15-62/2025-Acad/Minutes-69th **दिनांक/dated. 31 July, 2026**

कार्यालय आदेश सं./Office Order No. 447/ 2026

Senate : 69th Meeting held on 13th April, 2026

Sub. : New course for Blended-Mode M.Tech "Electric Vehicle Technology" in SECS, SMS & SMMME –reg

Ref. : Agenda Item No. 69.A.C.4

1. The undersigned is directed to convey that the Senate has approved the introduction of a new course, **"Electric Vehicle Technology,"** under the **Blended-Mode M.Tech. Programme**.

2. The programme will be jointly coordinated by the **School of Electrical and Computer Sciences**, **School of Mechanical Sciences and School of Minerals, Metallurgical** and **Materials Engineering.**

3. The detailed course structure is enclosed as **Annexure-II**.

4. All other generic terms and conditions governing the programme shall be as prescribed in the **Blended-Mode M.Tech. Regulations**, as amended from time to time.

Jigyasha 31/07/2026

सहायक कुलसचिव (स्ना. और अ.का.) /
Assistant Registrar (PG & RP)

सेवा में /To

Committee Members

प्रतिलिपि/Copy to

1. Chairperson, Senate
2. All Members of the Senate
3. All Heads of the Schools/Departments
4. Respective Blended Mode Coordinator
5. Faculty Members
6. PS to Director
7. PS to Registrar
8. Office Order file
9. Senate File

Blended-mode M. Tech programme in Electric Vehicle Technology

Blended-mode M. Tech programme in **Electric Vehicle (EV) Technology** is designed to produce "industry-ready" specialists capable of designing, simulating, and managing complex EV systems. The proposed programme is in collaboration with **pManifold EV Academy Pvt. Ltd, Nagpur, Maharashtra.** The company has been working in providing consultancy and technical education in the E-mobility domain for the last 8 years and runs various courses and training programs in emerging areas.

1. Program Objectives

- Combination of multidisciplinary engineering fields to solve complex problems in drivetrain design, power electronics, and vehicle integration.
- To provide in-depth knowledge of critical EV components, including: Electric Propulsion, motor controllers, power converters, Battery Management Systems (BMS), Charging Infrastructure.
- To gain proficiency in using industry-standard software (such as MATLAB, Ansys, Cosmol,etc.) for modeling vehicle dynamics, energy consumption, and powertrain performance.
- To understand compliance with global safety and testing standards.
- To foster research capabilities through year-long dissertations or industry-sponsored projects, preparing students for R&D roles in automotive industries.

2. Key Learning Outcomes

- Design and develop efficient e-mobility systems for sustainable transportation.
- Utilize AI and IoT to optimize vehicle performance and energy management.
- Conduct independent research to solve practical engineering challenges in the EV ecosystem.
- Manage projects involving the integration of EVs with smart grids and renewable energy sources.

3. **Eligibility**:

- B.Tech or equivalent in Mechanical Engg., Electrical Engg., Electronics & Communication Engineering and other relevant equivalent degrees with minimum 60% marks (or 6.5 CGPA on a 10- point scale).
- Minimum 2 years of experience in industry at engineering level.

4. Course Structure:

Semester	Course Name	Code	L-T-P	Credit	Concerned faculty
1 (Autumn)	Electric Vehicle Systems	To be issued	3-0-0	3	Prof. Pravas Ranjan Sahu
	Traction Motors, converters and drives	To be issued	3-0-0	3	Dr. Ankit Dalal, Prof. C. N. Bhende
	Battery Technology for EVs		3-0-0	3	Dr. Soobhankar Pati, Industry person
	EV sub-systems laboratory – I (SECS)	To be issued	0-0-3	2	
	Elective - I	To be issued	3-0-0 / 3–1-0	3 / 4	
	Seminar*		0-0-4	3	
	Semester-wise credits			17/18	
2 (Spring)	Control System in Electric Powertrain	To be issued	3-0-0	3	Dr. Ankit Deshmukh
	Design of Electric Vehicles	To be issued	3-1-0	4	Dr. Pattabhi Ramaiah
	EV sub-systems laboratory – II (SMS)		0-0-3	2	
	Elective - II	To be issued	3-0-0 / 3–1-0	3 / 4	
	Elective - III	To be issued	3-0-0 / 3–1-0	3 / 4	
	Thesis - Part I	To be issued		2	
	Semester-wise credits			17/19	
3 (Autumn)	Elective - IV		3-0-0 / 3–1-0	3 / 4	
	Thesis - Part II	To be issued	---	14	
	Semester-wise Credits			17/18	
4 (Spring)	Thesis - Part III	To be issued	---	14	
	Semester-wise credits			14	
	Total credits			65 / 69	

* In the 'Seminar' course the students are exposed to certain advanced techniques/tools. Senior industry experts are invited to interact and share their knowledge. In addition, the students are required to give seminars on assigned topics. An examination is conducted on the items learned by students.

List of Electives:

Elective	Course	Code	L-T-P	Credit	Concerned faculty
I & IV	Battery thermal management systems	To be issued	3-0-0	3	Prof. Mihir Das
	Vehicle Dynamics	To be issued	3-0-0	3	Dr. Pattabhi Ramaiah
	Switched Mode Power Conversion	EE6L051			Dr. Narsa Reddy, Dr. S. B. Karanki
	Soft computing and applications	ME6L060	3-0-0	3	Prof. Panduranga, Dr. Satish Panda
II & III	Engineering Measurements	ME6L009	3-1-0	4	Dr. Venugopal
	Charging Infrastructure	To be issued	3-0-0	3	Dr. C. Perumalla, Dr. Narsa Reddy, Prof. C. N. Bhende
	Maintenance, Diagnostics and Prognostics	To be issued	3-0-0	3	Dr. Pattabhi Ramaiah, Industry person
	Engineering Design Optimization	ME6L007	3-0-0	3	Dr. Kannan

5. **Fee Structure**:

S.No.	Tuition fee component	Rs.	Remarks
Part-A			
1.	Registration fee (one-time)	25,000/-	One time (valid for 5 years). After 5 years, Rs. 5,000/- per semester
Part-B			
1.	Tuition fee for lecture/lab course	1000/- per hour	40 hours for 3 credit course, 52 hours for 4 credit course
2.	Tuition fee for project work	40,000/-	For every 4 credits
3.	Tuition fee for seminar course	1000/- per hour	3 contact hour per week

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

	भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: M. Tech programme in Electric Vehicle Technology

Name of the School: ---

1.	**Course Title:**	Electric Vehicles Systems
2.	**Subject Code:**	To be issued
3.	**L-T-P-:**	3-0-0
4.	**Credit:**	3
5.	**Semester No:**	1^{st}
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	
11.	**Pre- requisite subject(s):**	NA
12.	**Lab:**	No.
13.	**Instructor(s):**	Prof P R Sahu

14. **Syllabus:**

Module I: Introduction to electric mobility: Classification of electric vehicles- IC engine vehicles, Hybrid electric vehicles (HEVs), pure electric vehicles, fundamentals of operation; electrical system architecture for electric vehicles; regulations and policies for electric vehicles, role of policies for deployment of charging infrastructures; Topologies for electric vehicles, plug-in HEVs;
Module II: Vehicle mechanics: mathematical modeling of electric vehicle dynamics, air drag, rolling and climbing force, torque and power in electric vehicles, system modeling, performance of electric vehicles, power source characterization, transmission characteristics,

Drive trains for electric vehicles; Regenerative braking concept **Module III:** Fundamentals of charging systems: Classification of charging systems, domestic and public charging systems, ac charging versus dc charging systems, battery swapping technology, Fast charging mechanisms, Standards for electric vehicle charging systems, Economics of charging systems, Metering, Concept of vehicle to grid (V2G), smart grid application for electric vehicles. **Module IV:** Electronic systems in electric vehicles: Electronic measurements in electric vehicles, Embedded systems in electric vehicles, Vehicle communications: OSI seven layer model, in-vehicle communication and control area network (CAN), processors for electric vehicle control, concept of autonomous vehicles, image processing in electric vehicle applications.

