

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY DESIGN AND MANUFACTURING  
(IIITDM) KANCHEEPURAM

<b>Course Title</b>	Design of Hybrid and Electric Vehicle	<b>Course No</b>				
<b>Specialization</b>	Integrated Product Design	<b>Structure (LTPC)</b>	2	1	0	3
<b>Offered for</b>	Master of Design (Semester 2)	<b>Status</b>	Core		Elective X	
<b>Prepared by</b>	Dr Raguraman Munusamy					
<b>Prerequisite</b>	B.Tech (Mechanical / Electrical)	<b>To take effect from</b>	2021 Batch			
<b>Course Objectives</b>	This course will provide a broad technical knowledge and practical expertise of hybrid and electric vehicle (HEV) technologies, analysis, design, component selection and sizing at both system and vehicle level.					
<b>Course Outcomes</b>	<p>On successful completion of this course students will be able to:</p> <ul style="list-style-type: none"> <li>Analyse the different powertrain architecture options and select the appropriate solutions within realistic performance and commercial constraints.</li> <li>Evaluate various technology options for (electrical and mechanical) energy generation, storage, transmission, and management for a HEV</li> <li>Size various HEV systems, within the constraints like performance, fuel economy and packaging.</li> </ul>					
<b>Contents of the course (With approximate break up of hours)</b>	<p><b>Module 1: Introduction to Electric Vehicle (3 hrs)</b></p> <ul style="list-style-type: none"> <li>History and Components of Electric Vehicle, Comparison with Internal combustion Engine : Technology, Benefits and Challenges, EV classification and their electrification levels and terminologies</li> </ul> <p><b>Module 2: Motor Torque Calculations for Electric Vehicle (6 hrs)</b></p> <ul style="list-style-type: none"> <li>Calculating the rolling resistance, grade resistance, acceleration, force and finding the total tractive effort, torque required on the drive wheel.</li> </ul> <p><b>Module 3: Electric Vehicle Architecture Design (9 hrs)</b></p> <ul style="list-style-type: none"> <li>Types of EV and components, electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV)</li> <li>Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), Electrification Level of EV</li> </ul> <p><b>Module 4: Electric Drive and controller (6 hrs)</b></p> <ul style="list-style-type: none"> <li>Types of motors, selection and sizing of motor, RPM and torque calculation of motor, motor controllers, component sizing, physical locations, mechanical and electrical connection of motor</li> </ul> <p><b>Module 5: Energy Storage Solutions (ESS) (6 hrs)</b></p> <ul style="list-style-type: none"> <li>Cell Types (Lead Acid/Li/NiMH), battery charging and discharging calculation, cell selection and sizing, battery lay outing design, battery pack Configuration, construction and selection criteria.</li> </ul> <p><b>Module 6: Battery Management System(BMS)/Energy Management System (EMS) (6 hrs)</b></p> <ul style="list-style-type: none"> <li>Need of BMS, rule based control and optimization based control, software-based high level supervisory control, mode of power, behavior of motor etc</li> </ul> <p><b>Module 7: Electric Vehicles charging station (6 hrs)</b></p> <ul style="list-style-type: none"> <li>Type of charging station, selection and sizing of charging station, components of charging station, single line diagram of charging station</li> </ul> <p>Evaluation: 70% assignments/activities + 30% End Semester</p>					
<b>Texts &amp; References</b>	<ol style="list-style-type: none"> <li>C.M. Jefferson &amp; R.H. Barnard (2002), Hybrid Vehicle Propulsion, WIT Press, ISBN: 9781853128875</li> <li>James Larminie and John Lowry (2012), Electric Vehicle Technology Explained, Oxford Brookes University, Oxford, UK, ISBN:9781119942733</li> <li>John Miller (2010), Propulsion Systems for Hybrid Vehicles, Institute of Electrical Engineers, UK, ISBN: 9781849191470</li> <li>Iqbal Husain (2010), Electric and Hybrid Vehicles – Design Fundamentals, CRC Press, ISBN:9781439811757</li> <li>Chris Mi, M A Masrur, D W Gao (2011), Hybrid Electric Vehicles – Principles and applications with practical perspectives,” Wiley, ISBN:9780470747735</li> <li>Vivek D Bhise (2017), Automotive product development: A systems engineering implementation, CRC Press, ISBN:9781498706810</li> </ol>					