Mandsaur University, Mandsaur

B.Tech. Electrical and Electronics Engineering (EVT)

Semester-VII

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

EPEEE0700A Internship/Industrial Training

Course Objective

The objective of undertaking industrial training is to provide work experience so that student's engineering knowledge is enhanced and employment prospects are improved.

- The student should take this course as a window to the real World of Work and should try to learn as much as possible from real life experiences by involving and interacting with industry staff.
- Industrial training of the students is essential to bridge the wide gap between the classroom and industrial environment.
- Industrial training also provides an opportunity to students to select an engineering problem and possibly an industry guide for their Major Project in final semester.
- This will enrich their practical learning and they will be better equipped to integrate the practical experiences with the classroom learning process.

Course Outcomes

1. Understand inside view of an industry and organization/company.
2. Understand the valuable skills and knowledge.
3. Apply the professional connections and enhance networking.
4. Apply the experience in a field to allow the student to make a career transition.

Course Description:-

- It is mandatory for every student to undergo this course.
- Every student is expected to spend a minimum of 60-days in an Industry/ Company/ Organization, during the summer vacation.
- The student must submit the "Training Completion Certificate" issued by the industry / company / Organization as well as a technical report within the stipulated time.
- Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations.

- It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits.

_____	_____	_____	_____
Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

Mandsaur University, Mandsaur

B.Tech. Electrical and Electronics Engineering (EVT)

Semester-VII

L-0, T-0, P-6, C-3

EPEEE0800A Major Project-I

Course Objectives:

1. To carry out budget and time planning for the major project.
2. To develop effective communication skill by delivering a presentation based on project.

Course Outcomes:

1. Understand methodologies and professional way of documentation and communication.
2. Create and systematic understanding of project contents.
3. Analysis the key stages in development of the project.

Major Project-I (Synopsis):

- The Project-I (Synopsis) work provides students an opportunity to do something on their own to plan, and study the project for two semesters under the supervision of a guide.

- Each student shall work on an approved project, which may involve fabrication, design or investigation of a technical problem that may take design, experimental or analytical character or combine element of these areas.

- The students have to keep in mind that in final semester they would be required to implement whatever has been planned in the Project-I.

- It is possible that a work, which involves greater efforts and time, may be taken up at this stage and finally completed in final semester, but partial completion report should be submitted in this semester and also evaluated by an external examiner.

Mandsaur University, Mandsaur

B.Tech. Electrical and Electronics Engineering (EVT)

Semester-VII

L-2, T-1, P-2, C-4

OEENG0101A Vehicular Electric Power System

Course Objectives:

- To define the basic concept of electrical vehicles and its operations.
- To Understand Architecture of EV's and HEV's in hybrid vehicles.
- To implement the control operation on the DC and AC Drives.
- To Design the battery parameters and modeling.
- To develop to the knowledge about various possible energy storage technologies that can be used in electric vehicles.

Course Outcomes:

1. Understand the fundamentals of electric vehicle mechanism.
2. Apply the Architecture of EV's and HEV's and transmission system of electric vehicles.
3. Analyze of chopper and inverter based derives system.
4. Evaluate and analyze of different types of battery storage modeling.
5. Create the storage of system operation in electric vehicles.

Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	-	1	1	2	2
CO2	3	2	2	1	-	-	-	-	-	-	-	1	2	2	1
CO3	3	2	3	1	-	-	-	-	-	-	-	1	2	2	2
CO4	3	2	3	1	-	-	-	-	-	-	-	1	2	3	2
CO5	3	2	2	1	-	-	-	-	-	-	-	1	3	2	1

High-3 Medium-2 Low-1

UNIT-I ELECTRIC VEHICLES AND VEHICLE MECHANICS **9 Hours**

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 **9 Hours**

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 CONTROL OF DC AND AC DRIVES **9 Hours**

DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor based vector control operation – Switched reluctance motor (SRM) drives.

UNIT-IV BATTERY ENERGY STORAGE SYSTEM **9 Hours**

Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries.

UNIT-V ALTERNATIVE ENERGY STORAGE SYSTEMS **9 Hours**

Fuel cell–Characteristics, Types –hydrogen Storage Systems and Fuel cell EV, Ultra capacitors.

Total 45 Hours

PRACTICALS

1. Battery testing
2. Alternator testing.
3. Starter motor testing
4. Diagnosis of ignition system.
5. Diagnosis of automotive electrical wiring.
6. Fault finding of relay & fuses in car using Off Board Diagnostics Systems (OBDS).
7. Fault finding location of sensor in car using OBDS

Total 75 Hours

Reference Books:

1. Iqbal Hussain, CRC Press, Taylor & Francis Group, Second Edition (2011).
2. Ali Emadi, Mehrdad Ehsani, John M.Miller Vehicular Electric Power Systems, Special Indian Edition, Marcel dekker, Inc 2010.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
4. James Larminie, John Lowry, Electric Vehicle Technology Explained Wiley, 2003.

