# E.G.S. PILLAY ENGINEERING COLLEGE

***(Autonomous)***

NAGAPATTINAM – 611002

*(Affiliated to Anna University, Chennai | Accredited by NAAC with 'A++' Grade)*

*(Accredited by NBA T1(B.E. – CSE, CIVIL, ECE, EEE, MECH&B.Tech – IT)*

*(Approved by AICTE, New Delhi)*

## B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING R – 2023

## THIRD YEAR

## CURRICULUM AND SYLLABUS FOR FIFTH SEMESTER

| SEMESTER V | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **Category** | **L** | **T** | **P** | **C** | **MAX. MARKS** | | |
| | | | | | | | **CA** | **ES** | **TOTAL** |
| **THEORY COURSES** | | | | | | | | | |
| 2302EE501 | Microprocessor and Microcontroller | PCC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| 2302EE502 | Power System Analysis | PCC | 3 | 2 | 0 | 4 | 40 | 60 | 100 |
| 2302CS505 | Java Programming | PEC | 2 | 0 | 2 | 3 | 50 | 50 | 100 |
| | Elective –I | PEC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| | Elective –II | PEC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| | Open Elective -I | OEC | 3 | 0 | 0 | 3 | 40 | 60 | 100 |
| **LABORATORY COURSES** | | | | | | | | | |
| 2302EE551 | Computer Aided Electrical Drawing Laboratory | PCC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 2302EE552 | Microprocessor and Microcontroller Laboratory | PCC | 0 | 0 | 2 | 1 | 60 | 40 | 100 |
| 2304GE501 | Professional Development Course III | EEC | 0 | 0 | 2 | 1 | 100 | 0 | 100 |
| 2301LS501 | Life skill course 5# | LS | 0 | 0 | 0 | 0 | 100 | 0 | 100 |
| **Total** | | | **17** | **02** | **08** | **22** | **570** | **430** | **1000** |

**L-Lecture |T –Tutorial |P- Practical |C-Credit |CA – Continuous Assessment |ES – End Semester**

**2302EE501 MICROPROCESSORS AND MICROCONTROLLER**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**PREREQUISITES:**

Digital Electronics

**COURSE OBJECTIVES:**

1. To understand the concepts of Architecture of 8085 and 8086 microprocessor
2. To understand the design aspects of I/O and Memory Interfacing circuits
3. To understand the architecture and programming of 8051 microcontroller.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Explain the architecture, instruction set, memory organization and interrupt structure of 8085 microprocessor.

**CO2:** Apply the functional behavior of 8086 signals, use of system bus, closely and loosely coupled multiprocessor and I/O memory interfacing circuits

**CO3:** Demonstrate programming proficiency using the various addressing modes and data transfer instructions of the microprocessor.

**CO4:** Explain the architecture, timers , ports, interrupts, various addressing modes and instruction set of the microcontroller

**CO5:** Compose an assembly language program using 8051 microcontroller for the control of simple electrical and electronics systems.

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | - | - | 2 | - | - | - | | - | 1 | - | 1 |
| CO2 | 3 | 2 | 2 | - | 2 | - | - | - | | - | 1 | - | 1 |
| CO3 | 3 | 2 | 2 | - | 2 | - | - | - | | - | 1 | - | 1 |
| CO4 | 3 | 2 | - | - | 2 | - | - | - | | - | - | - | 1 |
| CO5 | 3 | 3 | 3 | - | 2 | - | - | - | | - | 1 | - | 2 |

**COURSE CONTENTS:**

**MODULE I 8085 MICROPROCESSOR 9 Hours**

Introduction to 8085- Pin outs- Microprocessor architecture -functional building blocks of processor- interrupts -Addressing modes - Instruction set-simple programs.

**MODULE II 8086 MICROPROCESSOR 9 Hours**

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation

**MODULE III 8086 SYSTEM BUS STRUCTURE 9 Hours**

8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

**MODULE IV 8051 MICROCONTROLLER 9 Hours**

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes – Assembly language programming.

**MODULE V INTERFACING OF MICROCONTROLLER 9 Hours**

Programming 8051 Timers — Serial Port Programming — Interrupts Programming — LCD & Keyboard Interfacing — ADC, DAC & Sensor Interfacing — External Memory Interface- Stepper Motor and Waveform generation — Comparison of Microprocessor and Microcontroller.

**TOTAL : 45 HOURS**

**REFERENCES:**

1. Ramesh Gaonkar, “Microprocessor Architecture, Programming and applications with 8085”, 5th Edition, Penram International Publishing Pvt Ltd, 2010
2. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007
3. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, PHI Ltd., 11th Edition, 2015. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2 nd Edition, Pearson Education, 2011.

