



**SARVAJANIK UNIVERSITY**  
**Sarvajanic College of Engineering and Technology**  
**Bachelor of Technology**



<b>B. Tech.- IV Semester-VII</b>	
<b>Subject Name: Smart Grid</b>	<b>Subject Code: BTEL14754</b>

<b>Type of course:</b>	<b>Professional Elective Course- Electrical Eng.</b>
<b>Prerequisite:</b>	Fundamentals of courses like Power Systems, Power Electronics, Renewable Energy Sources
<b>Rationale:</b>	This course helps in understanding concept of smart grid and developments on smart grid. The smart grid technologies and application of smart grid concept in hybrid electric vehicles etc. are also discussed. Moreover, smart substations, feeder automation and application for monitoring and protection, micro grids and distributed energy systems, and significance power quality aspects in smart grid is also addressed.

**Teaching and Examination Scheme:**

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	0	0	

**CA1:** Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Content:**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	<b>Introduction to Smart Grid</b> Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Architecture of Smart Grid System, Opportunities & Barriers of Smart Grid, Difference between Conventional & Smart grid, Concept of Resilient & Self-Healing Grid, Present Development & International policies on Smart Grid, Case study of Smart Grid.	8	20
2.	<b>Smart Grid Technologies</b> Introduction to Smart Meters, Signal conditioning, Analog to Digital conversion, Computation, Communications Infrastructure and Protocols for Smart Metering, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Smart Sensors, Home & Building Automation, Phase Shifting Transformers, Smart	10	25

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*W.e.f. AY 2021-22*



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	Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their Application for Monitoring & Protection, Smart Storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phasor Estimation, Phase Measurement Unit(PMU), Demand-side integration		
3.	<b>Micro grids and Distributed Energy Resources</b> Concept of Micro Grid, Need & Applications of Microgrid, Formation of Microgrid, Issues of Interconnection, Protection & Control of Microgrid, Islanding Detection Techniques, Smart Grid Protection.  Distributed Energy Resources: Small Scale Distributed Generation, Distributed Generation Technology, Solar Photovoltaic, Wind Turbine, Internal Combustion Engines, Gas Turbines, Combined Cycle Gas Turbines, Micro turbines, Fuel Cells, Solar thermal, Geothermal, Advantages and disadvantages of DG.	10	20
4.	<b>Power Quality Management in Smart Grid</b> Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit, Information and Communication Technology for Smart Grid, Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN), Zig-Bee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Broadband over Power line (BPL), Distribution and Feeder Automation System	10	20
5.	<b>Electric Vehicles &amp; Smart grid integration</b> Smart grid and smart charging, Smart Grid and Plug-in Vehicles, Electric vehicles and smart grid interaction, vehicle to grid and renewable energy sources integration	7	15

**Suggested Specification table with Marks (Theory/Practical):**

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	20	25	15	15	10

**Legends: R:** Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **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 **Professional Elective Course- Electrical Eng.**



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actual distribution of marks in the question paper may vary slightly from above table.

**Reference Text Books:**

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of publication	Publication Edition
1.	Integration of Green and Renewable Energy in Electric Power Systems	Ali Keyhani, Mohammad N. Marwali, Min Dai	Wiley	2009	
2.	The Smart Grid: Enabling Energy Efficiency and Demand Response	Clark W. Gellings	CRC Press	2009	
3.	Smart Grid: Technology and Applications	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama	Wiley	2012	
4.	Smart Grids	Jean Claude Sabonnadière, Nouredine Hadjsaïd	Wiley Blackwell	2012	
5.	Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities	Peter S. Fox Penner	Island Press	2010	First
6.	Microgrids and Active Distribution Networks	S. Chowdhury, S. P. Chowdhury, P. Crossley	Institution of Engineering and Technology	2009	
7.	Smart Grids (Power Engineering)	Stuart Borlase	CRC Press	2012	
8.	Communication and Networking in Smart Grids	Yang Xiao	CRC Press	2012	First
9.	Substation Automation (Power Electronics and Power Systems)	MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert	Springer	2010	



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**Course Outcome:**

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Explain smart grids and review smart grid policies and developments.	20
CO-2	Identify components/technologies used in Smart grid	25
CO-3	Demonstrate micro grids and renewable energy sources.	15
CO-4	Investigate power quality issues and communication technologies for Smart grid.	20
CO-5	Develop and apply concepts of smart grid technologies in contest of electrical vehicles.	20

**Mapping with POs:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	1	1	1	1	1	1	2	1	1	3	1	1	2	1	2
CO-2	1	2	1	2	1	1	2	0	1	2	1	1	2	2	3
CO-3	1	2	1	1	1	1	2	1	1	3	1	1	2	1	2
CO-4	0	2	1	2	3	0	3	0	1	1	1	0	2	2	3
CO-5	0	2	2	2	3	1	2	0	1	1	1	0	2	2	2
Rationale	3	9	6	8	9	4	11	2	5	10	5	3	10	8	12

**List of Open Source/learning website:**

[https://onlinecourses.nptel.ac.in/noc22\\_ee82/preview](https://onlinecourses.nptel.ac.in/noc22_ee82/preview)