Indian Institute of Technology Madras

Interdisciplinary Dual Degree in Electric Vehicles (IDDD-EV)

The Interdisciplinary Dual Degree programme in EVs has been conceived to cater to the medium-term needs of Automotive OEMs and their Tier 1 vendors- as well as the requirements of the numerous StartUps that are evolving in this space. It is proposed to develop industry-ready professionals who can take up careers in the Functions of Engineering and Development of various types of EVs- starting from e2W and e3W and going all the way to eBuses and eTrucks. The different skills and domain required to train such professionals lie in different departments of IITM- and it is hence imperative that it is offered as an Inter-Disciplinary degree. Upon completion of the degree, the students will be able to, given their strong and application-oriented fundamentals, take up immediate and productive Engineering and Developmental roles. While care has been taken to minimise the number of new courses in the curriculum, existing courses already being offered would be modified marginally to suit the EV domain as well as to increase the practicality/ application of the training by way of Micro Projects and Application Assignments/ Tutorials.

Learning Outcomes:

Students graduating with a dual degree in EVs shall be capable of understanding, conceptualising, analysing, applying and debugging in the following areas related to EVs:

1. Vehicle Dynamics.
2. Battery Engineering, including Cell Development and use.
3. Power Electronics and Embedded Systems for EVs.
4. Motors and their Controllers.
5. Vehicle Control strategies and algorithms.
6. Financial, Market and Economic considerations for an EV EcoSystem.
7. Material Engineering, including advanced Materials and their processes, for EVs.
8. The Fundamental Taxonomy, Topology and Architecture of xEVs.
9. Thermal Management of all EV systems and aggregates.

The specific learning outcomes include

1. Understand and develop drives and controls for EV Motors.
2. Model, optimise and develop the overall dynamics and controls of an EV with suitable mathematical and empirical tools.
3. Understand and engineering Battery Packs for EVs including Thermal Management, Safety Management and Battery Overall Management.
4. Use the fundamentals of Electrochemistry to design and test Cells with different chemistries and form factors.
5. Understand the basics of Data-based analytics to be able to apply to different sub-systems of an EV.

Who offers the programme?

The ID-DD programme is offered by faculty from the departments of Engineering Design, Mechanical Engineering, Chemical Engineering, Electrical Engineering, Chemistry, Management Studies and Metallurgical & Materials Engineering.

Who can enrol in this programme?

A B. Tech student or a Dual Degree student of IIT Madras in any discipline (except biosciences) is eligible to upgrade/opt for this programme provided the student has a CGPA of 8.0 or above up to 5th semester. Total number of seats will be fixed at 25 and allocation of dual degree specialization and award of the degree will be governed by the rules of the Institute.

What is the future potential for Students who completed ID-DD?

For those students seeking to go in for employment right after this ID-DD:

The curriculum has been drawn up after very detailed inputs were received from Industry. Over time, further industry-oriented courses are to be included with due process and approvals- with members from Industry actually conducting those courses as Adjunct Faculty. The balanced approach to the fundamentals of vehicles, and deep science behind each topic will help the students perform readily after being placed in Industry. Moreover, the Projects and Assignments, along with possible internships, being offered as part of the Program, will help the students be productive assets in employment or as Entrepreneurs right from the first day.

For those students seeking to go in for further studies and research:

The Core as well as the Elective subjects provide for deep dives into the fundamental sciences behind each domain thus equipping the students well for further research or studies, if they so choose. The Electives Basket has been drawn up with focus and care, in order to permit a student to specialise in one of the Domains if he/she so chooses- be it Battery Technology or Power Electronics or Motor Engineering.

What is the curriculum?

ID-DD-EVs has a flexible curriculum. The programme spans a period of five semesters of the five-year dual degree programme. This course will ensure that the students who enter into this specialisation from different streams have the basic understanding of the principles and fundamentals for the different EV-related topics. Some of the subjects, in order to increase the application strengths of the students and to make them more industry-ready, will have Micro Projects (some of them lab-based, where required) as part of the training and assessment. The curriculum also allows short term (1-3 months)/ long term (up to 6 months) internships with potential companies.

In tune with the overall structure of the dual degree program being offered in the Institute, the number of courses to be offered and the credit distribution are as follows:

Total Credits required:	**155 to 160**
No. of PMT CORE courses to be offered:	4 (39 credits)
No. of electives to be offered:	4 (~36 credits)
No. of labs. to be offered:	1 (3 credits, already included in the 39 CORE credits)
Project work/internship	3 (20 + 30 + 35 = 85 credits)

Total credits for the ID-DD specialization: ~160 credits

Interdisciplinary DD in EVs -course curriculum

Sl. No	Course No	Course Name	L	T	E	P	O	C
Semester 6								
C1	ED5220	Core 1: Vehicle Dynamics	3	0	0	3	6	12
C2	ED5235	Core 2: Power Electronics and Motor Drives for Electrified Vehicles	3	0	0	0	6	9
		Total Credits :						21
Semester 7								
C3	ED5330	Core 3: Control of Automotive Systems	3	0	0	0	6	9
C4	ID5500	Core 4: Battery Technology	3	0	0	0	6	9
		Total Credits :						18
Semester 8								
		Summer						
P1		Project I – Summer Project						20
Semester 9								
P2		Project II						30
Semester 10								
P3		Project III						35

Project: **85** credits to be completed in the summer after the 8th semester, 9th and 10th semesters.

Electives: Around **36** credits to be completed from the approved list in 8th, 9th and 10th semesters.

Total credits for the DD programme: ~160

ELECTIVE COURSES

Faculty/Department consent has been received for the electives or is in process.

		L	T	E	P	O	C
ED5340	Data Science: Theory and Practice	3	0	0	3	6	12
ED5160	Fundamentals of Automotive Systems	4	0	0	3	8	15

EDXXXX	Thermal Engineering for EVs (new course introduced by ED)	3	0	0	0	6	9
ED5270	Motorcycle Dynamics	3	0	0	0	6	9
CY6015	Electrochemistry: Fundamentals and Applications	3	0	0	0	6	9
CY6998	Electrochemical Approaches to Functional Supramolecular Systems	3	0	0	0	6	9
ME5228	Engineering Acoustics	3	0	0	0	6	9
ID5020	Multi-Body Dynamics and Applications	3	0	0	0	6	9
EE5200	Power Converter Analysis and Design	3	0	0	0	6	9
EE5201	Modelling and Analysis of Electric Machines	3	0	0	0	6	9
EE5203	Switched Mode Power Conversion	3	0	0	0	6	9
EE6262	Advanced Motor Control	3	0	0	0	6	9
EE5204	Electric Vehicles and Renewable Energy	3	0	0	0	6	9
ID6106	Materials for Energy Storage and Conversion	3	0	0	0	6	9
ID6XXX	Process and Design for Additive Manufacturing	3	0	0	0	6	9
MM5210	X-Ray Diffraction Techniques	3	0	0	0	6	9
MM5030	Materials in Renewable Energy Technologies	3	0	0	0	6	9

Note: Students are required to take the appropriate pre-requisites for courses or obtain Consent of Teacher.