Syllabus

M.Tech.

Electric Vehicle Technology

REGULATIONS, CURRICULUM AND SYLLABUS

(for Affiliated Colleges)

(2025- 26)

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Board of Studies
HPTU, Hamirpur (H.P.)

HIMACHAL PRADESH TECHNICAL UNIVERSITY, HAMIRPUR (H.P.)

CURRICULUM FOR M. TECH. IN ELECTRIC VEHICLE TECHNOLOGY

1. DURATION OF THE PROGRAMME

A student is ordinarily expected to complete the M. Tech. program in Electric Vehicle Technology in four semesters from the date of initial registration. However, a student may complete the program at a slower pace by taking more time, but in any case, not more than 8 semesters (4 years) from the date of initial registration. Further, extension in genuine hardship cases can be allowed by the Vice-Chancellor of H.P. Technical University Hamirpur, (H.P.) and as per the prevailing rule and regulations & ordinance of H.P. Technical University.

2. STRUCTURE OF THE PROGRAM

M. Tech. program shall be designed to have a minimum of 72 credits. M. Tech. degree curriculum under different categories of courses as follows:

S No	Program Component	Minimum Credits
1	Compulsory Core (including Theory, Laboratory & Seminar)	28
2	Elective courses	12
3	Thesis/Dissertation	32

The Curriculum is based on the guidelines of National Education Policy (NEP) – 2020. The curriculum has embedded the Multi Exit/ Multi Entry in the M. Tech program. The curriculum is designed to meet the prevailing and ongoing industrial requirements. This includes Project based Education with adequate exposure for Thesis work. Also there is flexible and offers adequate Choice of Electives (Program Elective Courses/ Open Elective Courses). The designed curriculum inherits the Value based Education aims the Holistic Development of the students. The Curriculum offers Digital Pedagogy & Flipped Learning with adequate motivation for Entrepreneurship/ Startups.

Students exiting after completing 1st Year will be awarded Post Graduate Diploma in Electrical Engineering respectively. A minimum Credit requirement for Post Graduate Diploma is 40 Credits.

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2. ASSESSMENT & EVALUATION

The assessment of the candidate shall be based on continuous assessment. Each course shall have two components of assessment i.e., Internal Assessment (Component-I) and External Assessment (end semester examination/evaluation - Component-II). The process of assessment/evaluation will be as per the ordinance of M. Tech. prescribed by Himachal Pradesh Technical University.

3. DISSERTATION

Every candidate shall be required to submit the Dissertation work on a topic approved by Dissertation Assessment Committee (DAC) to be constituted by the Dean of the School/ Principal/ Director of the affiliated college with Head of the Department as the Chairman and two senior faculties as members to oversee the proceedings of the dissertation work from allotment to submission.

4. COURSES OF STUDY

In the M. Tech. (Electrical Vehicle Technology) programme, there will be total of 10 theory subjects, each of 100 marks (including 40 marks for internal assessment and 60 marks for End Semester examination), 06 laboratory courses and Dissertation work. The Preliminary Dissertation work in 3rd semester will have 100 marks as an internal assessment & 100 marks for External assessment. Further, the Main Dissertation work in 4th Semester will have 200 marks as an internal Assessment and 200 marks for External assessment. M. Tech. degree will be awarded from 1900 marks.

A candidate will have to study 05 theory courses (03 compulsory & 02 elective) each and 03 laboratory courses each in first two semesters. Further in the 3rd semester, the students are required to start Dissertation work and complete it in the 4th semester.

The courses of study and evaluation scheme for M. Tech. (Electrical Vehicle Technology) programme will be as below: -

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SEMESTER WISE STRUCTURE

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Semester 1

Total 5 Theory Courses (3 Core courses & 2 Elective courses) & 3 laboratory courses.

Semester-I									
S. No.	Course Code	Course Title	L	T	P	Credit	Marks		
							IA	UE	TM
1	MEVT-101	Fundamental of Electric vehicles & Economics	3	1	0	4	40	60	100
2	MEVT-102	Hybrid and Electric Vehicles	3	1	0	4	40	60	100
3	MEVT-103	Thermal Management of EV System	3	0	0	3	40	60	100
4	MEVT-11x	Elective - I	3	0	0	3	40	60	100
5	MEVT-12x	Elective -II	3	0	0	3	40	60	100
6	MEVP-111	Power Converter Lab	0	0	2	1	30	20	50
7	MEVP-112	Hybrid and Electrical Vehicles Lab	0	0	2	1	30	20	50
8	MEVP-113	Programming Digital Signal Controller	0	0	2	1	30	20	50
TOTAL						20	290	360	650

Elective Courses : Two elective courses are to be selected, one from Elective -I and Elective II.

ELECTIVE –I	
MEVT111	Advanced Battery Technology for Electrical Vehicles
MEVT112	Advance Power Electronics
MEVT113	Power Semiconductor Devices
ELECTIVE-II	
MEVT121	Automotive Electronics for EVs
MEVT122	Switch Mode Power Conversion
MEVT123	Vehicle Design Engineering

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Semester 2

Total 5 Theory Courses (3 Core courses & 2 Elective courses) & 3 laboratory courses.

Semester-II									
S. No.	Course Code	Course Title	L	T	P	Credit	Marks		
							IA	UE	TM
1	MEVT-201	EV Charging Infrastructure and Design	3	1	0	4	40	60	100
2	MEVT-202	Electrical Power Quality	3	1	0	4	40	60	100
3	MEVT-203	Vehicle Dynamic and Control	3	0	0	3	40	60	100
4	MEVT-21x	Elective –III	3	0	0	3	40	60	100
5	MEVT-22x	Elective –IV	3	0	0	3	40	60	100
6	MEVP-211	EV Charging and Infrastructure and Design Lab	0	0	2	1	30	20	50
7	MEVP-212	EV Motor drives and control Lab	0	0	2	1	30	20	50
8	MEVP-213	PCB Design	0	0	2	1	30	20	50
TOTAL						20	290	360	650

Elective Courses : Two elective courses are to be selected, one from Elective -III and Elective IV.

ELECTIVE –III	
MEVT211	Battery Management System
MEVT212	Energy Storage Systems for EV
MEVT213	Smart Grid: Basics to Advanced Technologies
ELECTIVE-IV	
MEVT221	Solar Battery Charging System
MEVT222	EV Standards & Testing
MEVT223	Control methods in switched mode power converter

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Semester 3

	Semester-III					
S. No.	Course Code	Course Title	Duration	Credit	Marks	
					IA	TM
1	**MEVP-301**	**Dissertations Phase – I**	**Full Semester**	**16**	**100 (Report) + 100(Presentation)**	**200**
OR						
2	**MEVPI-301**	**Dissertations Phase – I and Internship**	**Full Semester**	**16**	**100 (Report) + 100(Presentation)**	**200**
	TOTAL			**16**	200	200

1. **MEVP-301 and MEVPI-301: Dissertations** Phase-I : To be evaluated after 8 weeks from the date of commencement of 3rd semester. The students give a minimum of two seminars on the progress of the project. The Department Committee (with guide as one of the member) accesses the progress of the work and the final assessment of Report and presentation will be done at the end of 3rd semester for 100 Marks each respectively.

Semester 4

	Semester-IV						
S. No.	Course Code	Course Title	Duration	Credit	Marks		
					IA	UE	TM
1	**MEVPI-401**	**Dissertations Phase – II + Internship**	**Full Semester**	**16**	**200**	**200**	**400**
	TOTAL			**16**	200	200	**400**
GRAND TOTAL From 1st to 4th semester: 72 credits (1900 Marks)							

***PPE- I and *PPE-II – Project Progress Evaluation**

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***Weightage of Journal publication [refer syllabus MEVPI-401(P)] is 50 marks out of 200.**

MEVPI-401: Dissertations Phase – II + Internship

A. IA will consist of two Project Progress Evaluation (PPE) by the Department Committee for 100 marks each.
B. During UE, the project report will be evaluated by the Guide and the external examiner for 200 marks. Viva-Voce will be conducted for 200 marks by a committee consisting of the following:
   (a) Chairman, HOD/OIC (PG)
   (b) Project Guide
   (c) External Examiner

- The List of Program Electives offered by the Department is tentative and will be reviewed on yearly basis and depending upon the requirements of the Industry/Availability of faculties.

