GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering
Level: PG
Branch: Electric Vehicle Technology
Course / Subject Code: ME01064051

Subject Name : Plug-in Electric Vehicles in Smart Grid

WEF Academic Year :	2024 – 25
Semester :	1st Semester
Category of the Course :	PEC

Prerequisite :	Nil
Objective :	The objective of this course is to understand the impact of the EV charging and Vehicle to Gridon the stability, power quality and economic impact on the existing grid and smart grid.

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content :

Sr. No.	Content	Total Hrs.
1	**INTRODUCTION:** Introduction, EV charging options and infrastructure, EV charging strategies, Impact of charging strategies on distribution system, energy, economic and environmental considerations.	03
2	**INFLUENCE OF EVS ON POWER SYSTEM :** Impact of EV charging on power grid, effect of EV charging on generation and loadprofile, EV penetration level for different scenarios, classification based on penetration level, EV impacts on system demand: dumb charging, multiple tariff charging, smart charging, case studies	08
3	**EV AND SMART GRID:** Architecture and model for smart grid & EV, Information and communication models in smart grid, smart metering, information & communication models, functional andlogical models.	06

4	**VEHICLE TO GRID (V2G):** Defining Vehicle to Grid (V2G) – History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering, V2G – Power Markets and Applications. V2G and its impact on Electricity Markets, Other grid application of V2G.	**09**
5.	**FREQUENCY CONTROL RESERVES & VOLTAGE SUPPORT FROM EVS:** Power system ancillary services, electric vehicles to support wind power integration, electric vehicle as frequency control reserves and tertiary reserves, voltage support and electric vehicle integration, properties of frequency regulation reserves, control strategies for EVs to support frequency regulation.	**09**
6.	**EV CHARGING FACILITY PLANNING:** Energy generation scheduling, different power sources, centralized charging schemes, decentralized charging schemes, energy storage integration into Microgrid,Concept of EV Charging Aggregator, Design of V2G Aggregator	**10**
	TOTAL	**45**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**25**	**30**	**15**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from the above table.

Reference Books :

1. "Plug In Electric Vehicles in Smart Grids, Charging Strategies", Sumedha Rajakaruna , Farhad Shahnia and Arindam Ghosh,Springer,2015, 1st Edition.
2. "Introduction to the Smart Grid: Concepts, Technologies and Evolution", Salman K. Salman, IET.
3. "Grid Integration of Electric Vehicles in Open Electricity Markets" Qiuwei Wu, John Wiley &

Sons,
Ltd.

4. "Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", Junwei Lu and Jahangir Hossain, IET2015, 1st Edition.
5. "ICT for Electric Vehicle Integration with the Smart Grid", Nand Kishor , Jesus Fraile-Ardanuy, IET2020, 1st Edition.

Course Outcomes :

S. No	CO STATEMENT	Bloom's taxonomy level	Marks % weightage
CO1	To learn the charging requirements for EV in existingsystem	Remember L1 , Understand L2, Evaluate L5,	**15%**
CO2	Analyze the influence of EVs on power system	Remember L1 , Understand L2, Evaluate L5,	**30%**
CO3	To study the benefits & challenges of V2G in theelectricity grid	Remember L1 , Understand L2, Evaluate L5	**30%**
CO4	To understand the EV charging facility planning.	Remember L1 , Understand L2, Evaluate L5 Create L6	**25%**

Suggestive List of Experiments :

- Study Micro Grid Operation in Smart Distribution System
- Study of Battery Management System for EVs.
- Micro grid Integration of Battery Management System.
- Study of increase of penetration of the EV charging in the grid.
- To analyze power quality issues with integration of EV on the microgrid.
- Study various charging strategies for EV charging.
- Study the role of aggregator in EV charging.
- To study impact of EV charging on electricity market with V2G.

List of Software/learning website :

- MATLAB

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