4. Doughlas V. Hall, “Microprocessors and Interfacing, Programming and Hardware”, Tata McGraw-Hill, 2012
5. Jonathan W. Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, 3 rd Edition, Cengage Learning, 2012
6. Kenneth L. Short, “Microprocessors and programmed Logic”, 2nd Ed, Pearson Education Inc.,2003
7. Barry B. Brey, “The Intel Microprocessors, 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, PentiumPro Processor, PentiumII, PentiumIII, Pentium IV, Architecture, Programming & Interfacing”, Eighth Edition, Pearson Prentice Hall, 2009.
8. https://archive.nptel.ac.in/courses/108/103/108103157/
9. https://nptel.ac.in/courses/108102045
10. https://archive.nptel.ac.in/courses/106/105/106105193/

**2302EE502** **POWER SYSTEM ANALYSIS**

| L | T | P | C |
|---|---|---|---|
| 3 | 2 | 0 | 4 |

**PREREQUISITES:**

Generation, transmission and distribution

**COURSE OBJECTIVES:**

1. To understand the necessity and to become familiar with the modeling of power system and components.
2. To apply efficient numerical methods to solve/analyze the power flow problems.
3. To model and analyze the power system under steady state and transient operating conditions.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Explain the fundamentals of power system and its components.

**CO2:** Solve power flow problem in planning and operation of power system.

**CO3:** Apply the symmetrical fault calculation methods for the balanced network using Z-bus matrix and thevenin's theorem.

**CO4:** Apply the unsymmetrical fault calculation methods for the unbalanced network components using sequence network analysis.

**CO5:** Carry out power system stability studies for planning and operation of network through various solution techniques.

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | 3 | - |
| **CO2** | 3 | 3 | 2 | - | 1 | - | - | - | - | - | - | 3 | - |
| **CO3** | 3 | 3 | 2 | - | 1 | - | - | - | - | - | - | 3 | - |
| **CO4** | 3 | 3 | 2 | - | 1 | - | - | - | - | - | - | 3 | - |
| **CO5** | 3 | 3 | 2 | - | 1 | - | - | - | - | - | - | 3 | - |

**COURSE CONTENTS:**

**MODULE I PER UNIT REPRESENTATION** **12 Hours**

Power system components – Representation; per unit quantities; single line diagram; impedance diagram of a power system; primitive network representation; representation of off-nominal transformer; formation of bus admittance matrix of large power network.

**MODULE II POWER FLOW STUDIES** **12 Hours**

Necessity of power flow studies – Derivation of static power flow equations; power flow solution using Gauss-Seidel method; Newton-Raphson method; fast decoupled methods; algorithmic approach – load flow computations in large systems.

**MODULE III SYMMETRICAL FAULT ANALYSIS** **12 Hours**

Assumptions in short circuit analysis – Symmetrical short circuit analysis using Thevenin's theorem; bus impedance matrix building algorithm; symmetrical fault analysis through bus impedance matrix; pre-fault current consideration; fault level; current-limiting reactors.

**MODULE IV UNSYMMETRICAL FAULT ANALYSIS** **12 Hours**

Symmetrical components – Sequence impedances; sequence networks; analysis of unsymmetrical faults at generator terminals: LG, LL, and LLG; unsymmetrical fault occurring at any point in a power system: problem approach; computation of post-fault currents in symmetrical component and phasor domains.

**MODULE V POWER SYSTEM STABILITY ANALYSIS** **12 Hours**

Elementary concepts of steady state – Dynamic and transient stabilities; determination of steady state stability; derivation of swing equation; determination of transient stability by equal area criterion; applications of equal area criterion; critical clearing angle and time – digital solution of stability studies by Runge-Kutta method; power reliability planning.

**TOTAL : 60 HOURS**

**REFERENCES:**

1. Grainger, J.J. and William D. Stevenson Jr., "Power System Analysis", Tata McGraw Hill, 2017
2. Gupta, B.R., "Power System Analysis and Design" S.Chand and Co., Ltd,
3. AbhijitChakrabarti, SunitaHalder "Power System Analysis: Operation and Control", 2nd Edition, Prentice Hall of India Learning Private Limited, 2008.
4. HadiSaadat, 'Power System Analysis', Tata McGraw Hill Publishing Company, New Delhi, 2002.
5. Elgerd, O.L., "Electric Energy Systems Theory", 2nd Edition, Tata McGraw Hill, 2007.
6. Gupta, J.B., "A Course in Electrical Power", S.K.Kataria and Sons, 2002.