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COURSE CONTENTS

M. Tech. (Electrical Vehicle Technology)

FIRST SEMESTER

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MEVT-101			Fundamentals of Electric Vehicles & Economics				
Teaching Scheme			Credits	Marks			Duration
L	T	P/D	C	Sessional	End Semester Exam	Total	End Semester Examination
3	1	0	4	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *To analyze the key forces acting on an electric vehicle (EV)—including aerodynamic drag, rolling resistance, and uphill resistance—and evaluate their impact on energy consumption and performance using standard and real-world drive cycles*
2. *To design an optimized lithium-ion battery pack by incorporating SoC/SoH estimation, self-discharge behavior, electrical, mechanical, and thermal considerations, and develop cost-effective strategies for battery integration in EV systems.*
3. *To apply motor control concepts such as d-q modeling and field-oriented control to demonstrate the working, efficiency, and torque-speed characteristics of EV motors under varying operating conditions.*
4. *To evaluate the economic and technical feasibility of EV charging and swapping infrastructure in the Indian context and propose innovative integration approaches using renewable energy sources like solar and wind for a sustainable EV ecosystem.*

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	Electric Vehicle Introduction, the drive Torque, Power, Speed and energy, Energy Source, Vehicle Auxiliary, Petrol pumps and Charging stations, Introduction to Electric Vehicles in India, India Drive its EV program Innovatively and Differently and scale, Battery Cost reduction strategy, Batteries, Charging and Swapping Infrastructure, Lithium for batteries and EV Subsystems,	10
II	Forces acting when a vehicle move, Aerodynamic drag, Rolling Resistance and Uphill Resistance, Power and torque to accelerate, Concept of drive cycle 1, Concept of drive cycle 2, Drive Cycles and Energy used per km , EV Subsystem: Design of EV Drive Train	10

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III	Introduction to Battery Parameters, Why Lithium Ion Battery, Batteries in Future, Li-Ion Battery Cells, SoH and SoC estimation and Self Discharge, Battery Pack Development, Computation of Effective cost of battery, Charging Batteries, Fundamentals of Battery Pack Design, Electrical Design of Battery Pack , Electrical Design of Battery Pack, Mechanical Design of Battery Pack, Thermal Design of Battery Pack, BMS Design and Embedded System, Cell Testing & Characterization,	10
IV	EV Motors and Controllers Vehicle Dynamics, EV Motors and Controllers - Understanding Flow, Power and Efficiency, Torque Production, Speed and Back EMF, The d-q Equivalent circuit, Field-oriented Control, Three phase AC ,Thermal Design, Engineering Considerations EV Charger Introduction, Charger Parameters and Types, Slow & Fast chargers, Swapping Standardization and on board chargers, Public chargers, Public charger economics in Indian Context, Bulk Chargers, Swapping stations and data analytics, The EV Ecosystem	10

Total Number of Hours = 40 Hrs

Text/Reference Books:

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, e- ISBN 978-0-387-74244-1.
4. Race Car Vehicle Dynamics, W.F. Milliken and D.L. Milliken, SAE, 1995, ISBN 1-56091-526-9.

Course Outcomes:

On learning this course students will be able to

1. Analyze the forces acting on an EV and interpret their effect using drive cycle data.
2. Design a lithium-ion battery pack considering electrical, thermal, and economic parameters.
3. Apply motor control techniques to assess the performance of EV motors and controllers.
4. Evaluate charging infrastructure models and propose renewable energy-based EV solutions..

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MEVT-102			Hybrid and Electrical Vehicles				
Teaching Scheme			Credits	Marks			Duration
L	T	P/D	C	Sessional	End Semester Exam	Total	End Semester Examination
3	1	0	4	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

This course introduces students to the principles, architectures, and control strategies of hybrid and electric vehicles (HEVs and EVs). It covers the historical evolution, environmental and economic impacts, and dynamic modeling of vehicle motion. Students will explore various drive train configurations, power converter topologies, motor technologies, and control systems essential for HEV/EV operation. The course emphasizes the design philosophy of hybrid systems, regenerative braking, and the integration of electronic control units and communication networks. By the end of the course, learners will be equipped to analyze, design, and optimize hybrid and electric vehicle systems for performance, efficiency, and sustainability

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, Economic and environmental impact of hybrid Electric vehicles, Motion & Dynamic equations of vehicles, Basic architecture of Hybrid Drive trains, Analysis of series drive train, Power flow in HEVs, Torque coupling and analysis of Parallel Drive train, Basic Architecture of Electric Drive Trains	10
II	EV and HEV configuration based on Power Converters, Multi quadrant DC-DC converter, Multi input Dc-DC converter using High/ Low Voltage sources, Flux additive DC-Dc converter DC-AC converters: Half Bridge with RL load, Full Bridge with RL load, 180 conduction 3 phase with RL load, Voltage control using Single PWM, Sinusoidal PWM, 3 Phase PWM.	10
III	Induction Motors configurations, optimization, control and application for	10

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	HEV/EVs, Permanent Magnet Motors: Principle, operation supplied by DC converter with 120 & 180 degree mode of operation	
IV	Design of Hybrid & EV: Definition of hybridness (Parallel hybrid, series, mixed and range extender(plug in) hybrids), Hybrid Design philosophy, range Extender, optimization & hybridness, Battery Power & Electric motor power. Control System: Function of Control systems in HEVs & EVs, Elementary of control theory, Electronic Control unit, Control area network, Regenerative Braking: Energy consumption in Braking, Braking Power and energy on front & Rear Wheels	10

Total Number of Hours = 40 Hrs

Text/Reference Books:

1. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives" CRC press, 2010.
2. E. G Janardanan, 'Special Electrical Machines' PHI Delhi, 2014.
3. T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Claredon press, London, 1989.
4. R.Krishnan, ' Switched Reluctance motor drives' , CRC press, 2001.

Course Outcomes:

On learning this course students will be able to

1. Understand the historical evolution, environmental impact, and dynamic modelling of hybrid and electric vehicles, including basic drive train architectures.
2. Analyse and evaluate various hybrid configurations (series, parallel, mixed, and range extender), power flow mechanisms, and converter topologies used in HEVs and EVs.
3. Examine the principles, control strategies, and performance characteristics of induction and permanent magnet motors in EV/HEV applications.
4. Apply control system concepts to vehicle electronics, including ECUs, CAN networks, and regenerative braking systems, and compute energy distribution during braking.

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MEVT-103			Thermal Management of EV System				
Teaching Scheme			Credits	Marks			Duration End Semester Examination
L	T	P/D	C	Sessional	End Semester Exam	Total	
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *To understand thermal management of electronics*
2. *To understand the importance of thermal resistance network*
3. *To understand thermal management of microelectronic packages*
4. *To comprehend the concepts of cooling techniques*
5. *To explain thermal management systems*

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction to thermal management of Electronics:** Semiconductor Technology Trends, Temperature Dependent Failures Temperature-Dependent Electrical Failures Importance of Heat Transfer in Electronics, Thermal Design Process Thermal Resistance Network: Thermal Resistance Concept, Series Thermal Layers, Parallel Thermal Layers General Resistance Network, Thermal Contact Resistance, Interface Materials, Spreading Thermal Resistance Thermal Resistance of Printed Circuit Boards (PCBs).	9
II	**Fins and Heat Sinks:** Fin Equation, Infinitely Long Fin, Adiabatic Fin Tip Convection and Radiation from Fin Tip, Constant Temperature Fin Tip Fin Thermal Resistance, Effectiveness, and Efficiency with Variable Cross Sections. Heat Sink Thermal Resistance, Effectiveness, and Efficiency, Heat Sink Manufacturing Processes.	9
III	**Advanced Cooling Technologies:** Pipes, Capillary Limit, Boiling Limit. Sonic	9

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	Limit, Entrainment Limit, Other Heat Pipe Performance Limits, Heat Pipe Applications in Electronic Cooling, Thermosyphons, Liquid Cooling.	
IV	**Thermal Specification of Microelectronic Packages:** Importance of Packaging, Packaging Types, Specifications of Microelectronic Packages, Junction-to-Air Thermal Resistance, Junction-to-Case and Junction-to-Board, Thermal Resistances, Package Thermal Characterization Parameters, Parameters Affecting Thermal Characteristics of a Package	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. Younes Shabany," Heat Transfer: Thermal Management of Electronics" 2010 , CRC Press.
2. Jerry Sergent, Al Krum, "Thermal Management Handbook: For Electronic Assemblies Hardcover", 1998, Mc Graw- Hill.
3. "Vehicle thermal Management Systems Conference Proceedings", 1st Edition; 2013, Coventry Techno centre, UK
4. T. Yomi Obidi, "Thermal Management in Automotive applications", 2015, SAE International.

Course Outcomes:

On learning this course students will be able to

1. Describe different types of temperature dependent failures in electronics systems.
2. Describe series and parallel thermal layers and thermal resistance in PCB.
3. Use suitable fins and heat sinks for a given electronic application.
4. Compare different advanced cooling technologies.

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MEVP-111			Power Converter Lab				
Teaching Scheme			Credits	Marks			Duration
L	T	P/D	C	Sessional	End Semester Exam	Total	End Semester Examination
0	0	2	1	30	20	50	3 Hrs

Course Objectives:

1. *To understand working of different electric motors drives used in Electric Vehicles.*
2. *To study off-grid solar inverters and inverter stack configurations.*
3. *To study the concept of solar based EV charging station.*
4. *To identify components of electric and hybrid electric vehicle*
5. *To understand the significance of BMS in managing energy storage.*

List of Experiments:

1. To understand the basic working of Electric two wheelers and identify the components.
2. Battery Cell Demonstrations .
3. Battery Module - BMS, voltage and temperature sensors.
4. Battery pack assembly series and parallel connection.
5 Wiring and Sensors – Types, Working, and Failures
6. Study of Induction motor based electric vehicle.
7. Study of off-grid solar Inverter
8. Study of 4 Leg Semikron Stack
9. Solar based EV Charging station.
10. Study of electric vehicle system.
11. Study of hybrid electric vehicle system.
12. Demonstration of battery management System

Course Outcomes: At the end of the course student will be able to

1. Demonstrate various electric motors drives used in Electric Vehicles.
2. Analyse off-grid solar inverters and inverter stack configurations.
3. Demonstrate use of solar based EV charging station
4. Identify various components of electric and hybrid electric vehicle and analyse its performance.
5. Demonstrate the use of BMS in managing energy storage devices of EVs.