15. Learning Outcomes:

LO1: Understanding of the Speed-Torque characteristics of IC Engine and Electric motor. Pure EV architecture, Hybrid-EV (HEV) architecture and its topologies. Understanding of accessories of EV. **LO2:** Understanding of vehicle mechanics fundamentals, transmission characteristics, drive train design, EV system modeling and performance metrics. Concept of regenerative braking. **LO3:** Understanding of the fundamentals of EV battery charging systems, classification of charging systems such domestic and public charging systems, fast charging mechanism, and standards for EV charging system, concept of vehicle-to-grid (V2G) and application of smart grid for EVs. **LO4:** Understanding of electronic systems in EVs, its use for measurements in EVs and embedded systems in EVs. **LO5:** Understanding of the requirement of communication technology application in EV operation with controlled area network (CAN) and its architecture. **LO6:** Understanding of the concept of autonomous vehicle and its architecture, different modules and their functions.

16. Module-wise break up of topics:

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	Comparison of Speed-Torque characteristic of electric motor with the Speed-Torque characteristics of IC engine and the advantage of electric motor for use in EV. EV and Hybrid-electric-vehicle (HEV) architectures. Topologies of HEVs.	4	
2	Vehicle mechanic fundamentals, driving terrains, drive train and its design, modeling of EV systems. Vehicle performance parameters. Concept of regenerative braking.	6	
3	Battery charging systems and its classification. Domestic and public charging systems.	6	
4	Fast battery charging mechanism and EV charging standards.	6	
5	Vehicle-to-Grid (V2G) concept and smart-grid for EVs	5	

6	EV electronic systems and application for measurements in EV. Embedded electronic systems in EV	6	
7	Communication technology for EV controls. Controlled area network (CAN) and its architecture. Controllers, sensors and protocols for communication.	6	
8	Concept of autonomous vehicle. Architecture of autonomous EVs and function of its modules.	3	
	Total	42	

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

1. Electric vehicle has many advantages over IC engine vehicle. EV has been considered as the future mode of transportation.
2. EV technology needs to be developed to improve vehicle efficiency to meet the future demands.
3. Lot of research initiatives has been taken up by different research groups and organizations for its development, standardization and build a sustainable commercial product.

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	IIT Delhi
ii.	**Course Name:**	Electric Vehicles
iii.	**L-T-P-:**	3-0-0
iv.	**Credit:**	3

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

The course includes a module on autonomous vehicle which is new content.

20. Suggested Books:*

Text Books:

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint

1	Electric and Hybrid Vehicles Design Fundamentals by Iqbal Husain, 2nd Ed., CRC Press	2010
2	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design by Mehrdad Ehsani, Y. Gao, S. E. Gay and Ali Emadi, CRC Press	2004

Reference Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**
1	Electric Vehicle Machines and Drives, Design, Analysis and Application by K. T. Chau, IEEE Press and Wiley	2015
2	E-Mobility by M. Kathiresh, G. R. Kanagachidambaresan, Sheldon S. Williamson Springer, ISBN: 978-3-030-85424-9.	2022
3	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design by Lino Guzzella and Antonio Sciarretta CRC Press, 2nd Edition, ISBN – 978-1-4200-5398-2	2009

Prof. P.R. Sahu

Name of the Subject Teacher

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PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

	भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: M. Tech programme in Electric Vehicle Technology

Name of the School: SECS

1.	**Course Title:**	Traction Motors, converters and drives
2.	**Subject Code:**	
3.	**L-T-P-:**	3-0-0
4.	**Credit:**	3
5.	**Semester No:**	1^{st}
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	
11.	**Pre- requisite subject(s):**	---
12.	**Lab:**	----
13.	**Instructor(s):**	Dr. Ankit Dalal, Prof. C. N. Bhende

14. Syllabus:

Module I: Electric machines for eVs: fundamentals of dc motors and generators, synchronous machines, single phase and three phase induction machines, permanent magnet (BLDC and PMSM) and switched and synchronous reluctance machines, stepper motors;

Module II: Fundamentals of single-phase and three-phase powers, Power switching devices and their characteristics, Power electronics for eVs: Concept of power electronic conversion: dc-ac, ac-dc, dc-dc, ac-ac conversion; types of power electronic converters: isolated and non-isolated converters; pulse width modulation.

Module III: Fundamentals of motor drives for electric vehicles: Components of electric drive trains, dc drives, ac drives, BLDC and PMSM drives, SRM drives; Braking of electric vehicles; Regeneration of energy during braking, topologies for implementation of regenerative braking, Control of electric drives, closed loop control of electric drives, stability criteria, drive cycle, electrical modeling of electric vehicle load.

Module IV: Practical aspects, case studies on Motors, converters and drives used in EVs.

15. Learning Outcomes:

- Identify various power converter components and their operations inside the power converter.
- Understand various power converters and their applications in an electric vehicle.
- Identify various types of electric machines, their modes of operations and applications in an electric vehicle.
- Classify various electric machine technologies, select appropriate technology for a particular EV application and match the characteristics to requirements.
- Examine various motor control strategies based on various operating scenarios of the vehicle.

16. Module-wise break up of topics:

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	Fundamentals of dc motors and generators,	2	
2	Single phase and three phase induction machines,	2	
3	Synchronous machines, Permanent magnet motors (BLDC and PMSM)	4	
4	Switched and Synchronous reluctance machines, Stepper motors	4	
5	Fundamentals of single-phase and three-phase powers, Power switching devices and their characteristics	4	
6	Concept of power electronic conversion: dc-ac, ac-dc, dc-dc, ac-ac conversion	4	
7	Types of power electronic converters: isolated and non-isolated converters; pulse width modulation	4	
8	Fundamentals of motor drives for electric vehicles: Components of electric drive trains, dc drives, ac drives,	3	
9	BLDC and PMSM drives, SRM drives	4	

10	Braking of electric vehicles; Regeneration of energy during braking, topologies for implementation of regenerative braking,	4	
11	Control of electric drives, closed loop control of electric drives, stability criteria, drive cycle, electrical modeling of electric vehicle load.	4	
12	Practical aspects, case studies on Motors, converters and drives used in EVs.	3	
	Total	42	

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

- The course provides fundamental knowledge of electric traction motors, power electronic converters, and drive control systems, which form the core propulsion architecture of modern electric vehicles.
- It addresses emerging technologies such as high-efficiency PMSM/BLDC motors, and advanced motor control techniques (FOC, DTC) used in next-generation EV drivetrains.
- It prepares students to work on integrated EV powertrain platforms, including traction inverters, regenerative braking systems, and intelligent embedded drive controllers.
- The course aligns with global electrification trends and national EV initiatives, enabling skilled manpower for EV manufacturing, smart mobility systems, and future autonomous electric transportation technologies.

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	IIT Roorkee
ii.	**Course Name:**	Electric Vehicles: Power Train & Drives
iii.	**L-T-P-:**	3-0-2
iv.	**Credit:**	4

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

The course is primarily designed from participants from various backgrounds. It introduces the students to various important sub-systems, such as motors, power electronics converts and drives for an electric vehicle.