**2302CS505** **JAVA PROGRAMMING**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 1 | 3 |

**PREREQUISITES:**

1. Programming in C & C++
2. Introduction to Computer

**COURSE OBJECTIVES:**

1. To introduce the object oriented programming concepts.
2. To understand object oriented programming concepts, and apply them in solving Problems.
3. To introduce the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes.
4. To introduce the implementation of packages and interfaces
5. To introduce the concepts of exception handling and multithreading.
6. To introduce the design of Graphical User Interface using applets.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Understand the use of OOP techniques for solving real world problems.
**CO2:** Apply the use of abstract classes and Packages in java.
**CO3:** Develop and understand exception handling and Interfaces in java.
**CO4:** Develop multithreaded applications with synchronization and design GUI based applications
**CO5:** Develop applets for web applications.

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | - | - | 3 | - | - | 1 | 1 | - | - | 1 | 1 |
| **CO2** | 3 | 2 | 1 | - | 3 | - | - | 1 | 1 | - | - | 1 | 1 |
| **CO3** | 3 | 2 | 1 | - | 3 | - | - | 1 | 1 | - | - | 1 | 1 |
| **CO4** | 3 | 2 | 1 | - | 3 | - | - | 1 | 1 | - | - | 1 | 1 |
| **CO5** | 3 | 2 | 1 | - | 3 | - | - | 1 | 1 | - | 1 | 1 | 1 |

**COURSE CONTENTS:**

**MODULE I INTRODUCTION TO JAVA** **6 Hours**

The History and Evolution of Java: An overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements. Data Types, Variables and Arrays.

**MODULE II CLASSES IN JAVA** **6 Hours**

**Introducing Classes:** Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Overloading Methods, Using Objects as Parameters

**MODULE III INHERITANCE , PACKAGES AND INTERFACES** **6 Hours**

**INHERITANCE:** Inheritance basics, Using super keyword, method overriding
**PACKAGES:** Defining a package, Finding packages, importing packages.
**INTERFACES:** Defining Interface, Implementing Interface

**MODULE IV EXCEPTION HANDLING** **6 Hours**

**EXCEPTION HANDLING:** Fundamentals, Exception types, uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws, finally, Java's built-in exceptions, Creating your own exception subclasses.

**MODULE V APPLET** **6 Hours**

**APPLETS:** Concepts of Applets, life cycle of an applet, types of applets, creating applets.

**TOTAL : 30 HOURS**

**LIST OF EXPERIMENTS:**

1. Create a java application that implements the concept of classes and objects.
2. Develop Java Application using inheritance.
3. Use interfaces and develop a java application.
4. Create a package and access members from a package.
5. Develop Java Application using Method overloading.
6. Develop Java Application using method overriding.
7. GUI Application using applets

**TOTAL: 15 HOURS**

**REFERENCES:**

1. The Complete Reference Java, 8th edition, Herbert Schildt, TMH.

2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.
3. An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, John Wiley & sons.
4. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
5. Object Oriented Programming through Java, P. Radha Krishna, Universities Press.
6. Programming in Java, S. Malhotra, S. Chudhary, 2nd dition, Oxford Univ. Press.
7. Java Programming and Object oriented Application Development, R. A. Johnson, Cengage Learning.
8. http://www.javatpoint.com/
9. java.sun.com/docs/books/tutorial/java/TOC.html
10. http://www.learnjavaonline.org/
11. http://www.tutorialspoint.com/java/

**REQUIREMENTS: (A batch of 30 students)**

1. Hardware Requirements: Standalone Desktop Computer or Server Supporting
2. Software Requirements: JDK 8 or 11 or 16 for windows 64 bit OS.

**2302EE551 COMPUTER AIDED ELECTRICAL DRAWING LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**PREREQUISITES:**

AutoCAD/ECAD/ MATLAB

**COURSE OBJECTIVES:**

1. To train students in using software AutoCAD and specialized electrical CAD tools for drafting and designing electrical layouts.
2. To provide knowledge of electrical symbols, wiring diagrams for creating professional and standardized electrical drawings.
3. Enable students to create detailed electrical schematics, wiring diagrams, single-line diagrams (SLDs), and panel layouts accurately and efficiently.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Draw the various symbols, notations and single line electrical drawings using software