List of e-Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc24_ee30/preview
2. https://nptel.ac.in/courses/108106170

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

B Tech. Electrical and Electronics Engineering (EVT)

Semester-VII

L-2 T-1 P-2 C-4

PCEEE1500A Internet of Things

Course Objectives:

- Describe what IoT is and how it works today.
- Recognize the factors that contributed to the emergence of IoT.
- To design and program IoT devices.
- Use of real IoT protocols for communication.
- To design an IoT device to work with a Cloud Computing infrastructure.

Course Outcomes (COs):

1. Understand the Concepts of IoT and Examine the IoT hardware.
2. Apply the design principles for web connectivity.
3. Analyze the interfacing of various sensors with Arduino/Raspberry Pi.
4. Evaluate design methodology of IOT.
5. Create IoT based prototypes.

Articulation Matrix

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CO1	3	1	1	-	-	-	-	-	-	1	-	2	1	2	2
CO2	3	2	2		2	1	-	-	-	1	-	2	3	3	2
CO3	3	2	3	2	2	1	-	-	-	1	-	2	3	3	2
CO4	3	3	3	2	2	1	-	-	-	1	-	2	3	3	2
CO5	3	3	3	2	2		-	-	-	1	-	2	3	3	3

High-3 Medium-2 Low-1

Unit-I 9 Hours

Introduction: Definition, Characteristics of IOT, IOT Conceptual framework, IOT Architectural view, Physical design of IOT, Logical design of IOT, Application of IOT.

Machine-to-machine (M2M), SDN (software defined networking) and NFV (network function virtualization) for IOT, data storage in IOT, IOT Cloud Based Services.

Unit-II 9 Hours

Design Principles for Web Connectivity: Web Communication Protocols for connected devices, Message Communication Protocols for connected devices, SOAP, REST, HTTP Restful and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IOT, Media Access control.

Unit-III **9 Hours**

Sensor Technology, Participatory Sensing, Industrial IOT and Automotive IOT , Actuator, Sensor data Communication Protocols ,Radio Frequency Identification Technology, Wireless Sensor Network Technology

Unit-IV **9 Hours**

IOT Design methodology: Specification -Requirement, process, model, service, functional & operational view.IOT Privacy and security solutions, Raspberry Pi &Arduino devices. IOT Case studies: smart city streetlights control & monitoring.

Unit-V **9 Hours**

Developing IoT solutions: Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi Implementation of IoT with Arduino and Raspberry, Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT.

Total: 45 Hours

List of Experiment:

1. Introduction to various sensors and various actuators & its Application

   a) PIR Motion Sensor.

   b) Rain Drop Sensor.

   c) Moisture Sensor.

   d) Temperature Sensor.

   e) Touch Sensor.

   f) Infrared Sensor.

   g) RFID Sensor.

   h) Bluetooth Module.

   i) Wi-Fi Module.

2. Demonstrate Node MCU and its working

3. Getting Started with ESP8266 Wi-Fi SoC

4. Hands-on with on-board peripherals of ESP8266

5. Demonstrate Arduino and its pins.

6. Perform Experiment using Arduino Uno to measure the distance of any object using Ultrasonic Sensor.

7. To perform LED Blink using Arduino.

8. Creating a webpage and display the values available through Arduino.

9. Demonstration of Setup & Working of Raspberry Pi.

10. Home Temperature Monitoring System

Total: 75 Hours

Reference(s)

1. Rajkamal,"Internet of Things", Tata McGraw Hill publication
2. Vijay Madisetti and ArshdeepBahga, "Internet of things (A-Hand-on-Approach)" 1st Edition, Universal Press
3. HakimaChaouchi "The Internet of Things: Connecting Objects", Wiley publication.
4. Charless Bell "MySQL for the Internet of things", Apress publications.
5. Francis dacosta "Rethinking the Internet of things: A scalable Approach to connecting everything", 1st edition, Apress publications 2013.
6. Donald Norris "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and Beagle Bone Black", McGraw Hill publication.
7. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014. Syllabus for Bachelor of Technology Computer Engineering
8. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

List of e-Learning Resources:

1. https://www.youtube.com/watch?v=WUYAjxnwjU4&list=PLE7VH8RC_N3bpVne8QzOAHziEgmjQ2qE
2. https://www.youtube.com/watch?v=urUBLmXFKl0&list=PLgMDNELGJ1CaBrefq-0eYatfOnoncW0y-

Subject Expert	Academic Coordinator	HoD	Appointed Senior Faculty by DoAA

B Tech.: Electrical and Electronics Engineering (EVT)

Semester-VII

L-2 T-1 P-2 C-4

PEEEE0801A Computer Network

Course Objectives:

- Define the basic fundamentals of computer network.
- To understand the concept of division of network functionalities into layers.
- To understand the use of components required to build different types of networks.
- To understand and analyze the concept of the error control, flow control and congestion control algorithms.
- To understand and analyze the basic concept of medium access techniques.