20. Suggested Books:*

Text Books:

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint
1	M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education India,	2009
2	N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons,	2007
3	B. K. Bose “Modern Power Electronics and AC Drives”, Pearson Eduction	2002

Reference Books:

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint
1	R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media	2007
1	L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India	2009

Dr. Ankit Dalal, Prof C N Bhende

Name of the Subject Teacher

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

	भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: M. Tech programme in Electric Vehicle Technology

Name of the School: ----

1.	**Course Title:**	Battery Technology for EVs
2.	**Subject Code:**	ML6L---
3.	**L-T-P-:**	3-0-0
4.	**Credit:**	3 Credits
5.	**Semester No:**	1st
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	6
11.	**Pre- requisite subject(s):**	None
12.	**Lab:**	None
13.	**Instructor(s):**	Dr. Soobhankar Pati

14. Syllabus:

Fundamentals of electrochemistry including redox reactions and electrode potential. Key battery parameters such as capacity, energy and power, C-rate, state of charge (SOC), depth of discharge (DOD), state of health (SOH), cycle and calendar life, internal resistance, and impedance. Mechanical characteristics, form factor, nominal voltage, energy density, and basic safety considerations.

Introduction to electrochemical cells including Daniell cell, lead-acid, and nickel-metal hydride (NiMH) batteries, with comparison to lithium-ion systems. Overview of battery pack architecture and battery management systems (BMS). Battery characterization including capacity testing, cycle life, and impedance spectroscopy. Modeling approaches: empirical, equivalent circuit, electrochemical, and machine learning models. Estimation of SOC, SOH, and remaining useful life (RUL). Lithium-ion battery fundamentals including cell components, charge-discharge mechanisms, ion transport and diffusion. Performance metrics and degradation mechanisms such as SEI formation and lithium plating. Materials and design aspects including electrode materials (graphite, LTO, NMC, NCA, LFP, LCO), electrode structures, cell configurations (cylindrical, prismatic, pouch), electrolytes, and separators. Safety and thermal management including thermal runaway, short circuits, fire hazards, and thermal management systems. Battery selection for EVs including energy–power trade-offs, lifetime, temperature effects, maintenance, cost and lifecycle analysis, recycling, second-life applications, and emerging technologies such as solid-state batteries, fast charging, AI-based diagnostics, and grid integration.

15. **Learning Outcomes:**

By the end of the course, students will be able to:

- Describe fundamental electrochemical principles and key battery parameters relevant to energy storage systems.
- Analyze and compare different battery chemistries (lead-acid, NiMH, lithium-ion) for electric vehicle applications.
- Apply battery characterization techniques and modeling approaches to evaluate performance and estimate SOC, SOH, and RUL.
- Interpret lithium-ion battery behavior, including charge–discharge processes, material roles, and degradation mechanisms.
- Evaluate and design battery systems for EVs considering safety, thermal management, performance trade-offs, cost, and emerging technologies.

16. Module-wise break up of topics:

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical

	Module 1: Electrochemical Fundamentals and Battery Terminology • Basic electrochemistry: redox reactions, electrode potential • Key parameters: capacity, energy, power, C-rate • SOC, DOD, SOH; cycle and calendar life • Internal resistance, impedance • Form factor, mechanical characteristics, nominal voltage, energy density • Overview of safety considerations	6	0
	Module 2: Electrochemical Cells and Battery Systems • Daniell cell and fundamentals of electrochemical cells • Lead-acid and NiMH batteries: construction and performance • Comparison with lithium-ion batteries • Battery pack architecture and introduction to BMS	6	0
	Module 3: Battery Modeling and Characterization • Capacity testing, cycle life, impedance measurement (EIS) • Modeling approaches: empirical, equivalent circuit, electrochemical, and machine learning • State estimation: SOC, SOH, and remaining useful life (RUL)	6	0
	Module 4: Lithium-Ion Battery Fundamentals • Cell components: electrodes, separator, current collectors • Charge-discharge mechanisms, ion transport, diffusion • Charging methods: CC, CV, fast charging • Performance metrics: energy density, power density, efficiency • Degradation: SEI formation, lithium plating, diffusion-induced stress	6	0
	Module 5: Materials and Cell Design • Electrode materials: graphite, LTO; NMC, NCA, LFP, LCO • Electrode structures: layered, spinel, olivine • Cell configurations: cylindrical, prismatic, pouch	9	0

	• Electrolytes (solvents and salts) and separators		
	Module 6: Safety and Thermal Management • Thermal runaway and failure mechanisms • Short circuits, dendrite formation, abuse conditions • Fire and explosion hazards • Thermal management systems and safety standards	3	0
	Module 7: Battery Selection and Emerging Technologies • Design trade-offs: energy vs power, electrode thickness, lifetime • Temperature effects, maintenance, and reliability • Cost and lifecycle analysis • Recycling and second-life applications • Emerging technologies: solid-state batteries, fast charging, AI-based diagnostics, and grid integration	6	0
	Total	42	

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

- Rapid global transition to electric mobility and renewable energy integration has made advanced battery technologies central to sustainable transportation and grid systems.
- Continuous advancements in lithium-ion and next-generation batteries (solid-state, fast-charging, high-energy-density systems) require skilled professionals with strong interdisciplinary understanding.
- Increasing emphasis on battery safety, lifecycle management, recycling, and second-life applications highlights the need for expertise in sustainable and circular energy systems.
- Growing adoption of data-driven approaches (AI/ML) for battery monitoring, diagnostics, and performance optimization is creating new opportunities in intelligent energy storage systems.

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	• IIT Madras • IIT Hyderabad

ii.	**Course Name:**	• IIT Madras (NPTEL – Electric Vehicle Battery Technology) • IIT Hyderabad (M.Tech EV – Electrochemical Energy Storage Systems course)
iii.	**L-T-P-:**	3-0-0
iv.	**Credit:**	3

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

- Integrates advanced battery modeling (physics-based and AI/ML approaches) beyond conventional equivalent circuit models.
- Emphasizes materials–design–performance linkage, including diffusion-induced stress and degradation, which is often not covered in standard EV courses.
- Incorporates emerging technologies and lifecycle perspective such as solid-state batteries, recycling, and second-life applications tailored to EV ecosystem.

20. Suggested Books:*

Text Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**
1	Lithium-Ion Batteries: Fundamentals and Applications, Yoshio et al., Springer	2009
2	Electrochemical Energy Storage for Renewable Sources and Grid Balancing, P. T. Moseley & J. Garche, Elsevier	2015

Reference Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**
1	*Electric Vehicle Technology Explained*, James Larminie & John Lowry, Wiley	2012
2	*Modern Electric, Hybrid Electric, and Fuel Cell Vehicles*, Mehrdad Ehsani et al., CRC Press	2018
3	*Battery Systems Engineering*, Christopher D. Rahn & Chao-Yang Wang, Wiley	2013

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint
4	*Lithium-Ion Battery Systems*, Gianfranco Pistoia, Elsevier	2014

Dr. Soobhankar Pati

Name of the Subject Teacher

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर

INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: M. Tech programme in Electric Vehicle Technology

Name of the School: SECS

1.	**Course Title:**	EV sub-systems laboratory - I
2.	**Subject Code:**	To be issued
3.	**L-T-P-:**	0-0-3
4.	**Credit:**	2
5.	**Semester No:**	2
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	3
8.	**Theory:**	No
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	--
11.	**Pre- requisite subject(s):**	None
12.	**Lab:**	Yes
13.	**Instructor(s):**	Dr. Ankit Dalal, Dr. Narsa Reddy, Dr. Soobhankar Pati

14. Syllabus:

- Familiarization with EV and EV Components.
- hands on assesmbly/dissesembly of different types traction motors, battery packs (cell to battery pack),
- Battery characterization
- Traction motor characterization, PE circuit characterization.
- Field Oriented control of PMSM Motor(Simulation/Hardware)
- Field Oriented control of Induction Motor (Simulation/Hardware
- Performance characteristics determination of BLDC motor (Hardware)

15. Learning Outcomes:

- Identify various electrical components in an Electric Vehicle.
- Explain the working of motor control.
- Explain the behaviour of battery during charging and discharging.