**CO2:** Sketch the electrical machine assembly and winding diagrams.

**CO3:** Draw the single line diagram of house wiring and lighting scheme.

**CO4:** Sketch the transmission overhead lines.

**CO5:** Prepare a PCB layout to enhance the knowledge for mini/major project.

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | - | 3 | - | - | 1 | 1 | - | 1 | 3 | - |
| **CO2** | 3 | 3 | 2 | - | 3 | - | - | 1 | 1 | - | 1 | 3 | - |
| **CO3** | 3 | 3 | 2 | - | 3 | - | - | 1 | 1 | - | 1 | 3 | - |
| **CO4** | 3 | 3 | 2 | - | 3 | - | - | 1 | 1 | - | 1 | 3 | - |
| **CO5** | 3 | 3 | 2 | - | 3 | - | - | 1 | 1 | - | 1 | 1 | 3 |

**LIST OF EXPERIMENTS:**

1. Draw the Lines, Arcs, Curves, Shapes, Filling of objects, Object editing & Transformation with the help of computer software.
2. Construct a simple power and control circuit diagrams.
3. Draw Electrical, Electronics & Electro – mechanical symbols.
4. Construct a House wiring diagrams and layout.
5. Develop a Lap winding and wave winding diagram.
6. Construct the Constructional diagram of D.C motors, AC motors and Transformers.
7. Construct the Transmission tower, Overhead lines – ACSR conductors, Single circuit, Double circuit, and Bundle conductor.
8. Construct a Single line diagram of Power System.
9. Design a lighting scheme in 3-D model using ECAD software.
10. Design a PCB layout of full wave rectifier using PCB Design Editor.

**TOTAL: 30 HOURS**

**REFERENCES:**

1. M. Yogesh, B. S. Nagaraja, N. Nandan, “Computer Aided Electrical Drawing” PHI Learning Pvt. Ltd., 2014
2. Sham Tickoo, “AutoCAD 2013 for Engineers and Designers”, Dream tech press, New Delhi, Latest edition
3. George Omura, “Mastering AutoCAD 2013 and AutoCAD LT 2013”, Sybex, New Delhi, Latest edition
4. Muhammad H. Rashid, “Introduction to PSpice Using OrCAD For Circuits And Electronics”, PHI Learning, New Delhi, Latest edition
5. http://students.autodesk.com/ (register and get free student version of LATEST AutoCAD software for approximately 3 years)
6. Android applications available on Google Play store like AutoCAD 360, Circuit Builder, Electric Circuit, Circuit Simulator, WeSpice Demo, Electric Circuit Calculator, Electrical Engineering
7. http://coolcadelectronics.com/coolspice/
8. Dr. M. Vinothkumar, “Computer Aided Electrical Drawing Laboratory Manual”, First Edition , July -2025

| 2302EE552 | MICROPROCESSORS AND MICROCONTROLLER LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**PREREQUISITES:**

Digital Electronics

**COURSE OBJECTIVES:**

1. To develop and execute variety of assembly language programs of Intel 8086 including arithmetic and logical, sorting, searching, and string manipulation operations.
2. To develop and execute the assembly language programs for interfacing Intel 8086 with peripheral devices.
3. To develop and execute simple programs on 8051 micro controller.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Apply andexecute assembly language programs for arithmetic and logical operations using 8085.

**CO2:** Apply andexecute assembly language programs for arithmetic and logical, sorting, searching, and string manipulation operations using 8086 microprocessor.

**CO3:** Apply and execute the assembly language programs for interfacing Intel 8086 with peripheral devices.

**CO4:** Apply and execute the assembly language programs for interfacing Intel 8051 with peripheral devices

**CO5:** Apply the concepts in the design of microprocessor/microcontroller based systems in real time applications

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | - | 3 | - | - | 2 | 3 | - | 2 | - | 3 |
| CO2 | 3 | 3 | 2 | - | 3 | - | - | 2 | 3 | - | 2 | - | 3 |
| CO3 | 3 | 3 | 2 | - | 3 | - | - | 2 | 3 | - | 2 | - | 3 |
| CO4 | 3 | 3 | 2 | - | 3 | - | - | 2 | 3 | - | 2 | - | 3 |
| CO5 | 3 | 3 | 2 | - | 3 | - | - | 2 | 3 | - | 2 | 1 | 3 |

**LIST OF EXPERIMENTS:**

1. 8 bit Arithmetic operations using 8085 microprocessor.(Add, Sub, MulDiv )
2. 16-bit Arithmetic Operations using 8086 microprocessor. .(Add, Sub, MulDiv)
3. Sorting of Array using 8086 microprocessor.(Maxima and minimum)
4. Searching a Character in a String using 8086 microprocessor.
5. String Manipulations using 8086 microprocessor.
6. Interfacing ADC&DAC using 8086
7. Arithmetic, Logical and Bit Manipulation Instructions using 8051
8. UART Operation using 8051 microcontroller.
9. Interfacing Keyboard/Display using 8051 microcontroller.
10. Interfacing stepper motor using 8051 microcontroller.