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MEVP-112			Hybrid and Electrical Vehicles Lab				
Teaching Scheme			Credits	Marks			Duration
L	T	P/D	C	Sessional	End Semester Exam	Total	End Semester Examination
0	0	2	1	30	20	50	3 Hrs

Course Objectives:

1. *To study conventional vehicle fuel economy and efficiency.*
2. *To understand the working of transmission control module.*
3. *To study hybrid electric vehicle (HEV) multimode reference application.*
4. *To understand hybrid electric vehicle (HEV) input power-split reference application.*
5. *Study of Electric Vehicle reference application using MATLAB*

List of Experiments

1. Study of Conventional Vehicle Spark-Ignition Engine Fuel Economy and Emissions using MATLAB
2. Chassis and Mechanical Components
3. Product Development of 2W Electric Vehicle
4. Study of Conventional Vehicle efficiency using MATLAB
5. Study of conventional vehicle reference application to optimize the transmission control module (TCM) shift schedules using MATLAB
6. Study of hybrid electric vehicle (HEV) multimode reference application using MATLAB
7. Study of conventional vehicle reference application to optimize the transmission control module (TCM) shift schedules to design control algorithms.
8. Study of conventional vehicle reference application to optimize the transmission control module (TCM) shift schedules to assess the impact of powertrain changes, such as an engine or gear ratio, on performance, fuel economy, and emissions.
9. Study of hybrid electric vehicle (HEV) input power-split reference application using MATLAB.
10. Study of HEV P0 reference application using MATLAB
11. Study of HEV P1 reference application using MATLAB
12. Study of Electric Vehicle reference application using MATLAB
13.

Course Outcomes: At the end of the course student will be able to.

1. Use the MATLAB as a tool to analyze the performance of conventional vehicle.
2. Analyze the working of TCM used in conventional vehicles.
3. Analyze transmission control module shift schedules to assess the impact of Powertrain changes.
4. Describe hybrid electric vehicle (HEV) input power-split reference application.
5. Use Electric Vehicle reference application in MATLAB

REFERENCE BOOKS:

https://in.mathworks.com/help/autoblks/powertrain-reference-applications.html

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MEVP-113			Programming Digital Signal Controller				
Teaching Scheme			**Credits**	**Marks**			**Duration End Semester Examination**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
0	**0**	**2**	**1**	**30**	**20**	**50**	**3 Hrs**

Course Objectives:

1. Understand the architecture and functional features of Digital Signal Controllers (DSCs).
2. Learn to program DSCs using C and embedded tools for real-time signal processing.
3. Develop applications for control systems, motor drives, and digital filters using DSCs.
4. Interface DSCs with sensors, actuators, and other peripheral modules.
5. Analyze and optimize code for performance and real-time constraints in embedded applications.

List of Experiments

1. Study of Digital Signal Controller (e.g., TI C2000) architecture and toolchain
2. Write and simulate a basic blinking LED code using DSC
3. Generate PWM signal using DSC and control duty cycle through variable input
4. ADC interface and data acquisition from analog sensor (e.g., temperature, voltage)
5 Interrupt handling and timer-based event generation in DSC
6. Implementation of a digital FIR filter using C programming in DSC
7 Speed control of a DC motor using PI controller implemented on DSC
8 Real-time serial communication (UART/SPI/I2C) between DSC and PC/another

Course Outcomes:

1. Explain the architecture and internal modules of a DSC.
2. Develop embedded C programs for DSC-based control and signal processing applications.
3. Implement real-time applications using interrupt, timer, ADC, and PWM modules.
4. Design and simulate a complete digital control system using DSCs for a given problem.

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MEVP-113			Programming Digital Signal Controller				
Teaching Scheme			Credits	Marks			Duration
L	T	P/D	C	Sessional	End Semester Exam	Total	End Semester Examination
0	0	2	1	30	20	50	3 Hrs

Course Objectives:

1. Understand the architecture and functional features of Digital Signal Controllers (DSCs).
2. Learn to program DSCs using C and embedded tools for real-time signal processing.
3. Develop applications for control systems, motor drives, and digital filters using DSCs.
4. Interface DSCs with sensors, actuators, and other peripheral modules.
5. Analyze and optimize code for performance and real-time constraints in embedded applications.

List of Experiments

1. Study of Digital Signal Controller (e.g., TI C2000) architecture and toolchain
2. Write and simulate a basic blinking LED code using DSC
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6. Implementation of a digital FIR filter using C programming in DSC
7 Speed control of a DC motor using PI controller implemented on DSC
8 Real-time serial communication (UART/SPI/I2C) between DSC and PC/another

Course Outcomes:

1. Explain the architecture and internal modules of a DSC.
2. Develop embedded C programs for DSC-based control and signal processing applications.
3. Implement real-time applications using interrupt, timer, ADC, and PWM modules.
4. Design and simulate a complete digital control system using DSCs for a given problem.

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ELECTIVE-I

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MEVT-111			Advanced Battery Technology for Electrical Vehicles				
Teaching Scheme			Credits	Marks			Duration
L	T	P/D	C	Sessional	End Semester Exam	Total	End Semester Examination
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. To understand electrical vehicle operation & battery basics
2. To study the electric vehicle battery requirement and battery efficiency
3. To explain electric vehicle battery charging methods
4. To understand electric vehicle fast charging & discharging behavior
5. To understand electric vehicle battery performance

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**ELECTRIC VEHICLE BATTERIES:** 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.	9
II	**ELECTRIC VEHICLE BATTERY CAPACITY:** 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. **ELECTRIC VEHICLE BATTERY CHARGING:** Charging NiMH Batteries, Rate of Charge Effect on Charge Acceptance Efficiency of Traction, Battery Packs,	9

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	Environmental Influences on Charging, Charging Methods for NiMH Batteries, Charging Technology, Battery Pack Corrective Actions.	
III	**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 **ELECTRIC VEHICLE BATTERY DISCHARGING** 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.	9
IV	**ELECTRIC VEHICLE BATTERY PERFORMANCE:** 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.	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. Electric vehicle battery systems by Sandeep Dhameja, Newnes Publishing, 2002

Course Outcomes:

On learning this course students will be able to

1. Describe 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. Compare the fast charging and discharging behavior of different types of batteries.
5. Analyze battery performance management systems used with respect to battery operation and safety.

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MEVT-112			Advance Power Electronics				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examination**
3	**0**	**0**	**3**	**40**	**60**	**100**	**3 Hrs**

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. Introduce advanced solid-state power electronic devices, wide bandgap technologies, and their thermal, protection, and control aspects.
2. Develop a deep understanding of non-isolated and isolated DC-DC converter topologies, including their operation in DCM and CCM modes.
3. Explore high-performance AC-DC converter systems, including multipulse and multilevel configurations, with applications in HVDC, SMPS, UPS, and EV charging.
4. Analyze resonant converter topologies and multilevel inverter drives for improved power quality and efficient motor control

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	Power Electronics Devices: An Introduction: Advanced solid-state devices: MOSFETs, IGBT, GTO, IGCT etc. Wide band gap devices (SiC and GaN), Power modules, intelligent power modules, gating circuits., Design of snubbers, Thermal design, protection., Digital signal processors used in their control. Choppers and Non-isolated DC-DC Converters: Choppers: Step-Down, Step-Up, Class-B, Class-C, Class-D, Class-E and Multi-Phase.Non-isolated DC-DC Converters: Buck, boost, buck-boost, Cuk, SEPIC, Zeta in DCM and CCM.	9
II	Isolated DC-DC Converters and Power Factor Correction Converter: Isolated DC-DC Converters: Flyback, Forward, Cuk, SEPIC, Zeta, Half Bridge, Push-Pull and Bridge in DCM and CCM.	9

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	Single-phase, Single-Stage Converters (SSSSC), Power Factor Correction at AC Mains in These Converters. Applications in SMPS, UPS, Welding, Lighting and EV Charging.	
III	Multiphase Converter and HVDC Systems: 12-Pulse Converter Based HVDC Systems. Multipulse And Multilevel VSC Based Flexible HVDC Systems. three-Phase and Multipulse Improved Power Quality AC-DC converters: Three-Phase Improved Power Quality AC-DC converters: VSC, Multilevel VSCs, Multipulse VSCs, PWM CSC (Current Controlled Voltage Source Converters). Multipulse AC-DC Converters: Diode and Thyristor-Based Converters	9
IV	Multilevel Inverter Drive: Multilevel Inverter Fed Induction Motor Drive. Harmonic Suppression and Modulation technique for Multipulse Converter Fed Multilevel Inverter-Based IM Drive. Power Quality Improvement in Multi-Pulse Converter Fed Multilevel Inverter Based Induction Motor Drives. Resonant Converter:Analysis and principle of operation of Resonant Converter. Series and Parallel Resonant Inverters. Zero Voltage Switching Resonant Converters. Zero Current Switching Resonant Converter. Quasi Resonant and Multi Resonant DC-DC Power Converters. Phase-Controlled Resonant Converters	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001

2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

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.

Course Outcomes:

On learning this course students will be able to

1. Explain the characteristics, control, and protection of advanced power semiconductor devices including MOSFETs, IGBTs, GTOs, IGCTs, and wide bandgap devices like SiC and GaN.
2. Analyze and design various non-isolated and isolated DC-DC converters (Buck, Boost, Cuk, SEPIC, Flyback, Forward, Push-Pull, Bridge) in both DCM and CCM modes.
3. Evaluate multipulse and multilevel AC-DC converter systems for power factor correction and power quality improvement in industrial applications including HVDC, UPS, and EV charging.
4. Examine the operation and modulation techniques of resonant converters and multilevel inverter drives, and assess their role in harmonic suppression and efficient motor control.