Course Outcomes (COs):

1. Understand the components required to build different types of networks.
2. Analyze the functionality of physical layer.
3. Analyze the functionality of data link layer.
4. Analyzethe flow of information from one node to another node in the network.
5. Analyze various types of networking devices.

Articulation Matrix

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CO3	3	2	3	1	-	-	-	-	-	-	-	1	2	2	2
CO4	3	2	3	1	-	-	-	-	-	-	-	1	2	3	2
CO5	3	2	2	1	-	-	-	-	-	-	-	1	3	2	1

High-3 Medium-2 Low-1

Unit-I Introduction to Computer Networks 09 Hours

Introduction: Definition of a Computer Network; Components of a Computer Network: Use of Computer Networks; Networks for companies, Networks for people, Social Issues: Classification of networks; Based on transmission technology, Based on the scale, Local area networks, Metropolitan area networks, Wide area networks, Wireless networks.

Network Software & Network Standardization: Introduction: Networks Software; Protocol hierarchy, Design issues for the layers, Merits and De-merits of Layered Architecture, Service Primitives: Reference models; The OSI Reference Model, The TCP/IP Reference Model, Comparison of the OSI& the TCP/IP Reference Models.

Data Communications: Introduction: Theoretical basis for communication; Fourier analysis, Band limited signals, Maximum data rate of a channel: Transmission impairments; Attenuation distortion,

Delay distortion, Dispersion, Noise: Data transmission modes; Serial & Parallel, Simplex, Half duplex & full duplex, Synchronous & Asynchronous transmission:

Unit-II Physical Layer **09 Hours**

Introduction: Network topologies; Linear Bus Topology, Ring Topology, Star Topology, Hierarchical or Tree Topology, Topology Comparison, Considerations when choosing a Topology: Switching; Circuit switching, Message switching, Packet switching, Implementation of packet switching, Relationship between Packet Size and Transmission time, Comparison of switching techniques: Multiplexing; FDM – Frequency division multiplexing, WDM – Wavelength division multiplexing, TDM – Time division multiplexing:

Transmission Medium: Introduction: Transmission medium; Guided & Unguided Transmission medium, Twisted pair, Coaxial cable, Optical fiber, Comparison of fiber optics and copper wire: Wireless transmission; Electromagnetic spectrum, Radio transmission, Microwave transmission:

Unit-III Data Link Layer **09 Hours**

Introduction; Goal of DLL: Design issues of DLL; Services provided to the Network layer, Framing, Error control, Flow control, Link Management, ARQ strategies: Error Detection and correction; Parity bits, Importance of flaming distance for error correction, Single bit error correction or (n, m) flaming code, Error Detection or Cyclic Redundant Code (CRC): Data Link layer protocols; Transmission control protocols, HDLC:

Medium Access Control Sub Layer: Introduction: The channel allocation problem; Static channels allocation, Dynamic channels allocation in LAN's and MAN's: Multiple access protocols; Pure ALOHA or Unslotted ALOHA Protocol, Slotted ALOHA or Impure ALOHA Protocol, CSMA Protocol, CSMA/CD Protocol, Binary exponential Algorithm, Comparison of channel access protocols: IEEE standards; Ethernets, Fast Ethernet, Gigabit Ethernet, IEEE 802.3 frame format:

Unit-IV Network Layer **09 Hours**

Introduction: Design issues of Network layer; Nature of the service provided, Internal organization, Routing, Congestion control, Internetworking: Principles of Routing; Types of routing algorithms, Classes of routing algorithms, Properties of routing algorithms, Optimality principle: Routing algorithms; Shortest path algorithm, Flooding, Distance vector routing, Hierarchical routing, Link state routing, Comparison of routing algorithms: Congestion; Factors of congestion, Comparison of flow control and congestion control, General principles of congestion control, Closed loop solution: IP protocol (IPV4):

Unit-V Networking Devices **09 Hours**

Introduction; Goal of networking devices: Repeaters; Uses of Repeaters: Hubs; Classification of Hubs, Stackable Hubs, USB Hub: Switches; Switching Methods, Comparison of switching methods, Working with Hubs and Switches, Cables Connecting Hubs and Switches, Managed Hubs and Switches, Port Density: Bridges; Bridge Implementation Considerations, Types of Bridges: Routers; Dedicated Hardware versus Server-Based Routers, Advantages and Disadvantages of dedicated hardware routers, Drawbacks of Routers: Gateways; Advantages of gateways, Gateways Functionality: Other Devices; Modems, Proxy Server, Wireless router, Brouter, Wireless Access Point (WAPs).