**TOTAL: 30 HOURS**

**REFERENCES:**

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007
2. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, PHI Ltd., 11th Edition, 2015. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2 nd Edition, Pearson Education, 2011.
3. Doughlas V. Hall, “Microprocessors and Interfacing, Programming and Hardware”, Tata McGraw-Hill, 2012
4. Jonathan W. Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, 3 rd Edition, Cengage Learning, 2012
5. Kenneth L. Short, “Microprocessors and programmed Logic”, 2nd Ed, Pearson Education Inc.,2003
6. Barry B. Brey, “The Intel Microprocessors, 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, PentiumPro Processor, PentiumII, PentiumIII, Pentium IV, Architecture, Programming & Interfacing”, Eighth Edition, Pearson Prentice Hall, 2009.

| 2303EE001 | FUNDAMENTALS OF ELECTRIC VEHICLE AND ITS ARCHITECTURE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**PREREQUISITES:**

1. Generation, Transmission and Distribution
2. Electrical Machines I & II

**COURSE OBJECTIVES:**

1. To familiarize students with the concept of electric vehicles and electric drives and their control.
2. To impart the knowledge of EV battery chargers, electric vehicle supply equipment, their components, charging protocols
3. To familiarize students with the types of EV architecture and Emerging Technologies In EV industries

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Understand the basic concepts of Electric Vehicles
**CO2:** Identify the appropriate charger by using different Charging Infrastructure
**CO3:** Select suitable traction motor and its drives for EV applications
**CO4:** Understand various types of Electric Vehicle Architecture
**CO5:** Describe the Emerging Technologies In EV field

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | - | - | - | - | 1 | - | - | - | - | 3 | - |
| CO2 | 3 | 2 | - | - | - | - | 1 | - | - | - | - | 3 | - |
| CO3 | 3 | 2 | - | - | - | - | 1 | - | - | - | - | 3 | - |
| CO4 | 3 | 2 | - | - | - | - | 1 | - | - | - | - | 3 | - |
| CO5 | 3 | 2 | - | - | - | - | 1 | - | - | - | - | 3 | - |

**COURSE CONTENTS:**

**MODULE I INTRODUCTION TO ELECTRIC VEHICLES 9 Hours**

Introduction: History and benefits of electric vehicles; fundamentals of EVs; Basics of Electric Vehicles , , tractive effort; vehicular dynamics; drive cycle and vehicle control unit, General Layout of EV, key Components of Electric Vehicle, Comparison with Internal Combustion Engine: Technology, Advantages & Disadvantages of EV, National Policy for adoption of EVs, Overview of Tesla car

**MODULE II ELECTRIC VEHICLE ARCHITECTURE 9 Hours**

Introduction , Types of architecture – battery electric vehicle – hybrid electric vehicle - Series HEVs, Parallel HEVs, Series–Parallel HEVs, Complex HEVs, Operating Modes, Comparison of HEVs, Plug-in Hybrid Electric Vehicles (PHEVs) , Fuel cell electric Vehicles - Real Life examples of HEVs

**MODULE III TRACTION MOTORS & DRIVES 9 Hours**

Principle and working of Traction motors with its drives- AC motor – Induction motor and drives, permanent magnet synchronous motor (PMSM) with basics of drives , Switched Reluctance Motor (SRM) and drives , DC motor- Characteristics and Types of DC Motors , BLDC Motor with drives , Comparison – simple machine modeling using Finite Element Method Magnetics (FEMM)

**MODULE IV CHARGING INFRASTRUCTURE 9 Hours**

Introduction – EV charger classification – battery charging modes – components of EV battery chargers AC to DC Converter , DC to DC converter , DC to AC converter - Soft Switched & hybrid type converter – protocols & communication – EMI/ EMC consideration - Case-studies on Delta, Hella on-board chargers, latest EV reports released by Government of India

**MODULE V EMERGING TECHNOLOGIES IN EV SYSTEM 9 Hours**

Introduction –wireless charging- bidirectional charging – autonomous driving – smart grid – vehicle to grid (V2G) integration- IOT & ML applications in EV industries – AI powered vehicle health check– Cyber Security Challenges.

