

Branch Name:	Electrical Engineering
Program Code:	ET109
Course Name:	EV Dynamics and control (Professional Elective-III)
Course Code:	2ET1090707T
Pre-requisite Course:	--

Course Objectives:

1. To provide students with a comprehensive understanding of the principles underlying electric vehicle dynamics and their influence on performance.
2. To develop proficiency in the design and selection of transmission systems for electric vehicles.
3. To apply powertrain modeling methods to develop and analyze cost-optimal control strategies that improve efficiency and performance of electric vehicle systems.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40	-	-	-	-	100

Course Contents:

Sr. No.	Topic	Total Hours	Weightage (%)
1	Structure Optimization and Generalized Dynamics Control: Fundamentals of vehicle dynamics, Distributed drive electrical vehicle model, Generalized dynamics models, Extended high efficiency area model, Typical applications.	07	16
2	Transmission System Design & Brake-Blending Control: Design of transmission systems for EVs, EVs equipped with IMT powertrain system, EV transmission design, Oscillation damping controller design, Modeling and analysis of suspension systems, Vehicle state and tire road friction co-efficient estimation, Brake-blending system modelling, Regenerative braking energy management strategy, Dynamic brake blending control algorithm.	10	20
3	Functional Safety: Functional safety standard, ISO 26262, Validation and quality, Design and integration, Vehicle ECU programming, Mounting and installation, Thermal management.	06	15
4	Dynamics Controllers: Controllers in EVs, Axle translational controls, Gearbox controllers, SW architecture and AUTOSAR, NVH in electric vehicle, Safety systems, FDSS, Isolation monitoring, HVIL, Junction boxes, Contactors, Relays, Fuses and its selection, Design, Component sizing, Issues in operating HV contactors, Pre-charge circuits, Diagnostics, Modelling and control of EVs, Sensing and Estimation, Active safety control, Riding and energy efficiency control.	10	20
5	Integration with a Smart Grid: EV role in smart grid, Powertrain modelling, Formulation of cost optimal control problem.	05	13

6	Harness Design: HV harness design, Including connectors, Fuses, Relays and sensors, LV harness design, Intra vehicle network design, EMI / EMC compliance, Energy management within the power train architecture.	07	16
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Text Books:

1. Modeling, dynamics, and control of electrified vehicles- Hui Zhang, Dongpu Cao, Haiping Du, Elsevier Woodhead Publishing, 2017.
2. Modeling and Dynamics Control for Distributed Drive Electric Vehicles- Xudong Zhang, Springer Nature, first edition, 2021.
3. Dynamics and control of Electrical Drive- P. Wach, Springer, 1st Edition, 2011.

Reference Books:

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicle Fundamentals, Theory and Design- M. Ehsani, Y. Gao, S.E. Gay and E. Ali, CRC press, 3rd Edition, 2018.
2. Hybrid Electric Vehicle System Modeling and Control- W. Liu, Wiley, Second Edition, 2017.

ICT/ MOOCS:

1. MS (by Research) in E-MOBILITY Jointly offered by the Departments of Electronics and Electrical Engineering (EEE) and Mechanical Engineering (ME), IIT Guwahati.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understanding of the principles underlying electric vehicle dynamics.	2 Understanding
CLO2	Demonstrate proficiency in designing transmission systems for electric vehicles.	1 Remembering
CLO3	Develop skills in validation, quality assurance, and safety system integration.	4 Analyzing
CLO4	Apply powertrain modelling to formulate cost-optimal control strategies.	3 Applying
CLO5	Evaluate the design of HV and LV harnesses, considering EMI/EMC compliance and energy management.	5 Evaluating

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PSO 4
CLO1	H	M	M	M	L	M	M	L	L	L	L	L	M	M	H	L
CLO2	H	M	M	M	M	M	M		M		L	L	M	M	H	L
CLO3	H	H	M	M	H	L	M	L	L		L	L	M	M	H	L
CLO4	H	M	M	M	L	L	M		L	L	L	L	M	H	H	
CLO5	M	M	H	M	L	L	M	H	L	L	L	L	M	M	M	M

H: High, M: Medium, L: Low