16. Module-wise break up of topics:

Sl. No.	**Course Contents**	**Contact Hours/ No. of Lectures**	**No. of Tutorial / Practical**
1.	Familiarization with EV and EV Components		
2.	Hands on assesmbly/dissesembly of different types traction motors, battery packs (cell to battery pack)		
3.	Battery characterization		
4.	Traction motor characterization, PE circuit characterization.		
	Total		

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

Motors, power converters and batteries are critical sub-systems in and Electric Vehicle. Experience of Hand-on assembly, disassembly and characterization are essential to gain deeper understanding of their working and design aspects.

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	
ii.	**Course Name:**	
iii.	**L-T-P-:**	
iv.	**Credit:**	

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

20. Suggested Books:*

Text Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**

Reference Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**

Dr.Ankit Dalal, Dr. Narsa Reddy, Dr. Soobhankar Pati

Name of the Subject Teacher

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

	भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: M. Tech programme in Electric Vehicle Technology

Name of the School: SMS

1.	**Course Title:**	Design of Electric Vehicles
2.	**Subject Code:**	ME6LXXX
3.	**L-T-P-:**	3-0-0
4.	**Credit:**	3
5.	**Semester No:**	2
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	Theory
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	6
11.	**Pre- requisite subject(s):**	NA
12.	**Lab:**	NA
13.	**Instructor(s):**	Dr. Pattabhi R Budarapu

14. Syllabus:

Power sources for electric vehicles; Estimation of power and torque requirements considering real time conditions

Design aspects of batteries: Types of batteries, working principles and their characterization, influence of anode, cathode materials, failure analysis, performance optimization.

EV Battery Pack design; Design of battery packs for the required power. Battery thermal management systems (BTMS).

Electric vehicle chassis design: stability, aerodynamic and materials for vehicle body.

Power train design; Hybrid Electric Drive-trains: hybrid traction, various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis

Study of IC engine-based vehicle designs; Design aspects of electric and hybrid electric vehicles; Efficiency and performance studies of EV and HEV.

Motor controller design, power electronics; Braking System design, regenerative braking

Design for vehicle accessories: cooling system, lighting system, tire, road load absorption.

Measurement of performance parameters; Life estimation and endurance of battery packs; Recycling of battery packs.

Challenges in Practical development of EV and HEV considering two wheelers, three wheelers, four wheelers and transport vehicles.

15. Learning Outcomes:

- To introduce the design concepts in electric vehicles such that the participants can conduct research in the field of Automotive Vehicles.
- Design aspects of electric and hybrid electric vehicles and knowledge gain on efficiency and performance studies of EV and HEV.
- Knowledge on the power sources for EVs; Estimation of power and torque requirements considering real time conditions.
- Design aspects of batteries, along with their failure and performance analysis, followed by the design and analysis of battery packs.
- Estimation of performance, life, endurance and recycling of battery packs.
- Challenges in practical development of EV and HEV considering two wheelers, three wheelers, four wheelers and transport vehicles.

16. Module-wise break up of topics:

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	Introduction to Electric Vehicles (EV) and Hybrid electric vehicles (HEV), Vehicle Dynamics, Vehicle Subsystems: EV Power-train.	4	0
2	Analysis of power transmission systems; Study of IC engine-based vehicle designs; Design aspects of electric and hybrid electric vehicles; Efficiency and performance studies of EV and HEV. Power sources for electric vehicles; Estimation of power and torque requirements considering real time conditions	8	0
3	Design aspects of batteries: Types of batteries, working principles and their characterization, influence of anode, cathode materials, failure analysis, performance optimization; Fundamentals of EV Battery Pack design; Design of battery packs for the required power. Battery thermal management systems (BTMS)	14	0
4	Introduction to electrical and control aspects of EVs: Electric Drivetrains; Electric machines; Motor Drives; Powertrain components EV Motors and Controllers: Fundamentals and Design; Vehicle Accessories; Battery Charging and Swapping	8	0
5	Measurement of performance parameters; Life estimation and endurance of battery packs; Recycling of battery packs; Challenges in Practical development of EV and HEV considering two wheelers, three wheelers, four wheelers and transport vehicles;	8	0
	Total	**42**	**0**

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

● To pace with rapid advances in EV technologies, engineers and researchers require the knowledge of design of various components of an EV. ● The proposed course integrates multiple disciplines, mechanical, electrical, electronics, control, energy systems, and sustainability. A well-structured course helps students understand both the fundamentals and practical aspects required for designing, operating, and managing electric mobility systems. ● The proposed course helps to develop skills like: EV powertrain modeling and Battery performance analysis which are essential. ● The proposed course supports research and innovation where the participants can gain the knowledge on Development of new battery technologies, Energy efficiency improvements, Lightweight vehicle design, Advanced simulation and modeling

18. Details of similar course/subject elsewhere, if any:

Design of EV, IIT Hyderabad, ME5710, Credits: 2 https://mae.iith.ac.in/files/Online_MTech_EV_Final_11_July_2021.pdf Introduction to Electrical Vehicles, EV Subsystems, Design of EV Drivetrain, Battery Performance Parameters, Mechanical and Thermal Design of EV, Noise and Vibration requirements
Fundamental Design of EV, IIT Hyderabad, DS5413, Credits: 2 https://mae.iith.ac.in/files/Online_MTech_EV_Final_11_July_2021.pdf Principles of Design: contrast, balance, emphasis, proportion, hierarchy, repetition, rhythm, pattern, white space, movement, variety, and unity. Elements of Design line, shape, space, value, color and texture. Form language for vehicles. Form abstraction, form expression, Form transition-use of metaphors.
Design Thinking for EV, IIT Hyderabad, DS5423, Credits: 2 https://mae.iith.ac.in/files/Online_MTech_EV_Final_11_July_2021.pdf This course teaches a unique approach to strategic problem solving to create experiences customers love. With EVs becoming mainstream in India and with unique challenges and opportunities Indian context pose, the student will get to practice design thinking on a real-life project and equip himself with a powerful set of tools to become more collaborative, innovative, and effective. In the course the student will explore: ● Understanding the problem from your customer's perspective. ● Brainstorm innovative ideas. ● How to go about creating prototypes to test new ideas before investing a lot of time and money.
Electric Vehicles and Renewable Energy, IIT Madras, SWAYAM, Credits: 3 https://onlinecourses.nptel.ac.in/noc21_ee112/preview o Overview of electric vehicles in India. o Vehicle dynamics. o Vehicle subsystems: EV power-train.

o Storage for electric vehicles. o Fundamentals of EV battery pack design. o EV motors and controllers: Fundamentals and design. o Vehicle accessories. o Battery charging and swapping. o Introduction to energy scenario in India. o Solar and wind energy in India: Economics of centralized generation. o Decentralized Solar energy generation. o Storage options for energy.
Michigan Technological University offers a Graduate Certificate program in Hybrid Electric Vehicle Drive Engineering with a variety of courses. Some of the relavent are listed below. **Vehicles battery cells and systems, MSE 5760, credits: 3** **Experimental studies in hybrid electric vehicles, MEEM 4296, credits: 3** **Vehicle dynamics, MEMM 5440, credits: 3** https://www.coursicle.com/mtu/courses/MSE/