**TOTAL : 45 HOURS**

**REFERENCES:**

1. KC Jain;Amit R. Patil " A Fundamentals of Hybrid and Electric Vehicles", Khanna publishers,2024
2. Alfred Rufer, "Energy Storage systems and components", CRC Press - 2017
3. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press - 2015
4. Iqbal Husain, "Electric and Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press. – 2021.
5. S. Nazrin Salma, S. ArumugaKani and A. NiyasAhamed , "Electric Vehicle Architecture" ,

AkiNikPublications – 2023
6. Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles by John G. Hayes and A. Goodarzi, Wiley Publication.
7. https://archive.nptel.ac.in/courses/108/102/108102121/

**2303EE002 ENERGY STORAGE AND BATTERY MANAGEMENT SYSTEM**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**PREREQUISITES:**

Fundamental chemistry

**COURSE OBJECTIVES:**

1. To comprehend the fundamentals of energy storage systems
2. To analyze the different types and applications of energy storage systems
3. To apply the concept of battery modeling and battery management system

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Elucidate the fundamental principles and processes involved in energy storage technologies.

**CO2:** Illustrate the fundamental concepts of batteries, including charging, discharging, energy density, and power density.

**CO3:** Explain the growth and development of lithium-ion batteries and their variants.

**CO4:** Explain the concept and components of a Battery Management System

**CO5:** Model the factors affecting lithium-ion battery aging and their implications for SOH estimation

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | - | - | - | 1 | - | - | - | - | - | 3 | - |
| CO2 | 3 | 2 | - | - | - | 1 | - | - | - | - | - | 3 | - |
| CO3 | 3 | 2 | - | - | - | 1 | - | - | - | - | - | 3 | - |
| CO4 | 3 | 2 | - | - | - | 1 | - | - | - | - | - | 3 | - |
| CO5 | 3 | 2 | - | - | - | 1 | - | - | - | - | - | 3 | - |

**COURSE CONTENTS:**

**MODULE I INTRODUCTION OF ENERGY STORAGE 9 Hours**

History of Energy storage, Energy Storage processes, Types of energy storage: Pumped storage, Compressed air, Elevated rail, Flywheels, Thermal, Advanced lead acid, Importance of energy storage systems in electric vehicles.

**MODULE II ELECTRICAL ENERGY STORAGE 9 Hours**

Fundamental concept of batteries – Measuring battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide– Flow batteries- Battery Hazards.

**MODULE III LITHIUM-ION BATTERY 9 Hours**

Introduction to lithium-ion battery, Components, functions, advantages and disadvantages of lithium-ion batteries, Growth and development of Li-Ion batteries, charging procedures and charging speed, depth of discharge limitations and cycle lives,Lithium Iron Phosphate Battery (LFP), Lithium Nickel Manganese Cobalt Oxide (LNMC)

**MODULE IV INTRODUCTION TO BATTERY MANAGEMENT SYSTEM(BMS) 9 Hours**

Introduction to Battery Management System(BMS), Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging

**MODULE V BATTERY STATE OF CHARGE AND STATE OF HEALTH ESTIMATION 9 Hours**

Preliminary definitions. - Battery state of charge estimation (SOC)- voltage-based methods to estimate SOC , Model-based state estimation - Battery State of Health Estimation (SOH),Lithium ion aging.- Build a simple model of a battery pack in MATLAB and simscape.

**TOTAL : 45 HOURS**

**REFERENCES:**

1. Jiuchun Jiang and Caiping Zhang, "Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles", Wiley, 2015.
2. Davide Andrea, "Battery Management Systems for Large Lithium-Ion Battery Packs" ARTECH House, 2010.
3. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper.
4. Wu, Yuping, “Lithium-ion Batteries Fundamentals and Applications”, CRC Press, Taylor and Francis, first edition, 2015.
5. San Ping Jiang, “Fundamentals and Application of Lithium-ion Battery Management in Electric Drive Vehicles”, Wiley, first edition, 2015.
6. James Larminie, John Lowry, “Electric Vehicle Technology Explained”, John Wiley and Sons Ltd, second edition, 2012.

7. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, “Thermal Management of Electric Vehicle Battery Systems”, John Wiley and Sons Ltd., first edition, 2016.
8. Ralph J. Brodd, Masaki Yoshio, Ralph J. Brodd, AkiyaKozawa, “Lithium-Ion Batteries Science and Technologies”, Springer, 2009.
9. Ru-shi Liu, Lei Zhang and Xueliang sun, ‘Electrochemical technologies for energy storage and conversion’, Wiley publications, 2nd Volume set, 2012.
10. https://nptel.ac.in/courses/113105102, Prof. SubhasishbasuMajumder , IIT Kharagpur.
11. https://nptel.ac.in/courses/112105221.Prof.Prasantakumar Das &Prof.Anandaroop Bhattacharya , IIT Kharagpur