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MEVT-113			Power Semiconductor Devices				
Teaching Scheme			Credits	Marks			Duration
L	T	P/D	C	Sessional	End Semester Exam	Tot al	End Semester Examinati on
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. To identify various power semiconductor devices and their ratings for various power electronic application.
2. To understand the static and dynamic characteristics of voltage and current controlled power semiconductor devices
3. To enable the students, the knowledge of selection of devices for different power electronics applications
4. To understand the control and Gate Drive requirements for different power devices.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Power Diodes:** on-state losses, switching characteristics-turn-on transient, turn-off transient and reverse recovery transient, Schottky diodes, series and parallel connections of diodes, snubber requirements for diodes, diode snubber. **Power BJT'S:** on state losses, switching characteristics, resistive switching specifications, clamped inductive switching specifications, turn-on transient, turn-off transient, storage time, base drive requirements, switching losses, device protection-snubber requirements for BJT'S and snubber design - switching aids. **Gate Turnoff Thyristor (GTO):** Basic structure and operation, GTO switching characteristics, GTO turn-on transient, GTO turn -off transient, minimum on and off state times, gate drive requirements, maximum controllable anode current, over current protection of GTO'S.	9
II	**Power MOSFET'S:** Basic structure, V-I characteristics, turn-on process, on state operation, turn-off process, switching characteristics, resistive switching specifications, clamped inductive switching specifications - turn-on transient and di/dt limitations, turn-off transient, turn off time, switching losses, effect of reverse recovery transients on	9

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	switching stresses and losses - dv/dt limitations, gating requirements, gate charge - ratings of MOSFET'S, FBSOA and RBSOA curves, device protection –snubber requirements, MOSFET drivers and protection, Miller region.	
III	**Insulated Gate Bipolar Transistors (IGBT'S):** Basic structure and operation, latch up IGBT, switching characteristics, resistive switching specifications, clamped inductive switching specifications - IGBT turn-on transient, IGBT turn off transient- current tailing - gating requirements -ratings of IGBT'S, FBSOA and RBSOA curves, switching losses - minimum on and off state times - switching frequency capability – over current protection of IGBT'S, short circuit protection, snubber requirements and snubber design. IGBT drivers and protection, Active clamping.	9
IV	**New Power Semiconductor Devices:** MOS gated thyristors, MOS controlled thyristors or MOS GTO'S, base resistance controlled thyristors, emitter switched thyristor, GaN and SiCdevices. Introduction to wide band gap devices. Thermal design of power electronic equipment, heat transfer by conduction, transient thermal impedance - heat sinks, heat transfer by radiation and convection - heat sink selection for power semiconductor devices.	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics Converters, Applications, and Design", 3rdEdition. Wiley India Pvt Ltd, 2011.
2. G. Massobrio, P. Antognetti, "Semiconductor Device Modeling with Spice", McGraw-Hill, 2nd Edition, 2010.
3. B. Jayant Baliga, "Power Semiconductor Devices", 1st Edition, International Thompson Computer Press, 1995.
4. V. Benda, J. Gowar, and D. A. Grant, "Discrete and Integrated Power Semiconductor Devices: Theory and Applications", John Wiley & Sons, 1999.
5. Joseph Vaithiyathil, "Power Electronics Principles and Applications" Mc Graw Hill Education,2010.

Course Outcomes:

On learning this course students will be able to

1. Comprehend the types, characteristics, protection and modeling of Power Diodes, Power BJT's and Thyristors.
2. Analyze the structure, characteristics, gate drive requirements and modeling of GTO's and TRIACS.
3. Explain the principle of operation of MOSFET with their characteristics and effect of reverse recovery transients on switching stresses & losses
4. Explain the principle of operation of IGBT with their characteristics and protection against over-current & short-circuit.

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ELECTIVE -II

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MEVT-121			Automotive Electronics for EVs				
Teaching Scheme			Credits	Marks			Duration End Semester Examination
L	T	P/D	C	Sessional	End Semester Exam	Total	
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *Understand the electrical and electronic systems in vehicles*
2. *Understand the principles of networking*
3. *Explain requirements and types of bus systems*
4. *Comprehend the lighting systems in vehicles*
5. *Understand the auxiliaries and chassis electric systems in automobiles.*

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Electrical And Electronic Systems in the Vehicle**: Overview, Motronic engine management system, Electronic diesel control, Lighting technology, Electronic stability program, Adaptive cruise control, Infotainment System. **Basic principles of networking:** Network topology, Network organization, OSI reference model, Control mechanisms. **Automotive networking:** Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, coupling of networks, Examples of networked vehicles system.	9
II	**Bus systems:** CAN bus: Applications, Topology , Data transmission system, CAN protocol , data transfer sequence, standardization, characteristics. LIN bus: Overview, Applications, Data transfer, Bus access, LIN protocol, network management, example. MOST bus: Introduction, features, data transfer, administrative functions, application layer Bluetooth: Overview, applications, Bluetooth versions, transmission technology,	9

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	power classes, topology, physical data channel, physical connections, Architecture.	
III	**Lighting system:** Lighting fundamentals Lighting circuits, Gas discharge and LED lighting, Case studies, Diagnosing lighting system faults, Advanced lighting technology, New developments in lighting systems **Auxiliaries in vehicles:** Windscreen washers and wipers, signalling circuits, Other auxiliary systems, Case studies, Diagnosing auxiliary system faults Advanced auxiliary systems technology, new developments in auxiliary systems	9
IV	**Chassis Electrical systems:** Anti-lock brakes, Active suspension, Traction control , Automatic transmission, Other chassis electrical systems, Case studies, Diagnosing chassis electrical system faults, Advanced chassis systems technology, New developments in chassis electrical systems	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. Robert Bosch GmbH, "Bosch Automotive Electrics and Automotive Electronics", 5th Edition.
2. John Wiley & Sons Ltd, 2007.
3. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier, 2003.
4. Tom Denton: "Automobile Electrical and Electronic Systems", 3rd Edition, Elsevier
5. Butterworth-Heinemann Publication, 2004.

Course Outcomes:

On learning this course students will be able to

1. Identify various electrical & electronic systems in vehicles and understand their working.
2. Discuss the basic principles of networking requirements in an automotive.
3. Explain requirements and types of bus systems.
4. Comprehend the lighting systems in vehicles.

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MEVT-122			Switched Mode Power Conversion				
Teaching Scheme			**Credits**	**Marks**			**Duration End Semester Examination**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	**0**	**0**	**3**	**40**	**60**	**100**	**3 Hrs**

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *Introduce the fundamentals of switch mode power conversion, including converter topologies, semiconductor switches, and reactive components.*
2. *Develop analytical skills for steady-state operation and performance evaluation of non-isolated and isolated DC-DC converters under CCM and DCM modes.*
3. *Provide foundational understanding of converter modeling techniques using state-space representation and circuit averaging.*
4. *Equip students with knowledge of control strategies and magnetic design principles essential for efficient converter operation and implementation*

COURSE CONTENT:

UNIT	Content	No of Hrs.
I	Introduction To Switch Mode Power Converters: About Switch Mode Power Conversion, introduction to DC-DC converter, Power Semiconductor Switches(Diode &Control Switches), Prior art(Linear Power Converter, Shunt Controlled Converter, Series Controlled Converter, Zener Regulator Converter), Reactive Component(inductor, Transformer, Capacitor, issues related to switches)	9
II	Non-isolated Converters: Steady State analysis of Buck, Boost, Buck-Boost and Flyback converter. Isolated Converters: Steady State analysis of Forward Converter, Push Pull Converter, isolated flyback converter and Half/Full Bridge Converter.	9
III	CCM and DCM operations of Converters: Buck Converter and Boost Converter	9

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	Modelling of Dc Dc Converter : Basic overview, State space representation & circuit averaging of Buck converter and Boost Converter	
IV	Controller Basics: DC-DC Converter Controller, Controlled Structure, PID Controller Magnetics Design: Magnetic Materials, Magnetic Losses, Magnetic Cores, Design of inductors	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. N Mohan, T M Undeland and W P Robbins, "Power Electronics: Converters, Applications and Design", Wiley , 3rd Edition, 2007

2. Abraham Pressman, Keith Billings, Taylor Morey, "Switching Power Supply Design", McGraw-Hill.3rd Edition, 2009

3. K. Kit Sum, Switch Mode Power Conversion: Basic Theory and Design 1st Edition, Kindle Edition,2017.

4. https://nptel.ac.in/courses/108108036

5. https://ee.iisc.ac.in/wp-content/uploads/2023/01/SMPC_VRamnarayanan.pdf

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Classify the DC to DC Converters and differentiate the various Power semiconductor switches.
2. Illustrate Isolated and Non-isolated Power Conversion
3. Analyze the operational modes, controller Design and Mathematical Modelling of DC-DC Converters
4. Design the inductor for DC DC converter

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MEVT-123			Vehicle Design Engineering				
Teaching Scheme			**Credits**	**Marks**			**Duration End Semester Examination**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *Understand different aspects of car body and bus body types*
2. *Understand different types and dimensions of commercial vehicle.*
3. *Understand driver's cab design regulations.*
4. *Know the role of various aerodynamic forces and moments, measuring instruments*
5. *Know body optimization techniques for minimum drag.*

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**CAR BODY DETAILS:** Types of Car body – Saloon, convertibles, Limousine, Estate Van, Racing and Sports car – Visibility regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car body construction-Various panels in car bodies. Safety aspect of car body.	9
II	**BUS BODY DETAILS:** Types of bus body: based on capacity, distance travelled and based on construction. – Bus body layout for various types, Types of metal sections used – Regulations – Constructional details: Conventional and integral. driver seat design- Safety aspect of bus body.	9
III	**COMMERCIAL VEHICLE DETAILS:** Types of commercial vehicle bodies – Light commercial vehicle body. Construction details of commercial vehicle body – Flat platform body, Trailer, Tipper body and Tanker body – Dimensions of driver's seat in relation to controls – Drivers cab design – Regulations.	9
IV	**VEHICLE AERODYNAMICS:** Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments. Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation, Types. Wind tunnel testing such as: Flow visualization techniques, Airflow management test, – measurement of various forces and moments by using wind tunnel.	9

Total Number of Hours = 36 Hrs

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Text/Reference Books:

1. Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 1998.
2. James E Duffy, "Body Repair Technology for 4-Wheelers", Cengage Learning, 2009.
3. Miles, G.J., "Body construction and design", Illiffe Books Butterworth & Co., 1991.
4. John Fenton, "Vehicle Body layout and analysis", Mechanical Engg. Publication Ltd., London, 1992.
5. Braithwaite, J.B., "Vehicle Body building and drawing", Heinemann Educational Books Ltd., London, 1997.
6. Dieler Anselm., The passenger car body, SAE International, 2000.