Total: 45 Hours

Total: 75 Hours

Reference(s)

1. Computer Networking-A Top-Down approach, 5thedition, Kurose and Ross, Pearson
2. Computer Networks-A Top-Down approach, BehrouzForouzan, McGraw Hill
3. Computer Networks (4th edition), Andrew Tanenbaum, Prentice Hall 4.Computer Networking and the Internet (5thedition),Fred Halsall, Addison Wesley
4. Data Communications and Networking (4th edition), BehrouzForouzan, McGraw Hill
5. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.3.Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks:

List of e-Learning Resources:

1. https://www.youtube.com/watch?v=O--rkQNKqls&list=PLbRMhDVUMngf-peFloB7kyiA40EptH1up
2. https://www.youtube.com/watch?v=3DZLItfbqtQ&list=PL32DBC269EF768F74

Subject Expert	Academic Coordinator	HoD	Appointed Senior Faculty by DoAA

B.Tech. Electrical and Electronics Engineering (EVT)

Semester-VII

L-2, T-1, P-2, C-4

PEEEE0802A Electric Drives

Course Objectives

- To provide fundamental knowledge of Electrical Drives.
- To understand the dynamics and control of Electric Drives
- To justify the selection of Drives for various applications.
- To apply the various semiconductor controlled drives employing different types motors.
- To formulate the DC & AC Drives.

Course Outcomes (COs)

1. Understand basic drive systems and analyze it for different types of loads.
2. Analyze the motor situation during starting and braking.
3. Apply the power electronics converter used in Electrical Drives.
4. Apply DC & AC Drives.
5. Evaluate the Simulation of Electrical drives using MATLAB.

Articulation Matrix

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CO1	3	2	1	-	-	1	-	-	-	-	-	1	1	1	1
CO2	3	2	1	-	-	1	1	-	-	-	-	-	-	1	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	1	1	-
CO4	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	1	-	-	-	-	-	-	-	2	1

High-3 Medium-2 Low-1

UNIT I: Introduction 9 Hours

Introduction to electric drives – Block diagram – advantages of electric drives – Dynamics of motor load system, fundamental equations, and types of load – classification of load torque, four quadrant operation of drives. Steady state stability, Introduction to closed loop control of drives.

UNIT II: Electric Drive Dynamics 9 Hours

Dynamics of motor-load combination Steady state stability of Electric Drive Transient stability of electric Drive. Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motorpower rating for continuous duty, short time duty and Intermittent duty, load equalization.

UNIT III: Electric Braking 9 Hours

Purpose and types of electric braking, braking of DC, three phase induction and synchronous motors. Dynamics During Starting and Braking: Calculation of acceleration time and energy loss during starting of DC shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking.

UNIT IV: Power Electronic Control of DC Drives 9 Hours

Single phase and three phase controlled converter fed separately excited DC motor drives, dual converter fed separately excited DC motor drive, rectifier control of DC series motor. Supply harmonics, power factor and ripples in motor current Chopper control of separately excited DC motor and DC series motor.

UNIT V: Power Electronic Control of AC Drives 9 Hours

Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo-converter based) static rotor resistance and slip power recovery control schemes.Three Phase Synchronous motor: Self controlled scheme.

Special Drives: Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications.

Total: 45 Hours

PRACTICAL

1. To study the fundamental and block diagram of Electric drive.
2. To study different methods of speed control of D.C. Motor.
3. To study the control techniques used in D.C. chopper.
4. To study chopper control of D.C. Motor for motoring and generating control.
5. To study D.C. Motor drive using PLL.
6. To study and simulate Inverter based speed control of Induction/Synchronous motor.
7. To study and simulate AC voltage controller based speed control of AC motor.

Total: 75 Hours

Reference(s)

1. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa publishing House.
2. S.K. Pillai, “A First Course on Electric Drives”, New Age International.
3. B.N. Sarkar, “Fundamental of Industrial Drives”, Prentice Hall of India Ltd.
4. Ned Mohan, Undeland and Robbins “Power Electronics – Converters, Applications and Design”, John Willey & sons.

List of e-Learning Resources:

1.https://nptel.ac.in/
2.https://www.coursera.org/

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

Mandsaur University, Mandsaur

B.Tech. Electrical and Electronics Engineering (EVT)

Semester-VII

L-2, T-1, P-2, C-4

PEEEE0803A Digital Signal Processing

Course Objectives:

1. To determine if a DT system is linear, time-invariant, causal, and memory less, determine asymptotic, marginal and BIBO stability of systems given in frequency domain.
2. To Perform Z and inverse Z transforms using the definitions, Tables of Standard Transforms and Properties, and Partial Fraction Expansion.
3. To Design FIR and IIR filters by hand to meet specific magnitude and phase requirements.
4. To understanding and working knowledge of design, implementation and analysis DSP systems.

Course Outcomes:

1. Understand the process discrete/digital signals and systems
2. Understanding of frequency domain analysis of discrete time signals.
3. Apply the properties of Z-Transform
4. Analyze FIR and IIR Filter etc.
5. Analyze IIR Filter.

Articulation Matrix

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CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	2	2	1	-	-	-	-	-	-	-	1	2	2	1
CO3	3	2	3	1	-	-	-	-	-	-	-	1	2	2	2
CO4	3	2	3	1	-	-	-	-	-	-	-	1	2	3	2
CO5	3	2	2	1	-	-	-	-	-	-	-	1	3	2	1

6. High-3 Medium-2 Low-1

UNIT-I INTRODUCTION 9 Hours

Introduction to Digital Signal Processing , classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance, classification of signals; continuous and discrete, energy and power. Stability and frequency domain representation of discrete time signals and systems. Linear Time Invariant (LTI) Systems, Discrete Time Fourier transform

(DTFT) and its properties. Mathematical representation of signals, spectral density, sampling techniques, Linear-constant coefficient difference equations.