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

NA

20. Suggested Books:*

Text Books:

Text Books:

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint
1.	Husain, Iqbal. Electric and hybrid vehicles: design fundamentals. CRC press	2010
2.	Larminie, James, and John Lowry. Electric vehicle technology explained. John Wiley & Sons	2012
3.	Jahn, Robert G. Physics of electric propulsion. Courier Corporation	2006
4.	Du, Haiping, Dongpu Cao, and Hui Zhang, eds. Modeling, dynamics, and control of electrified vehicles. Woodhead Publishing	2017

Reference Books:

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint
1.	Fischer, Robert, Ferit Küçükay, Gunter Jürgens, Rolf Najork, and Burkhard Pollak. The automotive transmission book. Springer	2015
2.	Jalali, Kiumars. "Stability control of electric vehicles with in-wheel motors."	2010
3.	Hu, Donghai, and Bifeng Yin. Stability Analysis and Control of Powertrain for New Energy Vehicles. Springer	2022
4.	Krause, Paul C., Oleg Wasynczuk, Scott D. Sudhoff, and Steven D. Pekarek. Analysis of electric machinery and drive systems. Vol. 75. John Wiley & Sons	2013
5.	Ehsani, Mehrdad, Yimin Gao, Stefano Longo, and Kambiz M. Ebrahimi. Modern electric, hybrid electric, and fuel cell vehicles. CRC press	2018

Dr. Pattabhi R Budarapu

Name of the Subject Teacher

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

	भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: **M. Tech programme in Electric Vehicle Technology**

Name of the School: SECS

1.	**Course Title:**	Control Systems in Electric Vehicles
2.	**Subject Code:**	To be issued
3.	**L-T-P-:**	3-0-0
4.	**Credit:**	3
5.	**Semester No:**	2
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	42
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	6
11.	**Pre- requisite subject(s):**	-
12.	**Lab:**	None
13.	**Instructor(s):**	Dr. Ankit Ravindra Deshmukh

14. **Syllabus:**

Module 1: Introduction to EV Control:
Various EV controllers - BMS, MCU, VCU; Sensors & actuators. Automotive controller development process - model-based development, MiL, SiL, HiL.
Module 2: System Modelling and Control fundamentals
Modelling-Electrical, Mechanical and Electromechanical systems in transfer function and state-space viewpoints, nonlinear dynamics and linearization. EV powertrain modelling.
Feedback systems, Stability and performance metrics, classical and modern approaches.
Module 3: Classical Control Design

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram. Design of PID controllers: Design of P, PI, PD and PID controllers in frequency domain. Applications in Motor control, drive control etc. **Module 4: Modern Control Design** Controllability, Observability; state-feedback, LQR; observers, Kalman filters, LQG, separation principle. Case studies employing Adaptive control, Robust control, Model predictive control for EVs. **Module 5: Optimization and Control in EVs** Energy Management-Optimization based strategies, control of battery management systems, case studies.

15. **Learning Outcomes:**

- Analyse EV control architecture and evaluate the roles of key controllers (BMS, MCU, VCU), along with sensors, actuators, and virtual sensing techniques.
- Design and evaluate classical compensators and PID controllers to meet time- and frequency-domain specifications in EV applications.
- Apply state-feedback, LQR, observers, and Kalman filtering for EV subsystem control and estimation.
- Assess and implement advanced control strategies for improving EV performance.
- Formulate and solve optimization problems for EV energy management and battery control, including real-time control strategies.

16. Module-wise break up of topics:

Sl. No.	**Course Contents**	**Contact Hours/ No. of Lectures**	**No. of Tutorial / Practical**
1	**Introduction to EV Control & Design Specifications:** Overview of EV control architecture, Controllers: BMS, MCU, VCU (roles interactions, detailed functions) Sensors in EVs: Current, voltage, temperature, speed, position; Actuators, Virtual sensors: SOC estimation, torque estimation. Automotive controller development process: Model-Based Design (MBD), MiL, SiL, HiL concepts.	3	-
2	**Module 2: System Modelling and Control fundamentals** Modelling-Electrical, Mechanical and Electromechanical systems in transfer function and state-space viewpoints, nonlinear dynamics and linearization. EV powertrain modelling. Feedback systems, Stability and performance metrics, classical and modern approaches.	9	-
3	**Module 3: Classical Control Design** Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward	12	-

	compensator design using bode diagram. Design of PID controllers: Design of P, PI, PD and PID controllers in frequency domain. Applications in Motor control, drive control etc.		
4	**Module 4: Modern Control Design** Controllability, Observability; state-feedback, LQR; observers, Kalman filters, LQG, separation principle. Case studies employing Adaptive control, Robust control, Model predictive control for EVs.	12	-
5	**Module 5: Optimization and Control in EVs** Energy Management-Optimization based strategies, control of battery management systems, case studies.	6	-
	Total	42	-

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

- Transition toward EV requires skilled manpower equiped with knowledge of advanced control of EV subsystems such as battery systems, electric drives, and energy management.
- The course provides strong foundations in modern control, estimation, and real-time implementation.

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	IIT Roorkee
ii.	**Course Name:**	Control Systems for Electric Vehicle (EEC-527)
iii.	**L-T-P-:**	3-0-2
iv.	**Credit:**	4

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

- Integrates classical and modern control theory directly with EV-specific applications.
- Incorporates optimization-based energy management and advanced control **techniques** tailored specifically for electric vehicle systems.

20. Suggested Books:*

Text Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**
1.	Design of Feedback Control Systems **by Raymond T. Stefani, Bahram Shahian, Cornelius J. Savant, Gene H. Hostetter, Oxford University Press.**	2002
2.	Electric Vehicle Powertrains: Design Fundamentals, Components, and Applications **by B. Ashok, V. Indragandhi, Elsevier.**	2026

Reference Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**
1.	Electric and Hybrid Vehicles: Technologies, Modeling and Control – A Mechatronic Approach **by Amir Khajepour, M. Saber Fallah, Avesta Goodarzi, Wiley.**	2014
2.	Power Electronics: Essentials and Applications **by L. Umanand, Wiley.**	2009

Dr. Ankit Ravindra Deshmukh

Name of the Subject Teacher

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

	भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: **M. Tech programme in Electric Vehicle Technology**

Name of the School: SMS

1.	**Course Title:**	EV sub-systems laboratory - II
2.	**Subject Code:**	To be issued
3.	**L-T-P-:**	0-0-3
4.	**Credit:**	2
5.	**Semester No:**	2
6.	**Core/Elective/Breadth:**	Core
7.	**Contact Hours:**	3
8.	**Theory:**	No
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	6
11.	**Pre- requisite subject(s):**	Basics of Mechanics, Thermodynamics, Electrical Engineering, Control Systems, and Engineering Mathematics.
12.	**Lab:**	Yes

13.	**Instructor(s):**	Dr. B. Pattabhi Ramaiah

14. Syllabus:

Simulation and experiments of electric vehicle components: Mechanical models of battery to estimate the current-voltage, discharge, heat generation and degradation characteristics. Simulation of battery thermal management system. Experimental analysis of gear, clutch and automatic transmission mechanisms. Simulation and experiments of vehicle dynamics considering electric power.

15. Learning Outcomes:

Model and simulate EV components (battery, thermal system, transmission, vehicle dynamics). Analyse performance, heat generation, and degradation with experimental validation.