**2303EE022 SPECIAL ELECTRICAL MACHINES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**PREREQUISITES:**

Electrical machinesIandII

**COURSE OBJECTIVES:**

1. To impart knowledge on Construction, principle of operation and performance of synchronous reluctance motors.
2. To impart knowledge on the Construction, principle of operation, control and performance of stepping motors and switched reluctance motors
3. To impart knowledge on the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors andpermanent magnet synchronous motors.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Elucidate the construction, working principle and characteristics of Stepper motor

**CO2:** Describe the construction, working principle and characteristics of Switched Reluctance Motor (SRM).

**CO3:** Examine the control circuits and motor behavior of Permanents Magnet Brushless DC (BLDC) Motor.

**CO4:** Develop phasor relationships and torque-speed characteristics of Permanents Magnet Synchronous Motors (PMSM).

**CO5:** Illustrate the construction, working principle and characteristics of Synchronous Reluctance Motor, hysteresis motor and linear motor.

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 3 | - |
| CO2 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 3 | - |
| CO3 | 3 | 3 | 1 | 1 | - | - | - | - | - | - | 1 | 3 | - |
| CO4 | 3 | 3 | 1 | 1 | - | - | - | - | - | - | 1 | 3 | - |
| CO5 | 3 | 2 | 1 | - | - | - | - | - | - | - | 1 | 3 | - |

**COURSE CONTENTS:**

**MODULE I STEPPER MOTORS 9 Hours**

Constructional features; Principal of operation Single and multi-stack configurations; Torque predictions; Modes of excitation; Characteristics; Drive circuits; Microprocessor control of stepper motors; Closed loop control; Applications.

**MODULE II SWITCHED RELUCTANCE MOTORS 9 Hours**

Evolution of switched reluctance motors; Constructional features; Rotary and linear SRM; Principle of operation; Torque production; Steady state performance prediction; Power converters and their controllers; Methods of rotor position sensing; Sensor less operation; Characteristics and closed loop control; Applications

**MODULE III PERMANENT MAGNET BRUSHLESS DC MOTORS 9 Hours**

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis; EMF and torque equations; Commutation; Power converter circuits and their controllers; Motor characteristics and control; Applications.

**MODULE IV PERMANENT MAGNET SYNCHRONUS MOTOR 9 Hours**

Principle of operation; Ideal PMSM; EMF and torque equations; Armature MMF; Synchronous reactance; Sine wave motor with practical windings; Phasor diagram; Torque / Speed characteristics; Power controllers; Converter volt-ampere requirements; Applications.

**MODULE V STUDY OF OTHER SPECIAL ELECTRICAL MACHINES 9 Hours**

Principle of operation and characteristics of Synchronous Reluctance motor,Voltage and torque equations - Hysteresis motor – AC series motors – Linear motor –Applications.

**TOTAL : 45 HOURS**

**REFERENCES:**

1. K. Venkataratnam, “Special Electrical Machines”, 1st Edition Reprinted, Universities Press (India) Private Limited, Hyderabad, 2013.
2. E.G. Janardanan, “Special Electrical Machines”, 1st Edition Reprinted, PHI Learning Private Limited, Delhi, 2014.
3. R.Krishnan, “Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application”,

CRC Press, New York, 2017.
4. J.R.Hendershot and T.J.E.Miller, “Design of Brushless Permanent Magnet Machines”, 2nd Edition, Venice Florida: Motor Design Books, 2010.
5. T.J.E.Miller, “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford, 1993.
6. T. Kenjo, “Stepping Motors and Their Microprocessor Controls”, Clarendon Press London,1984.
7. https://nptel.ac.in/courses/108/102/108102156/

**2303EE009** **POWER QUALITY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**PREREQUISITES:**

Generation,Transmission and distribution

**COURSE OBJECTIVES:**

1. To explain the basic concepts of power quality issues in power systems
2. To analyze power quality terms and power quality standards.

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Understand the reasons power interruptions and methods for power quality improvement

**CO2:** Explain various power quality mitigation techniques.

**CO3:** Understand the overvoltage concepts and protection schemes

**CO4:** Understand the impact of harmonics in the power appliances.

**CO5:** Explain the important standards and regulations of power quality monitoring.

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - |
| CO2 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - |
| CO3 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - |
| CO4 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - |
| CO5 | 3 | 2 | - | - | - | - | - | - | - | - | - | 3 | - |

**COURSE CONTENTS:**

**MODULE I INTRODUCTION TO POWER QUALITY** **9 Hours**

Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients – power interruptions.-Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations- power quality improvement techniques- International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve.