UNIT-II :- Z-transform **9 Hours**

Z-transform and its properties, inverse z-transforms; difference equations, solution by z transform, application to discrete systems, stability criterion, Convolution, frequency response of stable systems, one sided Z-transform, its application.

UNIT-III Discrete Fourier series **9 Hours**

Properties of discrete Fourier series. DFT properties, magnitude and phase representation. Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure. Inverse FFT.

UNIT-IV IIR DIGITAL FILTERS **9 Hours**

IIR Digital filters from analog filters, Bilinear transformation method, step & impulse invariance techniques, Spectral Transformations, Analog filter approximations - Butterworth and Chebyshev, design of realization of IIR digital filters - direct, canonic, cascade & parallel forms.

UNIT V FIR DIGITAL FILTERS **9 Hours**

Characteristics of FIR Digital Filters frequency response, Design of FIR Digital Filters using Window Techniques. Comparison of IIR and FIR filters, Realization of FIR digital filters - direct, linear phase, cascade & parallel forms.

Total 45 Hours

PRACTICAL'S

1. To find Discrete Fourier Transform and Inverse Discrete Fourier Transform of given digital signal.
2. To obtain Linear Convolution of two finite length sequences
3. To compute auto correlation between two sequences
4. To find frequency response of a given system in differential equation form.
5. To find the FFT of a given sequence
6. Determination of Power Spectrum of a given signal.
7. To implement LP FIR filter for a given sequence.
8. To implement HP FIR filter for a given sequence.
9. To implement LP IIR filter for a given sequence.
10. To implement HP IIR filter for a given sequence.

Total 75 Hours

References:

1. Oppenheim & Schaffer, Digital Signal Processing, PHI.
2. J Cavacchi Digital Signal Processing Wiley India
3. John G. Proakis Digital Signal Processing: Principles, Algorithms, And Applications,4/E
4. Ludeman Fundamental of Digital Signal Processing, wiley india
5. A. Antoniou, Digital Filters Analysis & Design, TMH
6. A. Anand Kumar Digital Signal Processing ,PH

7. S.K. Mitra, Digital Signal Processing, TMH
8. S. Salivahanan, Digital Signal Processing, TMH
9. Proakis, John G. Digital signal processing: principles algorithms and applications. Pearson Education India.
10. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing, 3rd edition, Tata McGraw-Hill.

List of e-Learning Resources:

1. **https://nptel.ac.in/courses/117102060**
2. **https://github.com/openlists/DSPResources**

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

B.Tech - Electrical& Electronics Engineering (EVT)
Semester-VII
PEEEE0804A Advanced Battery Technology for Electrical Vehicles

L-2 T-1 P-2 C-4

Course Objectives

- To Understand electrical vehicle operation & battery basics.
- To Study the electric vehicle battery requirement and battery efficiency.
- To Explain electric vehicle battery charging methods.
- To Understand electric vehicle fast charging & discharging behavior.
- To Understand electric vehicle battery performance.

Course Outcomes (COs)

1. Understand battery basics and its different types used in electric vehicles.
2. Analyze the capacity of different types of batteries used in electric vehicles.
3. Analyze the impacts of rate of charge effect and environmental effects in different battery charging methods.
4. Apply the fast charging and discharging behavior of different types of batteries.
5. Evaluate battery performance management systems used with respect to battery operation and safety.

Articulation Matrix

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CO3	1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	1	2	-	-	-	-	-	-	-	-	-	-	-	1	1
CO5	1	2	-	-	-	-	-	-	-	-	-	-	1	-	-

High-3 Medium-2 Low-1

Unit-I ELECTRIC VEHICLE BATTERIES **09 Hours**

Electric Vehicle Operation, Battery Basics, Introduction to Electric Vehicle Batteries, Fuel Cell Technology, Choice of a Battery Type for Electric Vehicles.

ELECTRIC VEHICLE BATTERY EFFICIENCY: Effects of VRLA Battery Formation on Electric Vehicle Performance, Regenerative Braking, Electric Vehicle Body and Frame, Fluids, Lubricants, and Coolants, Effects of Current Density on Battery Formation, Effects of Excessive Heat on Battery Cycle Life, Battery Storage, The Lithium-ion Battery, Traction Battery Pack Design

Unit-II ELECTRIC VEHICLE BATTERY CAPACITY **09 Hours**

Battery Capacity, The Temperature Dependence of Battery Capacity, State of Charge of a VRLA Battery, Capacity Discharge Testing of VRLA Batteries, Battery Capacity Recovery, Definition of NiMH Battery Capacity, Li-ion Battery Capacity, Battery Capacity Tests, Energy Balances for the Electric Vehicle.