16. Module-wise break up of topics:

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1.	Simulation and experiments of electric vehicle components: Mechanical models of battery to estimate the current-voltage, discharge, heat generation and degradation characteristics.		
2.	Simulation of battery thermal management system.		
3.	Experimental analysis of gear, clutch and automatic transmission mechanisms.		
4.	Simulation and experiments of vehicle dynamics considering electric power.		
	Total		

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

Electric vehicles focus on battery technology, thermal management, and safety. Emphasises simulation-driven design and mechatronic integration for modern EV development.

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	
ii.	**Course Name:**	
iii.	**L-T-P-:**	
iv.	**Credit:**	

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

Combines simulation with experimental validation of EV components. Focuses on battery modelling, thermal management, and EV-specific dynamics beyond traditional

20. Suggested Books:*

Text Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**

Reference Books:

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint

Dr. B. Pattabhi Ramaiah

Name of the Subject Teacher

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

	भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: M. Tech programme in Electric Vehicle Technology

Name of the School: SMS

1.	**Course Title:**	Battery thermal management systems
2.	**Subject Code:**	To be issued
3.	**L-T-P-:**	3-0-0
4.	**Credit:**	3
5.	**Semester No:**	2nd
6.	**Core/Elective/Breadth:**	Elective
7.	**Contact Hours:**	42
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	6
11.	**Pre- requisite subject(s):**	Battery Technology in EVs or equivalent
12.	**Lab:**	No
13.	**Instructor(s):**	Prof. Mihir Das

14. Syllabus:

Review of Heat Transfer Fundamentals : Steady and Transient Conduction heat transfer with heat generation, Forced and natural convection heat transfer, Dimensionless parameters governing the conduction and convection heat transfer, Empirical correlations for forced and natural convection. Battery Management Systems: Battery States Estimation, State of Charge (SOC), Depth of Discharge (DOD), Battery Characteristics, Safety Management/Fault Diagnosis, Thermal Management, Joule heat and entropic heat effect in Battery thermal Management System Need of Thermal Management in EV Batteries: Heat generation in EV batteries, Battery Heat Transfer Analysis, Battery Temperature Distribution, Battery Temperature Uniformity, Thermal runaway in Li-ion batteries. Battery Thermal Management Systems : Design of battery thermal management systems, Categories of battery thermal management systems, Air-based battery thermal management systems, Liquid-based battery thermal management systems, Phase change material (PCM)-based battery thermal management systems, Liquid-vapor phase change-based battery thermal management systems, Recent developments in battery thermal management systems. Case Studies: Experimental and Theoretical Investigation of Temperature Distributions in a Prismatic/Cylindrical Lithium-Ion Battery, Thermal Management Solutions for Electric Vehicle Lithium-Ion Batteries based on Vehicle Charge and Discharge Cycles, Heat Transfer and Thermal Management of Electric Vehicle Batteries with Phase Change Materials / Immersion Cooling.

15. Learning Outcomes:

After studying these topics, learners will gain a strong understanding of fundamental heat transfer mechanisms, including steady and transient conduction with heat generation, as well as forced and natural convection, and will be able to apply dimensionless parameters and empirical correlations to analyze and solve real engineering problems. They will also develop knowledge of Battery Management Systems (BMS), including battery state estimation such as State of Charge (SOC) and Depth of Discharge (DOD), battery characteristics, safety aspects, and heat generation mechanisms like Joule and entropic heating. Furthermore, learners will be able to analyze the need for thermal management in electric vehicle batteries by evaluating heat generation, temperature distribution, and thermal runaway risks in lithium-ion batteries, and will gain the ability to design and compare different Battery Thermal Management Systems (BTMS), including air-based, liquid-based, phase change material (PCM), and liquid–vapor phase change systems, while also developing practical skills through case studies to interpret experimental and theoretical results and apply heat transfer concepts to enhance battery performance, safety, and efficiency in real-world applications.

16. Module-wise break up of topics:

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	Introduction to battery thermal management system, Review of Heat Transfer Fundamentals -Steady and Transient Conduction heat transfer with heat generation, Forced and natural convection heat transfer, Dimensionless parameters governing the conduction and convection heat transfer, Empirical correlations for forced and natural convection.	4	
2	Battery Management Systems: Battery States Estimation, State of Charge (SOC), Depth of Discharge (DOD), Battery Characteristics, Safety Management/Fault Diagnosis, Thermal Management, Joule heat and entropic heat effect in Battery thermal Management System	4	
3	Need of Thermal Management in EV Batteries: Heat generation in EV batteries, Battery Heat Transfer Analysis, Battery Temperature Distribution, Battery Temperature Uniformity, Thermal runaway in Li-ion batteries.	8	
4	Battery Thermal Management Systems : Design of battery thermal management systems, Categories of battery thermal management systems, Air-based battery thermal management systems, Liquid-based battery thermal management systems.	8	
5	Battery Thermal Management Systems : Phase change material (PCM)-based battery thermal management systems, Liquid-vapor phase change-based battery thermal management systems, Recent developments in battery thermal management systems.	8	
6	Case Studies: Experimental and Theoretical Investigation of Temperature Distributions in a Prismatic/Cylindrical Lithium-Ion Battery, Thermal Management Solutions for Electric Vehicle Lithium-Ion Batteries based on Vehicle Charge and Discharge Cycles, Heat Transfer and Thermal Management of Electric Vehicle Batteries with Phase Change Materials / Immersion Cooling.	8	
	Total	42	

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

- Growing adoption of electric vehicles (EVs) and energy storage systems demands
- advanced battery thermal management to ensure safety, efficiency, and longer battery life.
- Rapid advancements in lithium-ion and next-generation batteries require deeper understanding of heat generation, thermal runaway prevention, and performance optimization.
- Increasing focus on high-performance electronics and compact systems makes efficient heat transfer analysis and cooling techniques essential in modern engineering design.

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	Anna university
ii.	**Course Name:**	Thermal management of batteries and fuel cells.
iii.	**L-T-P-:**	3-0-0
iv.	**Credit:**	3

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

- Integrates **core heat transfer fundamentals with advanced EV battery applications,** whereas many existing courses treat these topics separately basic heat transfer vs. specialized EV thermal management

- Includes case studies and real-world battery behavior analysis, bringing the gap between theoretical concepts and practical EV system design, which is often limited in conventional courses.

20. Suggested Books:*

Text Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**

1	Thermal Management of Electric Vehicle Battery Systems, Ibrahim Dinner, Halil S. Hamut, and Nader Javani, Wiley.	2017
2	Battery Management Systems for Large Lithium-Ion Battery Packs, Davide Andrea, ARTECH House.	2010
3	Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles, Jiuchun Jiang and Caiping Zhang, Wiley.	2015

Reference Books:

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint
1	Vehicle thermal Management Systems Conference Proceedings, Coventry Techno centre, UK	1st Edition 2013
2	Thermal Management in Automotive applications, 2015, SAE International, T. Yomi Obidi,	2015

Pro. Mihir Das

Name of the Subject Teacher

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

	भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: **M. Tech programme in Electric Vehicle Technology**

Name of the School: SMS

1.	**Course Title:**	Vehicle Dynamics
2.	**Subject Code:**	To be issued
3.	**L-T-P-:**	3-0-0
4.	**Credit:**	3
5.	**Semester No:**	1st
6.	**Core/Elective/Breadth:**	Elective
7.	**Contact Hours:**	42
8.	**Theory:**	Yes
9.	**(Autumn/ Spring):**	Autumn
10.	**Level:**	6
11.	**Pre- requisite subject(s):**	Basics of mechanics, control systems, and mathematics.
12.	**Lab:**	No
13.	**Instructor(s):**	Dr. B. Pattabhi Ramaiah

14. **Syllabus:**

Introduction to the automobile; understanding subsystems responsible for ensuring satisfactory longitudinal, lateral, and vertical dynamics performance of vehicles. Suspension kinematics and compliance; brake design and force portioning; pneumatic and hydraulic braking systems; antilock braking system (ABS); electronic brake force distribution (EBD) and traction control; vehicle stability and tire friction ellipse; different types of vehicle transmission systems; steering and handling; ride quality and suspension control; introduction to hybrid and electric vehicles. ePowertrain architectures; vehicle longitudinal dynamics (1 & 2 wheel models); key performance attributes (starting from rest and initial vehicle movement, acceleration and deceleration, energy efficiency, energy density and range, etc.). Vehicle control: longitudinal acceleration control; yaw rate control; lateral positioning; path planning/tracking; adaptive cruise control; automatic vehicle following and convoys. Testing of vehicle performance and handling; lab-based and field-testing approaches; different sophistications of lab-based vehicle testing: MIL, SIL, and HIL.