Course Outcomes:

On learning this course students will be able to

1. Describe different aspects of car body and bus body types.
2. Illustrate different types and dimensions of commercial vehicle.
3. Design driver's cab in relation to controls.
4. Illustrate the role of various aerodynamic forces and moments, measuring instruments

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COURSE CONTENTS

M. Tech. (Electrical Vehicle Technology)

SECOND SEMESTER

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MEVT-201			EV Charging and Infrastructure and Design				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examination**
3	1	0	4	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1.This course focuses on the key components of the charging infrastructure available for electric vehicles and its challenges.

2. The course includes the discussion related to the various stages of power conversion unit, its associated protection and communication (to exchange various data between the vehicle and electric vehicle supply equipment).

3. It includes the detailed design, modelling and control of various AC-DC and isolated DC-DC converters.

4.The also course discusses the protocols, charging procedures and associated communication of AC and DC charging with a special focus on AC type-2 and CCS2 charging.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Introduction to Charging System :**Electric Vehicle Supply Equipment (EVSE) for on-board charger , EVSE for off-board charger, Charging Infrastructure Challenges **Classification and Standards:** Levels of charging ,Classification based on connectors and modes, Standards governing the charging systems	**10**
II	**AC-DC power converters:** Various types of AC-DC converters used for EV chargers, Single phase Boost derived topologies: operating principles, modelling and control, Single phase Bridgeless topologies: operating principles, modelling and control, Three phase AC-DC converter: operating principles, modelling and control , Bidirectional power flow	**10**

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III	**Isolated DC-DC converters:** Various types of isolated converters used for EV chargers , Losses and soft-switching criteria, Phase-shift full bridge: operating principles and control , Dual active bridge: operating principles, modulation and control , Introduction to resonant type converters for EV chargers	10
IV	Charging procedure, protocols and communication: AC type2, DC charging (CCS2) EMI/EMC considerations: sources of EMI, differential mode noise , common mode noise , design of DM and CM filters	10

Total Number of Hours = 40 Hrs

Text/Reference Books:

1. Denton, T., *Automotive Electrical and Electronic Systems*, 5th Edition, Routledge, 2018.
2.Husain, I., *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press, 2021.
3. Erickson, R. W., & Maksimovic, D., *Fundamentals of Power Electronics*, 3rd Edition, Springer, 2020.
4. Umanand, L., *Power Electronics: Essentials and Applications*, Wiley India, 2012.
5. Mohan, N., Undeland, T. M., & Robbins, W. P., *Power Electronics: Converters, Applications and Design*, 3rd Edition, Wiley India, 2003. *(Note: You had a typo in the year; the correct year for the 3rd edition is 2003.)*

Course Outcomes:

On learning this course students will be able to

1. Analyze the operation of different power converters.
2. Design of non-isolated converters used in electric vehicles
3. Design front end for practical offline converters.
4. Analyze the operation of practical isolated converters and the Bidirectional converter topologies used in Electric Vehicles.

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MEVT-202			Electrical Power Quality				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examination**
3	1	0	4	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1.To understand the concepts and significance of electrical power quality in modern power systems.

2. To analyze power quality problems such as voltage sags, swells, harmonics, flicker, interruptions, and transients.

3.To study the effects of power quality issues on equipment and system performance.

4.To explore mitigation techniques and standards related to power quality.

5.To introduce monitoring and measurement techniques of power quality parameters.

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Power quality:** An Introduction, Classification of power quality, Causes of Power quality, Effect of Power quality, Power quality Mitigation classification Technique	10
II	Voltage flicker: sources and effects, Measurement and evaluation of flicker (IEC standards), Electrical transients: types, causes, and mitigation, Power frequency variations and their impact **Compensators:** Passive Shunt, Passive Series, Active Shunt, Active Series, UPQC	10

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III	**Loads:** An introduction, Non Linear Loads **Filters:** Passive Power Filters, Shunt Active Power Filters, Active Series Power Filters	10
IV	**AC-DC Converter:** AC-DC Converter that cause Power Quality, improved Power quality AC-DC Boost Converter, Buck Converter, Buck-Boost Converters	10

Total Number of Hours = 40 Hrs

Text/Reference Books:

1. "Power Quality" by C. Shankaran
2. "Power Quality in Electrical System" by Alexander Kusko McGraw-Hill Companies.
3. "Electrical Power System Quality" by Roger C. Dugan, Mark F. Mcgranaghan,SuryaSantosoH.WayneBeaty Tata McGraw-Hill Publishing company Limited
4. https://archive.nptel.ac.in/courses/108/102/108102179/#

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Understand Power Quality Fundamentals, Power Quality Effects and Power Quality Mitigation Techniques
2. Apply Compensation Techniques
3. Investigate Non-Linear Loads and Implement Filtering Solutions
4. Assess AC-DC Converters and Their Impact on Power quality with solutions.

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MEVT-203			Vehicle Dynamic and Control				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examinatio n**
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *Introduce the fundamentals of vehicle dynamics including longitudinal, lateral, and vertical motion.*
2. *Develop mathematical models of vehicles to study ride, handling, and stability.*
3. *Explain the control strategies used for improving performance, safety, and comfort.*
4. *Familiarize students with active and passive vehicle control systems (e.g., ABS, ESC, TCS).*
5. *Equip students to analyze and design control systems using simulation tools for real-world scenarios*

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	Introduction to Vehicle Dynamics: Types of forces acting on a vehicle, Coordinate systems and equations of motion, Overview of dynamic models (lumped and multi-DOF) Longitudinal Dynamics: Acceleration and braking performance, Gradeability and tractive effort, Braking force distribution and ABS principles	9
II	Lateral Dynamics and Handling: Steering geometry and kinematics, Bicycle model and yaw rate dynamics, Understeer, oversteer, and cornering stability, Electronic Stability Control (ESC)	9
III	Vertical Dynamics and Ride Comfort: Suspension system modeling: quarter-car and half-car models, Vibration isolation and transmissibility ,Active suspension control systems	9

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IV	Control Systems in Vehicles: Control strategies: PID, state feedback, LQR, Control system design for cruise control, traction control (TCS), lane keeping,ADAS overview: ACC, AEB, ESC, Simulation tools for vehicle dynamics (MATLAB/Simulink, CarSim, ADAMS)	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. **Rajesh Rajamani**, *Vehicle Dynamics and Control*, 3rd Edition, Springer, 202
2. **Thomas D. Gillespie**, *Fundamentals of Vehicle Dynamics*, SAE International, 1992.
3. **Hans B. Pacejka**, *Tire and Vehicle Dynamics*, 3rd Edition, Butterworth-Heinemann, 2012.
4. **William F. Milliken & Douglas L. Milliken**, *Race Car Vehicle Dynamics*, SAE International, 1995.
5. **Jazar, Reza N.**, *Vehicle Dynamics: Theory and Application*, Springer, 2017.

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Explain the physical principles governing vehicle motion dynamics.
2. Derive and interpret models for longitudinal, lateral, and vertical dynamics of vehicles.
3. Analyze ride comfort and handling performance using suspension and steering models.
4. Apply control strategies to improve braking, stability, and traction in dynamic conditions.
5. Simulate and evaluate advanced driver-assistance systems (ADAS) using tools like MATLAB/Simulink.

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<table>
<tr><td colspan="3">MEVP-211</td><td colspan="5">EV Charging and Infrastructure and Design Lab</td></tr>
<tr><td colspan="3">Teaching Scheme</td><td>Credits</td><td colspan="3">Marks</td><td>Duration</td></tr>
<tr><td>L</td><td>T</td><td>P/D</td><td>C</td><td>Sessional</td><td>End Semester Exam</td><td>Total</td><td>End Semester Examination</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td><td>30</td><td>20</td><td>50</td><td>3 Hrs</td></tr>
</table>

Course Objectives:

1. *Understand the design and operation of buck converter*
2. *Understand and design synchronous and buck-boost converter powered by car battery.*
3. *Understand the design and operation of rectifier with PFC.*
4. *Understand the design and operation of flyback and forward converter.*
5. *Understand the operation of non-isolated bidirectional onboard charger and inverter.*

List of Experiments:

1. EV -charger types, working and components.
2. Common charger failure.
3. CAN - communication in EV charger.
4. Design and simulate a buck-boost converter operated from a car battery.
5. Design a 100 W rectifier operated on universal mains and demonstrate the starting inrush current.
6. Design and simulate the passive PFC for a rectifier circuit.
7. Design and simulate flyback converter without parasitic elements.
8. Design and simulate a two-switch forward converter using two MOSFETs and a couple of diodes to recycle the magnetizing energy.
9. Design and simulate non-isolated bidirectional onboard charger
10. Design and simulate DC- AC converter using IGBT.