Unit-III ELECTRIC VEHICLE BATTERY CHARGING **09 Hours**

Charging NiMH Batteries, Rate of Charge Effect on Charge Acceptance Efficiency of Traction, Battery Packs, Environmental Influences on Charging, Charging Methods for NiMH Batteries, Charging Technology, Battery Pack Corrective Actions.

ELECTRIC VEHICLE BATTERY FAST CHARGING: On-board & off-board charging, The Fast Charging Process, Fast Charging Strategies, The Fast Charger Configuration, Using

Equalizing/Leveling Chargers, Inductive Charging—Making Recharging Easier, Range Testing of Electric Vehicles Using Fast Charging, Electric Vehicle Speedometer Calibration. Wireless Charging

Unit-IV ELECTRIC VEHICLE BATTERY DISCHARGING **09 Hours**

Definition of NiMH Battery Capacity, Discharge Capacity Behavior, Discharge Characteristics of Li-ion Battery, Discharge of an Electric Vehicle Battery Pack, Cold-Weather Impact on Electric Vehicle Battery Discharge.

Unit-V ELECTRIC VEHICLE BATTERY PERFORMANCE **09 Hours**

The Battery Performance Management System, BPMS Thermal Management System, The BPMS Charging Control, High-Voltage Cabling and Disconnects, Safety in Battery Design, Battery Pack Safety— Electrolyte Spillage and Electric Shock, Charging Technology, Electrical Insulation Breakdown Detection, Electrical Vehicle Component Tests, Building Standards, Ventilation.

Total 45 Hours

PRACTICALS

1. To study the types of Energy Storage Systems.
2. To perform the common charging methods of EV batteries.
3. To determine the energy density of different battery chemistries and identify the most promising candidates for maximizing energy storage capacity in electric vehicle applications.
4. To evaluate the efficiency and feasibility of fast-changing technologies for electric vehicle batteries, aiming to reduce charging time and improve user convenience without compromising battery lifespan.
5. To investigate the impact of temperature on battery performance and safety, aiming to optimize thermal management systems and ensure reliable operation across a wide range of environmental conditions.
6. To identify potential safety hazards and risks associated with battery technologies under extreme conditions, aiming to develop mitigation strategies and enhance the overall safety of electric vehicles.
7. To perform comparison between NiMH and Li-Ion batteries in PHEV (plug-in hybrid electric vehicles).
8. To simulate real-world driving conditions and assess the mechanical robustness of battery systems, aiming to improve their reliability and longevity in electric vehicle applications.
9. To optimize electrode materials and configurations to maximize energy density, power density, and cycle life, aiming to develop high-performance batteries tailored for electric vehicle applications.
10. To improve electrolyte formulations to enhance battery performance, safety, and stability, particularly under challenging operating conditions encountered in electric vehicles.

Total: 75 Hours

Reference(s)

1. “Electric vehicle battery systems” by Sandeep Dhameja, Newnes Publishing, 2002.
2. "Battery Management Systems for Electric Vehicles" by S. A. Mohammed Shuaib, M. Balasubramanian, and R. Murugan (2021).
3. "Electric Vehicles: Principles, Concepts, and Applications" by Niharika Maheshwari and Aparna Tiwari (2020).

List of e-Learning Resources:

3. https://nptel.ac.in/
4. https://www.coursera.org/

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

B. Tech - Electrical & Electronics Engineering (EVT)

Semester-VII

PEEEE0805A Vehicle Dynamics

L-2 T-1 P-2 C-4

Course Objectives

- To Learn about basics of vehicle dynamics.
- To Understand the concepts of acceleration system in electric vehicles.
- To Define and understand underlying concepts and methods behind vehicle dynamics.
- To Analysis of the various loads and forces associated to the vehicles.
- To Examine the behavior of the vehicles under acceleration, ride and braking

Course Outcomes (COs)

1. Understand about the dynamics of vehicle under different riding condition..
2. Understand acceleration and braking performance in electric vehicle to understand the vehicle dynamics
3. Apply the braking system in electric vehicle.
4. Analyze road loads and tire dynamics in electric vehicles.
5. Evaluate suspension kinematics and controllable suspension elements used in electric vehicles.

Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO3	1	2	3	-	-	-	-	-	-	-	-	1	-	-	-
CO4	1	1	2	2	-	-	-	-	-	-	-	-	-	1	-
CO5	1	1	1	2	2	-	-	-	-	-	-	-	-	-	-

High-3 Medium-2 Low-1

Unit-I Basics of Vehicle Dynamics 9 Hours

History, vehicle classifications, fundamental approaches to vehicle dynamics modelling; SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system, Dynamic

axle loads, Equations of motion, transmission characteristics, vehicle performance, Brake proportioning, braking efficiency.

Unit-II Acceleration Performance **9 Hours**

Power train components; power and traction limited acceleration; transverse weight shift; front wheel drive vs rear wheel drive vs. all-wheel drive vehicles

Unit-III Braking Performance **9 Hours**

Braking force analysis; brake design and analysis; federal regulation on braking performance; antilock braking system; wheel lock-up; tire/road friction; safety and maintenance issues in braking.