15. **Learning Outcomes:**

Analyze vehicle dynamics (longitudinal, lateral, vertical) and key subsystems (brakes, suspension, steering, powertrain). Apply control strategies and testing methods (MIL, SIL, HIL) for performance evaluation, including EV/hybrid systems.

16. Module-wise break up of topics:

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1.	Introduction to the automobile; understanding subsystems responsible for ensuring satisfactory longitudinal, lateral, and vertical dynamics performance of vehicles.	8	
2.	Suspension kinematics and compliance; brake design and force portioning; pneumatic and hydraulic braking systems; antilock braking system (ABS); electronic brake force distribution (EBD) and traction control; vehicle stability and tire friction ellipse; different types of vehicle transmission	8	

	systems; steering and handling; ride quality and suspension control; introduction to hybrid and electric vehicles.		
3.	ePowertrain architectures; vehicle longitudinal dynamics (1 & 2 wheel models); key performance attributes (starting from rest and initial vehicle movement, acceleration and deceleration, energy efficiency, energy density and range, etc.).	10	
4.	Vehicle control: longitudinal acceleration control; yaw rate control; lateral positioning; path planning/tracking; adaptive cruise control; automatic vehicle following and convoys.	8	
5.	Testing of vehicle performance and handling; lab-based and field-testing approaches; different sophistications of lab-based vehicle testing: MIL, SIL, and HIL.	8	
	Total	42	

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

- The rapid growth of electric and hybrid vehicles demands an understanding of e-powertrains, energy efficiency, and the integration of vehicle dynamics.
- Advancement in autonomous driving and ADAS requires strong knowledge of vehicle control (yaw, stability, path tracking, cruise control).
- Increasing focus on vehicle safety and performance drives the need for advanced braking systems, stability control, and testing methods (MIL, SIL, HIL).
- Emphasis on sustainable mobility and smart transportation requires optimization of energy usage, range, and intelligent vehicle systems.

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	
ii.	**Course Name:**	

iii.	L-T-P-:	
iv.	Credit:	

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

Combines vehicle dynamics with EV/hybrid systems. Covers ADAS and modern vehicle control concepts. Focuses on industry-relevant testing (MIL, SIL, HIL).

20. Suggested Books: *

Text Books:

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint
1.	Jazar, Reza N. Vehicle dynamics. Vol. 1. New York: Springer.	2008
2.	Gillespie, Thomas D. Fundamentals of vehicle dynamics. Vol. 114. SAE Technical Paper.	1992
3.	Rajamani, Rajesh. Vehicle dynamics and control. Springer Science & Business Media.	2011
4.	Pacejka, Hans. Tire and vehicle dynamics. Elsevier.	2005

Reference Books:

Sl. No.	Name of the Book, Author & Publisher	Year of Publication / Reprint
1.	Borgnakke, C and Sonntag, R.E., Fundamentals of Thermodynamics, 10th edition, Wiley.	2019
2.	Mi, C and Masrur, MA, Hybrid electric vehicles: principles and applications with practical perspectives, 2nd edition, Wiley.	2017
3.	Miller, J, Propulsion Systems for Hybrid Vehicles, IET.	2010

4.	Emadi, A, Advanced Electric Drive Vehicles, 1st edition, CRC Press.	2014

Dr. B. Pattabhi Ramaiah

Name of the Subject Teacher

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

	भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: M. Tech programme in Electric Vehicle Technology

Name of the School: SECS

1.	**Course Title:**	Charging Infrastructure
2.	**Subject Code:**	To be issued
3.	**L-T-P-:**	3-0-0
4.	**Credit:**	3
5.	**Semester No:**	2nd
6.	**Core/Elective/Breadth:**	**Elective**
7.	**Contact Hours:**	42
8.	**Theory:**	Theory
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	6
11.	**Pre- requisite subject(s):**	None
12.	**Lab:**	No
13.	**Instructor(s):**	Dr. C Perumalla, , Dr. Narsa Reddy, Prof. C N Bhende

14. Syllabus:

Basics of Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power. Neutral Grounding. Lightning and Switching Surges. Protection against Overvoltage.

Basics of EV charging and working principles, Charging levels (Level 1, Level 2, DC fast charging), Connector types and standards (Type 1, Type 2, CCS, CHAdeMO), EV charging station components and overall system architecture, and communication (OCPP basics), Charging control, CCCV (Constant-Current-Constant-Voltage) charging, Pulse-Burp charging.

Smart charging and grid distribution system; Network impact of EVs on distribution and transmission levels such as over-voltage, power quality issues etc.; Communication interface between EV and the electric power network; Mitigation techniques to overcome EV Impacts on grid/distribution network; Interdependency of EV and Renewable Energy Penetrations; Role of business models for charging and discharging; Insights on Vehicle to home and V2G applications of EVs.

15. Learning Outcomes:

- Understand the fundamentals of power transmission and distribution systems, including three-phase circuits, power flow, and protection mechanisms.
- Explain EV charging principles, charger types, standards, and different charging methods such as CCCV.
- Identify components and architecture of EV charging stations and their installation requirements.
- Analyze the impact of EV charging on power grids, including voltage, load, and power quality issues.
- Apply concepts of smart charging, communication protocols (OCPP), and charging control strategies.
- Evaluate solutions for grid integration, including renewable energy use and mitigation techniques.
- Understand advanced applications such as Vehicle-to-Home (V2H) and Vehicle-to-Grid (V2G) systems.

16. Module-wise break up of topics:

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	Basics of Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections.	5	
2	Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power. Neutral Grounding. Lightning and Switching Surges. Protection against Overvoltage.	7	
3	Basics of EV charging and working principles, Charging levels (Level 1, Level 2, DC fast charging), Connector types and standards (Type 1, Type 2, CCS, CHAdeMO),	8	

4	EV charging station components and overall system architecture, and communication (OCPP basics), Charging control, CCCV (Constant-Current-Constant-Voltage) charging, Pulse-Burp charging.	7	
5	Smart charging and grid distribution system; Network impact of EVs on distribution and transmission levels such as over-voltage, power quality issues etc.; Communication interface between EV and the electric power network;	7	
6	Mitigation techniques to overcome EV Impacts on grid/distribution network; Interdependency of EV and Renewable Energy Penetrations; Role of business models for charging and discharging; Insights on Vehicle to home and V2G applications of EVs.	8	
	Total	42	

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

- Growing adoption of electric vehicles (EVs) worldwide requires skilled professionals who understand EV charging technologies, infrastructure, and grid integration.
- Rapid advancements in renewable energy and smart grid systems make knowledge of EV-grid interactions, load management, and mitigation techniques essential.
- Emerging technologies like ultra-fast charging, wireless charging, and Vehicle-to-Grid (V2G) applications are shaping the future of sustainable mobility, creating a demand for trained workforce.
- Understanding the technical, operational, and business aspects of EV charging supports innovation, energy efficiency, and the transition to low-carbon transportation systems.