Course Outcomes:

At the end of the course student will be able to

1. Analyze the effect ESR of filter capacitor on the performance of the buck converter.
2. Compare the performance of synchronous buck converter with buck converter.
3. Design rectifier operated on universal mains with the feature of PFC.
4. Design flyback and forward converter.

Reference Books

1. Christophe Basso, "Switch Mode Power Supplies : SPICE Simulations and Practical Designs", McGraw-Hill,2008.

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MEVP-212			EV Motor drives and control Lab				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examination**
0	0	2	1	30	20	50	3 Hrs

Course Objectives:

1. *To study the effect of field weakening in DC motor control*
2. *To understand the open loop and closed loop control of DC motor.*
3. *To study PWM generation and control of 3-phase induction motor.*
4. *To understand the significance of dead time in PWM generation.*
5. *To study the control of BLDC and PMSM motor*

List of Experiments:

1 Motor working, types and Transmission.
2. Motor Failure and Diagnosis.
3. Controllers - components, functions and working.
4. GPS- working, parameters and types.
5. Model the DC motor and study the effect of field weakening on the speed.
6. For a DC motor design suitable current PI gains so that current control bandwidth is 150 Hz and the damping coefficient is 0.7.
7. For a DC motor, demonstrate four quadrant operation.
8. Study the stability of the DC motor using bode plot for open loop and closed loop cases.
9. Design and simulate Variable Voltage Variable Frequency Control for 3 phase induction motor.
10. Generate sinusoidal PWM for single phase inverter.
11. Generate PWM signals for H bridge inverter incorporating dead time.
12. Simulate space vector PWM technique
13. Study of BLDC motor drives.
14. Study of PMSM drives.

Course Outcomes:

At the end of the course student will be able to

1. Demonstrate the effect of field weakening in DC motor control.
2. Design open loop and closed loop control of DC motor.
3. Analyze the control of 3 phase induction motor.
4. Demonstrate the significance of dead time in PWM generation.
5. Develop controllers for BLDC and PMSM drives.

Reference Books

1 K Wang Hee Nam: AC Motor Control & Electrical Vehicle Application, CR Press, Taylor & Francis Group, 2019

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MEVP-213			PCB Design				
Teaching Scheme			Credits	Marks			Duration
L	T	P/D	C	Sessional	End Semester Exam	Total	End Semester Examination
0	0	2	1	30	20	50	3 Hrs

Course Objectives:

1. *Introduce the fundamentals of Printed Circuit Board (PCB) design and fabrication.*
2. *Develop skills in schematic capture, component placement, and PCB layout using EDA tools.*
3. *Familiarize students with design rules, signal integrity, and electromagnetic compatibility.*
4. *Enable design of single-layer, double-layer, and multi-layer PCBs.*
5. *Impart practical experience in prototype development and testing.*

List of Experiments:

1. Introduction to PCB Design Tools (KiCad / Eagle / Altium Designer / OrCAD)
2. Designing and Simulating a Schematic for a Basic Power Supply Circuit (e.g., 7805)
3. Creating Custom Component Symbols and Footprints
4. PCB Layout and Routing: Manual and Auto-Routing Techniques
5. Design Rule Check (DRC) and Electrical Rule Check (ERC)
6. Generation of Gerber Files and Bill of Materials (BOM)
7. Design and Layout of a Two-Layer PCB (e.g., op-amp or sensor-based circuit)
8. PCB Fabrication Demonstration / Simulation of Fabrication Process
9. Soldering and Assembling Through-Hole and SMD Components on PCB
10. Testing and Debugging the Assembled PCB (Continuity, Signal Flow, Output Verification)

Course Outcomes:
At the end of the course student will be able to

1. Explain the basics and classifications of PCBs and the design workflow.
2. Create electronic circuit schematics and footprints using PCB design tools.
3. Design and simulate PCB layouts considering electrical and mechanical constraints. Apply design rules for signal integrity, EMI/EMC, and thermal management.
4. Fabricate a prototype PCB and perform testing/debugging of the circuit.

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Elective –III

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MEVT-211			Battery Management System				
Teaching Scheme			Credits	Marks			Duration
L	T	P/D	C	Sessional	End Semester Exam	Total	End Semester Examination
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *To introduce the various Battery Management System parts*
2. *To understand basic information about batteries*
3. *To measure different battery parameters*
4. *To estimate state of charge of the battery*
5. *To estimate state of health of the battery*

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Battery Management System parts:** The Power Module (PM), The battery, The DC/DC converter, load, communication channel, Examples of Battery Management Systems, Comparison of BMS in a low-end and high-end shaver, Comparison of BMS in two types of cellular phones **Basic information on batteries:** Battery systems, Definitions Battery design, Battery characteristics, General operational mechanism of batteries, Basic thermodynamics, Kinetic and diffusion over potentials, Double-layer capacitance, Battery voltage Lithium-Ion Battery Fundamentals: Battery Operation, Battery Construction, Battery Chemistry, Safety Longevity, Performance, Integration.	9
II	**Measurement of battery parameters:** Cell Voltage Measurement, Current Measurement, Current Sensors Current Sense Measurements, Synchronization of Current and Voltage, Temperature Measurement, Measurement Uncertainty and Battery Management, System Performance **Battery Management System Functionality:** Charging, Strategies, CC/CV Charging	9

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	Method, Target Voltage Method, Constant Current Method, Thermal Management, Operational Modes.	
III	**Charge Balancing:** Balancing Strategies, Balancing Optimization, Charge Transfer Balancing, Flying Capacitor, Inductive Charge Transfer Balancing, Transformer Charge Balancing, Dissipative Balancing, Balancing Faults. **State-of-Charge Estimation Algorithms:** Challenges, Definitions, Coulomb Counting, SOC Corrections, OCV Measurements, Temperature Compensation, Kalman Filtering, Other Observer Methods.	9
IV	**State-of-Health Estimation Algorithms:** State of Health, Mechanisms of Failure, Predictive SOH Models Impedance Detection, Passive Methods, Active Methods, Capacity Estimation, Self-Discharge Detection Parameter Estimation, Dual-Loop System, Remaining Useful Life Estimation, Fault Detection, Overview, Failure Detection, Overcharge/Overvoltage, Over-Temperature, Overcurrent Battery Imbalance/Excessive Self-Discharge, Internal Short Circuit Detection, Detection of Lithium Plating, Venting Detection, Excessive Capacity Loss, Reaction Strategies.	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. H. J. Bergveld, "Battery management systems : design by modelling" University Press Facilities, Eindhoven,2001
2. Phillip Weicker, "A Systems Approach to Lithium-Ion Battery Management", artech house, 2014
3. Gregory L. Plett, "Battery Management Systems: Battery Modeling", Artech house, 2015
4. M. Barak (Ed.), T. Dickinson, U. Falk, J.L. Sudworth, H.R. Thirsk, F.L. Tye, "Electrochemical Power Sources: Primary & Secondary Batteries", IEE Energy Series 1, A. Wheaton &Co, Exeter, 1980.

Course Outcomes:

On learning this course students will be able to

1. Review various Battery Management System parts
2. Clarify the basic information about batteries and demonstrate Lithium-Ion Battery Fundamentals
3. Measure different battery parameters and analyze battery performance to identify Battery Management System Functionality
4. Detail the need of Charge Balancing and state of charge estimation using various algorithms

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MEVT-212			Energy Storage Systems for EV				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examination**
3	**0**	**0**	**3**	**40**	**60**	**100**	**3 Hrs**

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *To understand working of different types of electric vehicles.*
2. *To explain the battery parameters.*
3. *To understand different types of batteries.*
4. *To illustrate battery charging and modelling*
5. *To introduce novel and alternate energy sources.*

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Types of Electric Vehicle:** Battery electric vehicles, The IC engine/electric hybrid vehicle, fueled electric vehicles, Electric vehicles using supply lines, Solar powered vehicles, Electric vehicles which use flywheels or super capacitors, Electric Vehicles for the Future	9
II	**Battery Parameters**: Electrochemical Batteries, Cell and battery voltages, Charge (or Amp hour) capacity, Energy stored, Specific energy, Energy density, Specific power, Amp hour (or charge) efficiency, Energy efficiency. Self-discharge rates, Battery geometry, Battery temperature, Battery life and number of deep cycles.	9
III	**Types of Batteries:** Lead Acid Batteries, Nickel-based Batteries: Introduction, Nickel cadmium, Nickel metal hydride batteries, Sodium-based Batteries, Lithium Batteries, Metal Air Batteries, **Battery Charging and Modelling:** Battery Charging, Battery chargers, Charge equalization, The Designer's Choice of Battery, Use of Batteries in Hybrid Vehicles, Internal combustion/battery electric hybrids, Battery/battery electric hybrids, Combinations using flywheels, Complex hybrids, Battery Modelling, the purpose of battery modelling, Battery equivalent circuit, Modelling battery capacity, Simulation a battery at a set power, Calculating the Peukert Coefficient, Approximate battery	9

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	sizing	
IV	**Alternative and Novel Energy Sources and Stores:** Introduction, Solar Photovoltaic, Wind Power, Flywheels, Ultra capacitors, Super Capacitors, Supply Rails, Hydrogen Fuel Cells: Basic Principles, Hydrogen Storage I: Storage as Hydrogen, Hydrogen Storage II: Chemical Methods.	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., UK, Electric Vehicle Technology Explained
2. M. Barak (Ed.), T. Dickinson, U. Falk, J.L. Sudworth, H.R. Thirsk, F.L. Tye, "Electrochemical Power Sources: Primary & Secondary Batteries", IEE Energy Series 1, A. Wheaton &Co, Exeter, 1980.
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.