Unit-IV Road Loads and Tire Dynamics **9 Hours**

Wind drag and car body design, rolling resistance; breakdowns of total road loads; gas mileage analysis and driving styles; Aerodynamics. Tire specifications and constructions; tire motion analysis; tire force analysis; tire contact stress analysis; tire vibration analysis; tire models

Unit-V Chassis and Suspension Systems **9 Hours**

Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Center Analysis, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points, Controllable Suspension Elements: Active, Semi-Active. Choice of suspension spring rate, Calculation of effective spring rate, Vehicle suspension in fore and apt directions.

Total: 45 Hours

PRACTICALS

1. Sensor installation and preparation of test set up for spectral testing
2. Determination of Frequency response function of a rim using instrumented hammer and an accelerometer
3. Determination of structural and vibro-acoustic transfer function for NVH study of a passenger car
4. Experimental modal analysis of a simple vehicle component
5. Sensor installation and preparation of test set up for signature testing
6. Interior noise measurement in a passenger car during different operating condition
7. Whole body vibration study of an occupant in a passenger car

8. Mathematical modelling of vehicle for ride analysis using Matlab/Simulink
9. Virtual vehicle testing & stability analysis using CARSIM
10. NVH simulation using Simcenter 3D

Total: 75 Hours

Reference(s)

1. Fundamentals of Vehicle Dynamics, Thomas Gillespie, SAE Publication.
2. The Multibody systems Approach to Vehicle Dynamics, Mike Blundell and Damian Harty, Elsevier, 2004.
3. Vehicle Dynamics, Theory and Application, Reza N. Jazar, Springer, 2009, ISBN 978-0-387-74243-4, eISBN 978-0-387-74244-1.
4. R.V. Dukkipati, Vehicle dynamics, Narsova Publications.

List of e-Learning Resources:

5. https://nptel.ac.in/
6. https://www.coursera.org/

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

B. Tech - Electrical & Electronics Engineering (EVT)

Semester-VII

PEEEE0806A Charging Infrastructure

L-2 T-1 P-2 C-4

Course Objectives

- To Learn about basics of electric vehicles equipment.
- To Understand the concepts of the different chargers.
- To Define and understand various types of converters.
- To Analysis of the rules and standards for communication.
- To Examine the working of disturbance and noise in system.

Course Outcomes (COs)

1. Understand about the components and equipment used in electric vehicle.
2. Understand the categories of chargers and their standards.
3. Apply of different types of converters used in electric vehicle.
4. Analyze the various communication models and their protocols.
5. Evaluate the different types of noise and their mitigation methods.

Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	1	1	1	1
CO2	1	3	2	-	-	-	-	-	-	-	-	-	1	1	1
CO3	1	1	3	1	-	-	-	-	-	-	-	1	1	1	1
CO4	1	1	2	2	-	-	-	-	-	-	-	-	1	1	1
CO5	1	1	2	1	1	-	-	-	-	-	-	-	1	1	1

High-3 Medium-2 Low-1

Unit-I Introduction 09 Hours

Introduction to EV systems, EV benefits, battery charging modes, types of EV supply equipment (EVSE), components of EV battery chargers, charging infrastructure challenges.

Unit-II Charger Classification and standards **09 Hours**

Classification based on charging levels (region-wise), modes, plug types, standards related to: connectors, communication, supply equipment, EMI/EMC.

Unit-III Converter **09 Hours**

Types of AC-DC converters; working principles, modulation, design, and closed loop control of power factor correction converters (PFC): Boost type PFC, Totem-pole PFC, active front-end converter, Types of DC-DC converter used for EV chargers; working principles, modulation, design, modelling and closed loop control of dual active bridge, LLC converter, high frequency magnetics, soft-switching criteria.

Unit-IV Protocols and communication **09 Hours**

Open charge point protocol (OCPP), Open System Interconnection-Layer-Model (OSI), adapted PWM signal based low level communication, PLC based high level communication, CAN communication, testing methodology for EV battery chargers and EVSE

Unit-V EMI/EMC considerations **09 Hours**

Sources of EMI, differential mode noise, common mode noise, LISN, measuring of EMI/EMC spectrum, design of DM filters, CM filters

Total 45 Hours

PRACTICALS

1. Generation of phase shift modulation for dual active bridge DC-DC converter using Microcontroller.
2. Compare the efficiency of different charging infrastructure setups, such as DC fast charging stations versus Level 2 chargers, in terms of energy transfer efficiency and charging time.
3. To study the various charging modes of the EV battery.
4. Working with the CAN communication
5. Measurement of EMI/EMC, design of CM and DM filters.
6. Experiments on 3.3kW Totem-pole PFC
7. Experiments on Type-I onboard charger

8. Evaluate the impact of widespread adoption of electric vehicles on the electrical grid by analyzing charging patterns, demand peaks, and potential solutions like smart charging or vehicle-to-grid (V2G) integration.
9. Study of OSI model for communication.
10. Designing of CM filters and measurement of its important parameters.

