

Chargers and Charging Infrastructure

(Course code: EV-355)



CoE for Electric Vehicles and Related Technologies

Department of Electrical Engineering

Delhi Technological University, Delhi-110042

Scheme for Minor Degree in Electric Vehicles Technology

Teaching Scheme				Exam Duration (Hrs)		Contact Hours / Week			Relative Weights (%)			
S. No.	Course Code	Course Title	Credits	T	P	L	T	P	CWS	PRS	MTE	ETE
Mandatory Courses												
1.	EV-301	Fundamentals of Electric Vehicles	4	3	0	3	0	2	15	25	20	40
2.	EV-302	Energy Storage Systems for Electric and Hybrid Vehicles	4	3	0	3	0	2	15	25	20	40
3.	EV-303	Power Electronics Converters and Drives for Electric Vehicles	4	3	0	3	0	2	15	25	20	40
Total Credits to be earned			12									
Teaching Scheme				Exam Duration (Hrs)		Contact Hours / Week			Relative Weights (%)			
Elective Courses												
4.	EV-351	E Mobility	4	3	0	3	0/1	2/0	15/25	25/0	20/25	40/50
5.	EV-352	Electric Vehicles Retrofitting, Testing and Troubleshooting	4	3	0	3	0/1	2/0	15/25	25/0	20/25	40/50
6.	EV-353	Electric Vehicles Design, Dynamics and Testing	4	3	0	3	0/1	2/0	15/25	25/0	20/25	40/50
7.	EV-354	Automotive Electronics and Embedded Systems	4	3	0	3	0/1	2/0	15/25	25/0	20/25	40/50
8.	EV-355	Chargers and Charging Infrastructure	4	3	0	3	0/1	2/0	15/25	25/0	20/25	40/50
9.	EV-356	Intelligent Transportation Systems	4	3	0	3	0/1	2/0	15/25	25/0	20/25	40/50
10.	EV-358	Plug in Electric Vehicles and Smart Grid	4	3	0	3	0/1	2/0	15/25	25/0	20/25	40/50
Total Credits to be earned			12									

Course Outline

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|---------------------------------|---|--------------------|---------------------|---------------------|
| 1. Subject Code: EV-355 | Course Title: Chargers and Charging Infrastructure | | | |
| 2. Contact Hours: | L: 3 | T: 0 / 1 | P: 2 / 0 | |
| 3. Examination Duration (Hrs.): | Theory: 3 | Practical: 0 | | |
| 4. Relative Weight: | CWS: 15 / 25 | PRS: 25 / 0 | MTE: 20 / 25 | ETE: 40 / 50 |
| 5. Credits: | 4 | | | |
| 6. Semester: | V/VII | | | |
| 7. Subject Area: | Minor | | | |
| 8. Pre-requisite: | NIL | | | |
| 9. Objective: | To understand the fundamentals technologies and practical aspects of EV charging systems and associated infrastructure. | | | |

Course Outline

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S. No.	Contents	Contact Hours
1	Unit I: Introduction Introduction of Electric Vehicles (EVs); EVs and Environment; Types of EVs: Battery EVs, Hybrid EVs, Fueled EVs, Solar Powered EVs; EV Architecture	04
2	Unit II: Energy Storage Systems Introduction to Energy Storage; Battery based energy storage: Parameters, Types of battery, Charging / Discharging cycle, Battery modelling; Battery Sizing; Battery EV, Plug-in Hybrid EVs; Fuel Cell based energy storage; Super Capacitor based energy storage; Fly wheel-based energy storage.	08
3	Unit III: Charging Methods and Infrastructure Electric Vehicle Technology and Charging Equipment's- Basic charging Block Diagram of Charger, Difference between Slow charger and fast charger, Slow charger design rating, Fast charger design rating, charging infrastructure, Types of chargers, standards used for chargers, grid interaction of chargers; Difference between charging station and charging point; Inductive charging, Flash Charging; Charger protocols, OCPP, V2G, CHADEMO, Bharat Charger; Impact of charging on grid; Renewable energy integration to chargers.	08
4	Unit IV: Fundamental of Chargers Introduction, Charger Classification and Standards, Charger Requirements, Topology Selection for Level 1 and 2 AC Chargers: Front-End AC-DC Converter Topologies, DC-DC Converter, Isolated DC-DC Converter Topologies; Topology Selection for Level 3 Chargers; Front-End PFC Boost Converter Design; Isolated DC-DC Converter Design; Wireless Chargers.	12
5	Unit V: Battery Charging Basic requirements for charging system; Charger architecture; Boost PFC; Sizing of Boost inductor; Average Input Current; Loss calculation; PFC stage losses.	4
6	Unit VI: Charging and EVSE Communication Selection of AC charger type-1, type -2 and type -3, Communication between AC charger and EV, Selection of DC charger connector GB/T, CHAdemo, CCS-1 and CSS-2, Communication methodology of DC fast chargers; EVSE Power Module selection and technical specification, Selection of EVSE Communication Protocol (PLC / Ethernet / Modbus/ CAN Module), Communication gateway, Specification of open charge point protocol (OCCP 1.6/2.0), Bharat DC001 & AC001, Charger specification, Communication Interface between charger and CMS (Central Management System).	6
Total		42

Reference Books

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S. No.	Name of Authors /Books / Publishers	Year of Publication/ Reprint
1.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design by Mehrdad Ehsani, Yimin Gao, Sebastian E. Gay and Ali Emadi, CRC press, 3rd Edition.	2010
2.	Advance Electric Drive Vehicles by Ali Emadi, CRC press.	2015
3.	Electric and Hybrid Vehicles Technologies, Modeling and Control: A Mechatronic Approach, by Amir Khajepour, saber Fallah and Avesta Goodarzi, John Wiley & Sons Ltd.	2014
4.	Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, by John G. Hayes and G. Abas Goodarzi, Wiley	2018
5.	Electric Vehicle Technology Explained, by John Lowry and James Larminie, John Wiley & Sons, 2nd Edition.	2003
6.	Developing Charging Infrastructure and Technologies for Electric Vehicles, by Mohammad Saad Alam, Reji Kumar Pillai, N. Murugesan. IGI global publisher	2021
7.	Electric Vehicle Charging Station (EVCS): Renewable Energy meets the Ultra-Low Emission Vehicle, D Smith, 1st edition	2015

A Typical EV Charging Station in India



Thankyou