Course Outcomes:

On learning this course students will be able to

1. Identify various types of electric vehicles and their performance parameters.
2. Analyse the battery parameters and their variations during charge and discharge cycles.
3. List different types of batteries and analyse their performance parameters.
4. Examine the battery charging requirements and develop the complete battery model.

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MEVT-213			Smart Grid: Basics to Advanced Technologies				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examination**
3	**0**	**0**	**3**	**40**	**60**	**100**	**3 Hrs**

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective :

1. *Introduce the fundamental concepts and components of the Smart Grid.*
2. *Explain the integration of renewable energy sources, energy storage systems, and communication infrastructure.*
3. *Study advanced metering infrastructure, demand-side management, and real-time grid monitoring techniques.*
4. *Analyze cybersecurity, interoperability, and regulatory issues in smart grid implementation.*
5. *Provide exposure to modern tools and technologies such as SCADA, PMUs, IoT, and AI in smart grid applications.*

COURSE CONTENT:

UNIT	Content	No of Hrs.
I	Introduction to Smart Grid-I, Introduction to Smart Grid-II, Architecture of Smart Grid system, Standards for Smart Grid system, Elements and Technologies of Smart Grid System, Elements and Technologies of Smart Grid System-II , Distributed Generation Resources-I , Distributed Generation Resources-II ,Distributed Generation Resources-III , Distributed Generation Resources-IV, Introduction to energy storage devices ,Different types of energy storage technologies , Analytical modelling of energy storage devices ,Optimal sizing and siting of storages, Battery management system (BMS)	9
II	Wide area Monitoring Systems-I , Wide area Monitoring Systems-II ,Phasor Estimation-I , Phasor Estimation-II , Digital Relays for Smart Grid Protection, Islanding Detection Techniques–I , Islanding Detection Techniques –II , Islanding Detection Techniques –III , Smart Grid Protection-I , Smart Grid Protection-II, Smart Grid Protection-III , Smart Grid Protection-IV , Modelling	9

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	of storage devices , Modelling of DC smart grid components , Operation and control of AC Microgrid-I	
III	Operation and control of AC Microgrid -II , Operation and control of DC Microgrid -I , Operation and control of DC Microgrid -II , Operation and control of AC-DC hybrid Microgrid -I ,Operation and control of AC-DC hybrid Microgrid -II, Phasor measurement unit placement ,Cyber security and resiliency , Virtual inertia and ancillary support , Demand side management of smart grid , Demand Response Analysis of smart grid, Demonstration of solar power generation , Demonstration of wind power generation , Demonstration of Battery Management System , Demonstration of EV charging system , Hierarchical control techniques in hybrid ac-dc microgrid	9
IV	Simulation and case study of AC Microgrid , Simulation and case study of DC Microgrid ,Simulation and case study of AC-DC Hybrid microgrid , Demonstration of parallel inverter operation in AC microgrid , Harmonic effects and its mitigation techniques, Energy management , Design of Smart Grid and Practical Smart Grid Case Study-I , Design of Smart Grid and Practical Smart Grid Case Study-II , System Analysis of AC/DC Smart Grid , Demonstration of grid-connected DC microgrid, Demonstration of energy management in microgrid , Demonstration of PHIL experimentation for symmetric and asymmetric fault analysis of grid-connected DFIG wind turbine. , Demonstration of ancillary support from virtual synchronous generator , Demonstration on peak energy management using energy storage system, Conclusions	9

Total Number of Hours = 36 Hrs

Course Outcomes:

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

1. Understand and describe the architecture, features, and need for smart grids.
2. Analyze and evaluate the integration of renewable energy sources and distributed generation into the smart grid.
3. Design demand response strategies using advanced metering infrastructure and real-time data.
4. Assess the role of communication technologies, IoT, and AI in grid automation and monitoring.
5. Examine the challenges of cybersecurity, interoperability, and regulatory compliance in smart grids.

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ELECTIVE-IV

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MEVT-221			Solar Battery Charging System				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examination**
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *To understand the functioning of solar photovoltaic cells and know the ratings*
2. *To know the solar array connection and estimate solar module power*
3. *To understand function of charge controller and MPPT techniques*
4. *To know the concept of solar PV system design and integration*
5. *To explain the installation, trouble shooting and safety requirement of solar system*

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**Solar Photovoltaic:** Solar Cell and its function, Solar Technologies, Solar Cell Parameters, Efficiency of Solar Cell, Solar PV Module, Rating of Solar PV Module, PV Module Parameters, Efficiency of PV Module, Measuring Module Parameter **Solar Photovoltaic Module:** Array Connection of PV Module in Series and Parallel, Estimation and Measurement of PV Module Power, Selection of PV Module.	9
II	**Charge Controller, MPPT and Inverter:** Power MOSFET and IGBT, Opto coupler, Buck and Boost Converter, Fly back Converter, Full Bridge Inverter, Voltage and Current Feedback, DC to DC power converter, DC to AC Converter, AC to DC Converter, Battery Charge controller, Maximum Power Point Tracking, Specification of Inverter and charger.	9
III	**Solar PV System Design and Integration:** Solar Radiation, Energy Measurements, Estimating Energy requirement, Types of Solar PV System, Design methodology for SPV system, Design of Off Grid Solar Power Plant, Case studies of 3KWp Off grid Solar PV Power Plant, Design and Development of Solar Street Light and Solar Lantern, Off Grid Solar power Plant.	9

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IV	**Installation, Trouble Shooting and Safety:** Installation and Trouble shooting of Standalone Solar PV System, Maintenance of Solar PV System, Safety in installation of Solar PV System, Maintenance of Solar PV System.	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. Chetan Singh Solanki, Solar Photovoltaic Technology and Systems A Manual for Technicians, Trainers and Engineers, PHI , 2013

Course Outcomes:

On learning this course students will be able to

1. Describe the functioning of solar photovoltaic cells and cell parameters.
2. Design the solar array connections and hence solar module for a given application.
3. Analyse the function of charge controller and need for MPPT techniques.
4. Design of off grid solar photo voltaic system.

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MEVT-222			EV Standards & Testing				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examination**
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *To introduce Understand different standards related to electric vehicles*
2. *Understand charger an HEV standards*
3. *Understand type testing of electric vehicle*
4. *Understand retro fitment standards*
5. *Know government policies related to EVs*

COURSE CONTENT:

UNIT	CONTENT	No. of Hrs.
I	**EV Standards**: 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 **Charger Standard**: 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.	9
II	**Retro fitment Standards:** 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.	9
III	**Safety Requirement of Traction Battery:** 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).	9

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IV	**Government Policies:** National Electric Mobility Mission Plan 2020 (NEMMP2020), Faster Adoption and Manufacture of (Hybrid and Electric Vehicles) – FAME, Niti Aayog Report on Transforming Mobility	9

Total Number of Hours = 36 Hrs

Text/Reference Books:

1. Automotive Industry Standards, India, 2015-2016

Other References

1. https://araiindia.com
2. https://emobility.araiindia.com
3. https://dhi.nic.in/writereaddata/Content/NEMMP2020.pdf
4. https://niti.gov.in/content/national-mission-transformative-mobility-and-battery-storage
5. https://niti.gov.in/writereaddata/files/document_publication/NITI RMI India_Report_web- v2.pdf _

Course Outcomes:

On learning this course students will be able to

1. Illustrate different standards related construction and safety in electric vehicles
2. Describe central motor vehicles rules (CMVR) type of standards for electric and hybrid electric vehicles.
3. Describe CMVR types of standards for retro fitment of existing IC engine driven vehicles.
4. Illustrate safety standards of traction batteries.

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MEVT-223			Control Methods In Switched Mode Power Converters				
Teaching Scheme			**Credits**	**Marks**			**Duration**
L	**T**	**P/D**	**C**	**Sessional**	**End Semester Exam**	**Total**	**End Semester Examination**
3	0	0	3	40	60	100	3 Hrs

Instructions to the question paper setter:

Question paper of end semester examination will be of 60 marks. The question paper will consist of five sections A, B, C, D and E. Sections A, B, C and D will have 2 questions of 12 marks each and section E has short answer type questions consisting of six parts of 02 marks each. The candidate will attempt five questions in all, i.e one question each from sections A, B, C, D and the compulsory question from section E. In the question paper, the questions available in sections A, B, C and D will be covered from Unit-I, Unit-II, Unit-III and Unit-IV respectively and section-E will cover whole syllabus.