Total: 75 Hours

Reference(s)

5. Tom Denton, “Automotive Electrical and Electronic Systems”, 5th Edition, Routledg.
6. Iqbal Husain, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press.
7. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India.
8. Christoph Marscholik and Peter Subke, “Road Vehicles - Diagnostic Communication” University Science Press

List of e-Learning Resources:

7. https://nptel.ac.in/
8. https://www.coursera.org/

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**

B.Tech - Electrical& Electronics Engineering (EVT)
Semester-VII
PEEEE0807A EV Standards & Testing

L-2 T-1 P-2 C-4

Course Objectives

- To Introduce Understand different standards related to electric vehicles.
- To Understand charger an HEV standards.
- To Understand type testing of electric vehicle.
- To Understand retro fitment standards.
- To Know government policies related to EVs.

Course Outcomes (COs)

1. Understand different standards related construction and safety in electric vehicles.
2. Understand the central motor vehicles rules (CMVR) type of standards for electric and hybrid electric vehicles.
3. Apply the CMVR types of standards for retro fitment of existing IC engine driven vehicles.
4. Analysis safety standards of traction batteries.
5. Evaluate government policies like national electronic mobility plan related to EVs.

Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
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CO2	3	1	1	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	2	1	-	-	-	-	-	-	-	-	1	1	1	1
CO4	2	1	1	-	-	-	-	-	-	-	-	1	1	1	1
CO5	1	1	-	-	-	-	-	-	-	-	-	-	1	1	1

High-3 Medium-2 Low-1

Unit-I EV Standards **09 Hours**

Electric power train vehicles-construction and functional safety requirements measurement of electrical energy consumption, Method of measuring the range, Measurement of net power and the maximum 30-minute power, CMVR type approval for electric power train vehicles, ISO 26262.

Unit-II Charger Standard **09 Hours**

Electric Vehicle Conductive AC Charging System, Electric Vehicle Conductive DC Charging System.

HEV Standard: CMVR Type Approval for Hybrid Electric Vehicles, CMVR Type Approval for Hybrid Electric Vehicles of M and N Category with GVW > 3500 kg

Unit-III Retro fitment Standards **09 Hours**

CMVR Type Approval of Hybrid Electric System Intended for Retro fitment on Vehicles of M and N Category having GVW <= 3500 kg and GVW > 3500 kg. CMVR Type Approval of Electric Propulsion Kit Intended for Conversion of Vehicles for Pure Electric Operation.

Unit-IV Safety Requirement of Traction Battery **09 Hours**

Introduction to Vehicle safety standards, Rules and Regulations, Environmental impurities and safety requirements, Battery Operated Vehicles -Safety Requirements of Traction Batteries, Automotive safety components certification by various organizations (ARAI, SIAM, SAE, ASME, FMVSS)..

Unit-V Government Policies **09 Hours**

National Electric Mobility Mission Plan 2020 (NEMMP2020), Faster Adoption and Manufacture of (Hybrid and Electric Vehicles) – FAME, Niti Aayog Report on Transforming Mobility.

Total: 45 Hours

PRACTICALS

1. To analyse the performance, efficiency, and reliability of electric power-train components to optimize power delivery and enhance overall system efficiency in electric vehicles.
2. Evaluate the efficiency and performance of electric motors used in power-trains of electric vehicle.
3. Optimize the design and parameters of inverters to improve power delivery and efficiency within electric power-trains.
4. Analyze the efficiency and effectiveness of transmissions within electric power-trains to optimize gear ratios and power transfer mechanisms.
5. To assess the performance, reliability, and safety of conductive AC charging systems for electric vehicles, aiming to optimize charging efficiency.
6. To evaluate the effectiveness, reliability, and safety of conductive DC charging systems for electric vehicles, with the goal of optimizing charging speed, efficiency.
7. To investigate safety protocols and requirements for traction batteries in electric vehicles.
8. To validate the robustness, reliability, and compliance of battery systems with industry standards and regulatory mandates, thus enhancing overall vehicle safety and minimizing potential hazards.

Total: 75 Hours

Reference(s)

1. "Electric Vehicle Charging Technology and Standards" by Muhammad Furqan and Ahmed Faheem Zobaa.
2. "Electric Vehicle Technology and Policy in India: A Study on Electric Vehicle Readiness" by Sujay S. Kurdi and Rupali R. Gaikwad.
3. Automotive Industry Standards, India, 2015-2016.

List of e-Learning Resources:

1. https://nptel.ac.in/
2. https://araiindia.com
3. https://emobility.araiindia.com
4. https://dhi.nic.in/writereaddata/Content/NEMMP2020.pdf
5. https://niti.gov.in/content/national-mission-transformative-mobility-and-battery-storage
6. https://niti.gov.in/writereaddata/files/document_publication/NITI-RMI_India_Report_webv2.pdf

Subject Expert	**Academic Coordinator**	**HoD**	**Appointed Senior Faculty by DoAA**