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	Indian Institute of Technology Roorkee, Indian Institute of Technology Delhi, Indian Institute of Technology Kanpur
ii.	**Course Name:**	Charging Infrastructure/Electrical Vehicle Technology
iii.	**L-T-P-:**	3-0-0
iv.	**Credit:**	3

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

- Integrated Power Systems and EV Charging Focus: Unlike many existing courses that focus mainly on EV technology or charging infrastructure in isolation, this course uniquely combines power transmission & distribution fundamentals with EV charging, grid impacts, and smart charging strategies — providing a holistic understanding of how EVs interact with electrical networks.
- Emphasis on Grid Impact and Mitigation: The curriculum includes detailed analysis of EV effects on grid voltage, power quality, and network loading, along with practical mitigation techniques, which are often not covered in depth in standard EV or charging infrastructure programs.
- Advanced & Emerging Applications: Inclusion of Vehicle-to-Home (V2H), Vehicle-to-Grid (V2G) systems, smart charging communication (OCPP), and integration with renewable energy reflects cutting-edge industry trends, making the course more future-oriented than conventional theoretical offerings.

20. Suggested Books:*

Text Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**
1	*Electric Vehicle Charging Infrastructure* by J. Larminie & J. Lowry, Wiley	2019

Reference Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**
1	Electric Vehicle Integration via Smart Charging: Technology, Standards, Implementation, and Applications by Vahid Vahidinasab & Behnam Mohammadi-Ivatloo, Springer	2022
2	*Modern Power System Analysis* by D. P. Kothari and I. J. Nagrath, McGraw Hill Education.	2003

Prof C N Bhende, Dr. Narsa Reddy

Name of the Subject Teacher

Annexure- I

PROPOSAL OF NEW ACADEMIC COURSE/SUBJECT

भारतीय प्रौद्योगिकी संस्थान भुवनेश्वर

INDIAN INSTITUTE OF TECHNOLOGY BHUBANESWAR

Name of the Programme: M. Tech programme in Electric Vehicle Technology

Name of the School: ---

1.	**Course Title:**	Maintenance, Diagnostics and Prognostics for Electric Vehicles
2.	**Subject Code:**	ME6LXXX
3.	**L-T-P-:**	3-0-0
4.	**Credit:**	3
5.	**Semester No:**	2
6.	**Core/Elective/Breadth:**	Elective
7.	**Contact Hours:**	42
8.	**Theory:**	Theory
9.	**(Autumn/ Spring):**	Spring
10.	**Level:**	6
11.	**Pre- requisite subject(s):**	NA
12.	**Lab:**	NA
13.	**Instructor(s):**	Dr. Pattabhi R, Dr. Venugopal Arumuru, Industry person

14. **Syllabus:**

Overview of EV subsystems: battery, motor, inverter, BMS, Differences between ICE and EV maintenance, Failure modes in EV systems, Basics of condition monitoring, Electrical safety in high-voltage systems, Thermal hazards and battery safety, Preventive and predictive maintenance strategies, Standard operating procedures (SOPs), Maintenance scheduling and lifecycle management, Fault classification: electrical, thermal, mechanical, Diagnostic techniques, Signal-based diagnostics, Model-based diagnostics, Fault detection in Battery systems (SoC, SoH issues), Motor and inverter systems, Use of onboard diagnostics and fault codes, Sensors used in EV diagnostics, Data acquisition systems, CAN bus and vehicle communication protocols, IoT

architecture for connected EVs, Remote diagnostics and cloud-based monitoring, Concept of prognostics and remaining useful life (RUL). Degradation modeling of batteries. End-of-life EV considerations, Battery reuse and second-life applications, Recycling technologies for lithium-ion batteries, Environmental and regulatory aspects, Circular economy in EV ecosystem

15. Learning Outcomes:

- Identify EV subsystems and compare maintenance strategies between ICE and electric vehicles.
- Classify faults in battery, motor, and inverter systems using signal and model-based diagnostics.
- Select appropriate sensors and configure data acquisition systems for EV diagnostic applications.
- Apply prognostic algorithms to estimate battery degradation and predict remaining useful life (RUL).
- Evaluate end-of-life EV options including battery reuse, recycling, and circular economy practices

16. Module-wise break up of topics:

Sl. No.	Course Contents	Contact Hours/ No. of Lectures	No. of Tutorial / Practical
1	**Introduction to EV Systems & Maintenance Fundamentals** • Overview of EV subsystems: battery, motor, inverter, BMS • Differences between ICE and EV maintenance • Failure modes in EV systems • Basics of condition monitoring • Electrical safety in high-voltage systems • Thermal hazards and battery safety • Preventive and predictive maintenance strategies • Standard operating procedures (SOPs) • Maintenance scheduling and lifecycle management	10	0
2	**Fault Classification & Diagnostic Techniques** • Fault classification: electrical, thermal, mechanical • Diagnostic techniques overview • Signal-based diagnostics • Model-based diagnostics	9	0

	• Fault detection in Battery systems (SoC, SoH issues) • Fault detection in Motor and inverter systems • Use of onboard diagnostics and fault codes		
3	**Sensors, Data Acquisition & Vehicle Communication** • Sensors used in EV diagnostics • Data acquisition systems • CAN bus and vehicle communication protocols • IoT architecture for connected EVs • Remote diagnostics and cloud-based monitoring	8	0
4	**Prognostics & Remaining Useful Life (RUL)** • Concept of prognostics and remaining useful life (RUL) • Degradation modeling of batteries • Prognostic methods: data-driven, model-based and hybrid approaches • Health index estimation and prediction algorithms • End-of-life EV considerations	9	0
5	**End-of-Life Management & Circular Economy** • Battery reuse and second-life applications • Recycling technologies for lithium-ion batteries • Environmental and regulatory aspects • Circular economy in EV ecosystem	6	0
	Total	**42**	**0**

17. Need of the course in terms of current & future trends in technology & science (3-4 bullet points)

- Rapid EV adoption demands engineers skilled in EV-specific maintenance and fault diagnostics.
- IoT and cloud-based monitoring are transforming real-time vehicle health management systems.
- AI-driven prognostics for battery RUL prediction is a critical frontier in EV reliability research.
- Circular economy and battery recycling regulations are shaping the future of sustainable mobility

18. Details of similar course/subject elsewhere, if any:

i.	**Name of the other IIT/ Universities offering the similar subjects:**	VNIT Nagpur
ii.	**Course Name:**	EV Diagnostics and Prognostics: Leveraging IoT and Data Analytics"
iii.	**L-T-P-:**	3-0-2
iv.	**Credit:**	4

19. Newness of the course as compared to existing similar courses, if any (in 2-3 bullet points):

NA

20. Suggested Books:*

Text Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**
1	Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press.	3rd Ed., 2018
2	Kai Goebel, Neil Eklund, Abhinav Saxena, Prognostics and Health Management of Electronics, Wiley-IEEE Press,	2nd Ed., 2018.

Reference Books:

Sl. No.	**Name of the Book, Author & Publisher**	**Year of Publication / Reprint**
1	Xiaosong Hu, Languang Lu, Xuebing Han, Battery Lifetime Prognostics, Frontiers Media SA	2020
2	Isidor Buchmann, Batteries in a Portable World: A Handbook on Rechargeable Batteries for Non-Engineers, Cadex Electronics,	4th Ed., 2016

Dr. Pattabhi R/Dr. Venugopal Arumuru

Name of the Subject Teacher