Solar photovoltaic (PV) systems-Small-scale hydroelectric power generation-Other renewable energy sources-Storage devices-Inverter interfaces

UNIT III DG PLANNING AND PROTECTION
Generation capacity adequacy in conventional thermal generation systems-Impact of distributed generation-Impact of distributed generation on network design-Protection of distributed generation- Protection of the generation equipment from internal Faults-Protection of the faulted distribution network from fault currents supplied by the distributed generator-Impact of distributed generation on existing distribution system protection.

UNIT IV CONCEPT OF MICROGRID

UNIT V IMPACTS OF MICROGRID
Microgrid economics-Main issues of Microgrid economics-Microgrids and traditional power system economics-Emerging economic issues in Microgrids-Economic issues between Microgrids and bulk power systems-Potential benefits of Microgrid economics.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Students able to
CO1: Understand the concepts of Distributed Generation and Microgrids.
CO2: Gain Knowledge about the various DG resources.
CO3: Familiarize with the planning and protection schemes of Distributed Generation.
CO4: Learn the concept of Microgrid and its mode of operation.
CO5: Acquire knowledge on the impacts of Microgrid.

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OBJECTIVES:
- To study the concepts behind economic analysis and load management
- To emphasize the energy management of various electrical equipment and metering
- To illustrate the concept of energy management technologies

UNIT I      ENERGY SCENARIO                     9

UNIT II     ENERGY COST AND LOAD MANAGEMENT     9
Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- Cost of electricity-Loss evaluation- Load management: Demand control techniques- Utility monitoring and control system-HVAC and energy management-Economic justification.

UNIT III    ENERGY MANAGEMENT                      9
Demand side management (DSM)– DSM planning – DSM techniques – Load management as a DSM strategy – Energy conservation – Tariff options for DSM.

UNIT IV     ENERGY AUDITING                     9

UNIT V      ENERGY EFFICIENT TECHNOLOGIES            9
Energy saving opportunities in electric motors - Power factor improvement benefit and techniques-Shunt capacitor, Synchronous Condenser and Phase Advancer - Energy conservation in industrial drives, electric furnaces, ovens and boilers - Lighting techniques: Natural, CFL, LED lighting sources and fittings.

TOTAL: 45 PERIODS

OUTCOMES:
Upon Completion of this course, the students will be able to
CO1: Understand the present energy scenario and role of energy managers.
CO2: Comprehend the Economic Models for cost and load management.
CO3: Configure the Demand side energy management through its control techniques, strategy and planning.
CO4: Understand the process of energy auditing.
CO5: Implement energy conservation aspects in industries.

REFERENCES
COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications.
- To get familiarized with the communication networks for Smart Grid applications.

UNIT I  INTRODUCTION TO SMART GRID
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II  SMART GRID TECHNOLOGIES
Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III  SMART METERS AND ADVANCED METERING INFRASTRUCTURE
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV  POWER QUALITY MANAGEMENT IN SMART GRID
UNIT V    HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS

Architecture and Standards - Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

COURSE OUTCOME:
Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications

REFERENCES

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PS4351    HVDC AND FACTS

OBJECTIVES:
- To emphasis the need for FACTS controllers.
- To learn the characteristics, applications and modeling of series and shunt FACTS controllers.
- To analyze the interaction of different FACTS controller and perform control coordination.
- To impart knowledge on operation, modelling and control of HVDC link.
- To perform steady state analysis of AC/DC system.

UNIT I        INTRODUCTION

Review of basics of power transmission networks-control of power flow in AC transmission line- Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need
for FACTS controllers- types of FACTS controllers-Need for HVDC system-MTDC system-
Review of basics of LCC and VSC HVDC system.Configurations-Monopolar Asymmetric and
Symmetric MMC-HVDC Scheme- Bipolar and Homopolar HVDC Scheme- Multi-Terminal
HVDC Configuration- Layout of HVDC system (LCC, VSC)

UNIT II  THYRISTOR BASED FACTS CONTROLLERS  9
Configuration of SVC- voltage regulation by SVC- Modelling of SVC for power flow analysis-
Stability studies- Applications: transient stability enhancement and power oscillation damping
of SMIB system with SVC connected at the mid-point of the line-Concepts of Controlled Series
Compensation – Operation of TCSC- Analysis of TCSC – Modelling of TCSC for power flow
and stability studies.