Course Objective:

1. *Introduce the fundamentals of control requirements in switched-mode power converters (SMPCs).*
2. *Develop analytical models for the dynamic behavior of DC-DC, DC-AC, and AC-DC converters.*
3. *Analyze linear and nonlinear control techniques for regulating voltage, current, and power.*
4. *Explore digital control implementations and compensation techniques for stability and performance.*
5. *Provide practical insight into controller design for SMPCs used in renewable energy, EVs, and microgrids.*

COURSE CONTENT:

UNIT	Content	No of Hrs.
I	Switched mode power converters (various types of DC-DC converters including buck, boost, buck-boost, Cuk, SEPIC, and isolated topologies like flyback, forward, push-pull, half-bridge, and full-bridge converters. The operating principles under continuous and discontinuous conduction modes are discussed in detail, along with critical inductance and voltage conversion ratios, analyzing conduction and switching losses, and thermal management using snubber circuits and heat sinks.) and MATLAB simulation , Modulation techniques in SMPCs, Fixed frequency control methods.	9
II	Variable frequency control methods ,Modeling and Analysis techniques in SMPCs , Small-signal performance analysis, state-space averaging model of	9

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	converter , predict converter behavior, especially for control system design, simplifying the nonlinear switching action into a linear system.	
III	Small-signal design and tuning of PWM voltage mode control , Small-signal design of current mode control , Large-signal model and nonlinear control. analyze the system using Bode plots to identify poles and zeros, then design a **compensator** (like Type II or Type III) to meet desired **phase margin, gain margin, and bandwidth**.	9
IV	Boundary control for time optimal recovery , Large-signal controller tuning method, performance comparison and simulation.	9

Total Number of Hours = 36 Hrs

Course Outcome :
Upon successful completion of this course, students will be able to:

1. Model and analyse the small-signal behaviour of switched-mode power converters.
2. Design linear controllers such as PID and lead-lag compensators for voltage and current regulation in SMPCs.
3. Evaluate the performance of voltage-mode and current-mode control techniques.
4. Select and apply appropriate control strategies in practical applications such as PV systems, electric vehicles, and UPS.

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COURSE CONTENTS

M. Tech. (Electrical Vehicle Technology)

THIRD SEMESTER

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MEVP-301			Dissertations Phase – I			
Teaching Scheme			Credits	Marks		
L	T	P/D	C	Report	Presentation	Total
0	0	32	16	200	200	100

The course aims to:

1. Guide students in identifying a relevant research problem based on literature and industrial trends.
2. Develop the student's ability to conduct a detailed technical literature review and formulate research objectives.
3. Enable the student to design a methodology and preliminary framework for solving the identified problem.
4. Familiarize the student with simulation/modeling tools, experimental setup, or algorithmic development as needed.
5. Build professional skills in technical writing, presentation, and research documentation.

Course Objectives:

1. Enable students to identify a relevant research problem in their area of specialization through comprehensive literature review and problem analysis.
2. Develop students' ability to plan and design research methodology, including data collection, analysis, and experimentation where applicable.
3. Enhance research skills through documentation of progress, interim reporting, and effective technical communication.

Pre-requisites: Seminar I and II CONTENT

1. The student shall identify a relevant research problem within their area of specialization and conduct in-depth research aimed at developing a novel or enhanced product, process, or solution with potential societal impact.
2. The M.Tech dissertation must emphasize social relevance, practical application, and strong research orientation. Each student is required to undertake the thesis work individually, spanning two phases: Phase–I in the 3rd semester and Phase–II in the 4th semester.
3. Depending on the nature of the research, the dissertation may be pursued either on-campus or off-campus, such as in an industry, research organization, or reputed academic institute.
4. The dissertation work will be carried out under the supervision of a designated Supervisor and, if required, a Co-Supervisor. If conducted off-campus, the appointment of a Co-Supervisor from the industry/organization/institute is mandatory.
5. In the initial duration of 3rd semester (within first 2 months), the student must submit a research Synopsis detailing the objectives, scope, study area, methodology/work plan, and required resources. The Dissertation Review Committee will assess the synopsis and provide recommendations for further progress.
6. A Progress Report is to be submitted by the end of the 3rd semester, summarizing the work completed.
7. Evaluation will include both internal and external assessments based on the research progress during the semester and review by an external examiner.

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Course Outcome :

Upon successful completion of this course, students will be able to:

1. Identify a relevant research problem aligned with the program of study and societal needs.
2. Formulate clear research objectives and define the scope and methodology of the proposed work.
3. Prepare a structured research synopsis outlining the plan, required facilities, and expected outcomes.
4. Demonstrate the ability to conduct literature review, technical analysis, and preliminary experimentation or simulation.
5. Document progress through a well-organized interim thesis report and communicate findings effectively.
6. Present and defend the work completed in Phase–I through a viva voce.

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MEVPI-301			Dissertations Phase – I and Internship			
Teaching Scheme			Credits	Marks		
L	T	P/D	C	Report	Presentation	Total
0	0	32	16	200	200	100

The course aims to:

1. To enable students to identify and initiate research on a relevant problem aligned with academic specialization and industry needs.
2. To expose students to real-world professional environments through internship in industry/research organizations.
3. To develop research, analytical, technical writing, and project planning skills through practical engagement.
4. To strengthen students' ability to communicate technical ideas effectively through reports, presentations, and viva-voce.

Course Objectives:

1. To enable students to identify and initiate research on a relevant problem aligned with academic specialization and industry needs.
2. Guide students in designing a research methodology and initiating simulation, modeling, or experimental work.
3. Provide exposure to industrial/research practices and real-world problem-solving during the internship.
4. Enhance skills in documentation, reporting, and effective technical communication.
5. Develop professionalism, teamwork, and time management skills during project/internship execution.

Pre-requisites:

1. **Seminar I and Seminar II** must be completed, where students are expected to present technical topics, conduct preliminary literature reviews, and develop awareness of current research trends and industrial practices in their area of specialization.
2. Successful completion of **core and elective courses** from the first and second semesters is essential to ensure the student possesses adequate theoretical and practical knowledge relevant to their proposed dissertation or internship area.
3. Students should have basic proficiency in **research methodology, technical writing, simulation tools, or laboratory practices**, which are foundational to undertaking research and solving real-world engineering problems.
4. Prior exposure to **project-based learning**, mini-projects, or industrial visits is recommended to better engage with the internship environment and apply academic learning to practical challenges.
5. Students must demonstrate the ability to **work independently and take initiative** in identifying problems, exploring solutions, and seeking guidance where necessary during research or internship tasks.

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6. Familiarity with **technical documentation standards and presentation tools** (e.g., LaTeX, MS Word, PowerPoint, MATLAB, or other domain-specific platforms) is desirable for preparing reports, research synopsis, and review presentations.

Course Outcome :

Upon successful completion of this course, students will be able to:

7. Identify a relevant research/internship problem aligned with their specialization and societal/industrial needs.
8. Formulate objectives, define the scope, and design a research or project methodology.
9. Apply theoretical knowledge to practical problems through initial implementation or professional internship.
10. Prepare a structured report, communicate findings effectively, and defend their work in presentations and viva.

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COURSE CONTENTS

M. Tech. (Electrical Vehicle Technology)

FOURTH SEMESTER

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	Semester-IV						
S. No.	**Course Code**	**Course Title**	**Duration**	**Credit**	**Marks**		
					IA	**UE**	**TM**
1	**MEVPI-401**	**Dissertations Phase – II + Internship**	**Full Semester**	**16**	**200**	**200**	**400**

The course aims to:

1. To complete the execution of the proposed research or industrial project with depth and rigor.
2. To analyze results, draw conclusions, and contribute novel findings to the academic or industrial domain.
3. To develop high-level technical writing skills for compiling the final dissertation and publishing outcomes.
4. To prepare the student for professional or research-based careers through viva-voce, report defense, and presentation.

Course Objectives:

1. To guide students in completing their research/internship work as per the scope defined in Phase–I.
2. To validate results using appropriate simulation, modeling, analytical, or experimental methods.
3. To enable students to compile a detailed dissertation that reflects technical quality, originality, and practical relevance.
4. To strengthen professional skills through industry interaction, teamwork, and project management.
5. To train students in technical presentation and defense of their work through final viva-voce.

Pre-requisites:

1. **Successful completion of Dissertation Phase–I and Internship (Phase–I)** is mandatory. Students should have submitted the research synopsis, interim progress report, and completed the internship with proper documentation and presentation.
2. The student must have demonstrated a **clear understanding of the research problem**, formulated objectives, and shown initial progress through modeling, simulation, or experimental work in Phase–I.
3. Familiarity with the **tools, techniques, and methodologies** related to their area of research or internship (e.g., MATLAB, ANSYS, Simulink, COMSOL, hardware platforms, etc.) is expected to continue advanced development in Phase–II.

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4. The student should have experience in **technical writing and communication**, including report formatting, referencing standards, and use of tools like LaTeX or MS Word for documentation.
5. Ability to **analyze, interpret, and validate data** from simulation or experiments, as demonstrated in Phase–I, is essential for concluding the research/project.
6. Students should be prepared to work independently and collaboratively, under the guidance of internal and/or external supervisors, to **complete the research project or industry-assigned task with rigor and professionalism**.

Course Outcome :

Upon successful completion of this course, students will be able to:

1. Execute and complete the proposed research/internship project with technical and professional depth.
2. Analyze data/results critically and derive valid conclusions that reflect innovation or practical significance.
3. Compile a comprehensive dissertation/report with adherence to academic or industrial standards.
4. Communicate technical content effectively through presentation and viva-voce.
5. Demonstrate readiness for higher studies, research, or professional employment through independent project execution and reporting.

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