**MODULE II VOLTAGE SAGS AND INTERRUPTIONS** **9 Hours**

Sources of sags and interruptions - Estimating Voltage Sag Performance -Fundamental Principles of Protection -Solutions at the End-User Level-Evaluating the Economics of Different Ride-Through Alternatives -Motor-Starting Sags, Utility System Fault- mitigation: voltage stabilizers, improvement in equipment immunity.

**MODULE III OVERVOLTAGES** **9 Hours**

Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding - line arresters - protection of transformers and cables –insulation coordination.

**MODULE IV HARMONICS** **9 Hours**

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion - voltage and current distortion - resonance – classification of power filters- introduction to active power filter technology. case study: harmonic analysis for a DC fast charger of 150KW rating.

**MODULE V POWER QUALITY STANDARDS AND REGULATIONS** **9 Hours**

Standards - IEEE, IEC, ANSI/UL, Limits and regulations on power quality in transmission and distribution network- Assessment of Power Quality Measurement Data-Application of Intelligent Systems-Power Quality Monitoring Standards- IoT based framework for power quality solutions.

**TOTAL : 45 HOURS**

**REFERENCES:**

1. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, Electrical Power Systems Quality, Tata McGraw Hill Education Private Ltd, 3rd Edition 2012.
2. Mohammad A.S Masoum, EwaldF.Fuchs, Power Quality in Power Systems and Electrical Machines", Academic Press, Elsevier, 2015.
3. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "Power Quality: Problems and Mitigation Techniques", John Wiley & sons Ltd, 2015
4. C. Sankaran, Power Quality, CRC Press 2001.

**2303EE029 ENERGY CONSERVATION AND ENERGY MANAGEMENT**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**PREREQUISITES:**

Generation,Transmission and distribution

**COURSE OBJECTIVES:**

1. To understand about energy auditing
2. To understand about electrical and thermal system auditing

**COURSE OUTCOMES:**

On the successful completion of the course, students will be able to

**CO1:** Explain about energy auditing
**CO2:** Describe the electrical system auditing
**CO3:** Discuss the mechanical system auditing
**CO4:** Understand the energy conservation in major utilities
**CO5:** Summarize the role of energy economics in auditing

**COs Vs POs & PSOs MAPPING:**

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | - | - | - | 2 | - | - | - | - | 1 | 3 | - |
| CO2 | 3 | 2 | - | - | - | 2 | - | - | - | - | 1 | 3 | - |
| CO3 | 3 | 2 | - | - | - | 2 | - | - | - | - | 1 | 3 | - |
| CO4 | 3 | 2 | - | - | - | 2 | - | - | - | - | 1 | 3 | - |
| CO5 | 3 | 2 | - | - | - | 2 | - | - | - | - | 1 | 3 | - |

**COURSE CONTENTS:**

**MODULE I INTRODUCTION** **9 Hours**

Energy, Power, Past and present scenario of World- National energy consumption data; Environmental aspects associated with energy utilization, Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies, ECBC code for Building Construction, Energy Auditing- Need, Types, Methodology and Barriers; Role of energy managers; Instruments for energy auditing.

**MODULE II ENERGY CONSERVATION IN ELECTRICAL SYSTEMS** **9 Hours**

Components of EB billing; HT and LT supply; Transformers; Cable sizing; Concept of capacitors; Power factor improvement; Harmonics; Electric motors- Motor efficiency computation, Energy efficient motors, LED lighting and scope of energy conservation in lighting

**MODULE III THERMAL SYSTEMS** **9 Hours**

Stoichiometry; Boilers; Furnaces and Thermic fluid heaters; Efficiency computation and Encon measures; Steam- Distribution and usage, Steam traps, Condensate recovery, Flash steam utilization, Insulators and Refractories

**MODULE IV ENERGY CONSERVATION IN MECHANICAL SYSTEMS** **9 Hours**

Energy conservation in pumps, fans, blowers, compressed air systems, refrigeration and air conditioning Systems, cooling towers, DG sets.

**MODULE V ENERGY ECONOMICS** **9 Hours**

Economic analysis: methods, cash flow model, time value of money, evaluation of proposals, pay-back period, average rate of return method, internal rate of return method, present value method, life cycle costing approach. ESCO concept, Computer aided Energy Management Systems (EMS).

**TOTAL : 45 HOURS**

**REFERENCES:**

1. Witte. L.C., P.S. Schmidt and D.R. Brown, “Industrial Energy Management and Utilization”, Hemisphere Publishing Corporation, Washington, 1988.
2. Callaghn, P.W., “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., “The Efficient Use of Energy”, Butterworths, London, 1982
4. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987.
6. https://beeindia.gov.in/content/energy-auditors