UNIT III  ANALYSIS OF LCC HVDC CONVERTERS AND HVDC SYSTEM CONTROL  9
Choice of converter configuration – Simplified analysis of Graetz circuit Converter bridge
characteristics – characteristics of a twelve pulse converter- detailed analysis of converters.
General principles of DC link control – Converter control characteristics – System control
hierarchy - Firing angle control – Current and extinction angle control – Generation of
harmonics and filtering - power control – Higher level controllers. Modelling of LCC HVDC
system and controllers, transformer derating and core saturation instability,Concepts of Power
Oscillation Damping Controller, Frequency Controller and Sub synchronous Damping
controller in LCC HVDC.

UNIT IV  VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS  9
Static synchronous compensator (STATCOM) - Static synchronous series compensator
(SSSC) Operation of STATCOM and SSSC-Power flow control with STATCOM and SSSC-
Modelling of STATCOM and SSSC for power flow and transient stability studies –operation of
Unified and Interline power flow controllers (UPFC) - Modelling of UPFC and IPFC for power
flow and transient stability studies-Concepts of Power Oscillation Damping using FACTS
controllers

UNIT V  VOLTAGE SOURCE CONVERTER BASED HVDC SYSTEM AND CONTROLS  9
Applications VSC based HVDC: Operation, Modelling for steady state and dynamic studies,
.Introduction to Modular Multilevel converters- Main circuit design-Converter Operating
Principle and Averaged Dynamic Model- Per-Phase Output-Current Control - Arm-Balancing
(Internal) Control- Vector Output-Current Control-Higher-Level Control-Modulation and
Submodule Energy Balancing- Offshore HVDC integration System Studies -Control and
Protection of MMC-HVDC under AC and DC Network Fault Contingencies- Modeling and
Simulation of MMC based MTDC Simulation exercises, Steady state, Fault recovery
characteristics - Solution of DC load flow-Solution of AC-DC power flow: Sequential and
Simultaneous methods.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Learners will be able to refresh on basics of power transmission networks and need for
FACTS controllers
2. Ability to design series and shunt compensating devices for power transfer
enhancement
3. Learners will understand the significance about different voltage source converter
based FACTS controllers
4. Learners will attain knowledge on AC/DC system coordinated control with FACTS and
HVDC link
5. Learners will be capable to explore the MMC converter applications FACTS and
MTDC system
REFERENCES

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ET4073 PYTHON PROGRAMMING FOR MACHINE LEARNING L T P C 3 0 0 3

COURSE OBJECTIVES:
1. Students will understand and be able to use the basic programming principles such as data types, variable, conditionals, loops, recursion and function calls.
2. Students will learn how to use basic data structures such as List, Dictionary and be able to manipulate text files and images.
3. To make the students familiar with machine learning concepts & techniques.
4. Students will understand the process and will acquire skills necessary to effectively attempt a machine learning problem and implement it using Python.
5. To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved research/employability skills

UNIT I INTRODUCTION TO MACHINE LEARNING AND PYTHON
Introduction to Python and its significance – Difference between C, C++ and Python Languages; Compiler and Interpreters – Python3 Installation & Running – Basics of Python Programming Syntax: Variable Types, Basic Operators, Reading Input from User – Arrays/List, Dictionary and Set – Conditional Statements – Control Flow and loop control statements
UNIT II   PYTHON FUNCTIONS AND PACKAGES

UNIT III IMPLEMENTATION OF MACHINE LEARNING USING PYTHON

UNIT IV CLASSIFICATION AND CLUSTERING CONCEPTS OF ML
Types of Clustering Algorithms & Techniques – K-means Algorithm, Mean Shift Algorithm & Hierarchical Clustering Algorithm – Introduction to Python Visualization using Matplotlib: Plotting 2-dimensional, 3-dimensional graphs; formatting axis values; plotting multiple rows of data in same graph – Implementation of K-means Algorithm and Mean Shift Algorithm using Python

