NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**II**
Course Code:	**6EE170**
Course Title:	**Electric Vehicles in Smart Grid**
Course Type:	(□ Core/ □ Value Added Course / √ **Department Elective** / □ Institute Elective/ □ University Elective/ □ Open Elective / □ Any other)
Year of Introduction:	**2022 – 23**

L	**T**	**Practical component**				**C**
		LPW	**PW**	**W**	**S**	
3	**0**	**0**	**-**	**-**	**-**	**3**

Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to-

1. elaborate about vehicle electrification and impact of charging strategies **(BL2)**
2. analyze the influence of EVs on power system **(BL5)**
3. distinguish the frequency control and voltage support from EVs **(BL4)**
4. interpret the ICT solutions for EV deployment **(BL3)**
5. understand the EV charging facility planning **(BL3)**

Syllabus: Teaching Hours: 45

UNIT-1: Introduction 9

Introduction, Impact of charging strategies, EV charging options and infrastructure, energy, economic and environmental considerations, Impact of EV charging on power grid, effect of EV charging on generation and load profile, Smart charging technologies, Impact on investment.

UNIT-2: Influence of EVs on Power System 9

Identification of EV demand, 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.

UNIT-3: Frequency Control Reserves and Voltage Support from EVs 9

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.

UNIT-4: ICT Solutions to Support EVs Deployment 9

Architecture and model for smart grid & EV, ICT players in smart grid, smart metering, information & communication models, functional and logical models, technology and

solution for smart grid: interoperability, communication technologies.

UNIT-5: EV Charging Facility Planning **9**

Energy generation scheduling, different power sources, fluctuant electricity, centralized charging schemes, decentralized charging schemes, energy storage integration into Microgrid, Design of V2G Aggregator.

Self-Study:

The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Suggested Readings:

1. Sumedha Rajakaruna, Farhad Shahnia and Arindam Ghosh, Plug In Electric Vehicles in Smart Grids-Integration Techniques, Springer Science + Business Media Singapore Pte Ltd.
2. Canbing Li, Yijia Cao, Yong hong Kuang and Bin Zhou, Influences of Electric Vehicles on Power System and Key Technologies of Vehicle-to-Grid, Springer-Verlag Berlin Heidelberg
3. Qiuwei Wu, Grid Integration of Electric Vehicles in Open Electricity Markets, John Wiley & Sons, Ltd.
4. Michael H Westbrook, The Electric Car - Development and Future of Battery, Hybrid and Fuel Cell Cars, IEE Power and Energy Series 38
5. Sandeep Dharmeja, Electric Vehicle Battery Systems, Newnes.
6. Salman K. Salman, Introduction to the Smart Grid: Concepts, Technologies and Evolution, IET.
7. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Smart Grid: Technology and Applications, John Wiley & Sons.
8. Chung Chow Chan, K. T. Chau, Modern Electric Vehicle Technology, Oxford University Press.
9. International standards in use, relevant research papers and articles from reputed journals.

L = Lecture, T = Tutorial, P = Practical, C = Credit