UNIT V INTRODUCTION TO NEURAL NETWORKS AND EMBEDDED MACHINE LEARNING

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Develop skill in system administration and network programming by learning Python.
CO2: Demonstrating understanding in concepts of Machine Learning and its implementation using Python
CO3: Relate to use Python’s highly powerful processing capabilities for primitives, modelling etc
CO4: Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.
CO5: Apply the concepts acquired over the advanced research/employability skills
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REFERENCES:

AX4091 ENGLISH FOR RESEARCH PAPER WRITING

OBJECTIVES
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS

UNIT III TITLE WRITING SKILLS
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES

AX4092 DISASTER MANAGEMENT LT P C 2000

OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

UNIT III DISASTER PRONE AREAS IN INDIA 6
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS
OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES

AX4093 CONSTITUTION OF INDIA L T P C
2 0 0 0

OBJECTIVES
Students will be able to:
• Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
• To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
• To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

UNIT IV ORGANS OF GOVERNANCE
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION
UNIT VI   ELECTION COMMISSION
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:

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

SUGGESTED READING
1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. பிருந்தானாள் - துண்டமில பெருக்க
- துண்டி, சிற்பரகாசம், சிற்பமாடுகள், அருங்காட்சிகள் (தங்கட்டிய விளைவுகள் வான்)

UNIT III
நூற்றாண்டு கருப்பினம்

1. கல்லழுத்திலிருந்து புந்தி
   - விளம்புத்தியா முதலிலான காட்சி

2. சுயக்கவாசு துண்டமில பெருவிறான
   - தியானமில கருப்பினம் காட்சி

UNIT IV
அதிருக்கும் களி

1. சிலமடைய்க்கப்பட்டிடும்
   - பாரி புலமாக்கத்துக்கு முன் கான்கள், புலம் பலியுடன்
   பாராட்டு கான்கள், ஆத்திவகாச தொழில்கள் புழுத்திகள்
   கான்கள், அருங்காட்சிகள்

2. காவராள்
   - அதிருக்கும் புலம் கின்பு

3. சிற்பமாடு (617, 618)
   - துண்டி சிற்பம் விளிம்பு

4. கருப்பினமாழும் பிறங்கிய விளிம்பு

5. புழுத்துக்கை
   - சிலமடைய்க்கப்பட்டிடும் விளிம்பு

6. அதிருக்கும் (4) - பாரி
   காவராள் (11) - காவராள்
   கருப்பினம் (11) - புழுத்துக்கை, புந்தி
   துண்டமில 50 (27) - புந்தி
UNIT V தொன்று செறியல்

1. உச்சகர்வத்து செறி,
   - குறிப்பிட்டு பக்து பிறவனை,
   - தொன்று பக்து சிக்காதே, 
   - குறிப்பிட்ட இந்தியவை,
   - பாண்டன் கைலகியல்,
   - நோக கைலகியல்,
   - காகம்,

2. தொன்று செறியல் வழக்காரம் செறியல் கைலகியல்,

3. செங்கணம் செறியல் செறியல் கைலகியல்,

4. பாண்டன் செறியல் சிக்காதே கீழ்வரைச்சித் தொன்று கைலகியல்,

5. அதிகாரிப்பு செறி,

6. மாடுகார் செறி,

7. குறிப்பிட்டு செறியல் வழக்காரம் செறியல் கைலகியல்.

செறியல் கைலகியல் சுருக்குப்பிரப்பு / புத்தகங்கள்

1. செறியல் தொன்று கைலக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org

2. செறியல் சிக்காரிப்புப்பிரப்பு (Tamil Wikipedia)
   - https://ta.wikipedia.org

3. குறிப்பிட்டு சிக்காரிப்பு

4. பாண்டன் கைலகியல்
   - செறியல் பாண்டன் கைலகியல், தொன்றுகள்

5. செறியல் கைலகியல்
   - செறியல் பாண்டன் கைலகியல் (thamilvalarchithurai.com)
6. அறிவியல் கல்வியம்கள்
- கைலக்கழகம் பல்கலைக்கழகம், குருக்கள்

TOTAL: 30 PERIODS