

HIGH VOLTAGE ENGINEERING AND SOLAR LABORATORY

VII Semester: EEE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEE111	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 48			Total Classes: 48			
OBJECTIVES: The course should enable the students to: I. Understand the principles of high voltage generation and measurements. II. Determine the break down voltage of atmospheric air using rod gap and sphere gap apparatus. III. Understand breakdown phenomena in solid, liquid and gas mediums. IV. Familiarize the students with solar power generation and measurement technology.								
COURSE LEARNING OUTCOMES (CLOs): The students should enable to: 1. Measure the value of high direct current voltages , high alternating current voltages , impulse voltage and current after generation. 2. Examine the power system equipment like insulators, bushings, isolators and circuit breakers for their breakdown strength. 3. Explain the various methods which causes breakdown in liquid dielectric medium and their importance in power system protection. 4. Illustrate the process which decreases the breakdown strength of solid insulating mediums and their application in power system. 5. Discuss different phenomenon which leads to break down of gas insulation medium and specify the particular gas any power system apparatus. 6. Study of off-grid solar inverter with battery charging controller. 7. Understand the role of solar energy in the context of regional and global energy system, its economic, social and environmental connotations, and the impact of technology on a local and global context. 8. Understand the physical principles of the photovoltaic (PV) solar cell and what its sources of losses are. 9. Draw and analysis of maximum power point tracker using Perturb and observe algorithm using digital simulation. 10. Study of characteristics and determination of parameters of solar cell using digital simulation.								
LIST OF EXPERIMENTS								
Expt. 1	GENERATION OF AC HIGH VOLTAGES							
Study of generation of high AC voltages using cascaded transformers.								
Expt. 2	VERIFICATION OF BREAKDOWN POTENTIAL OF AIR AT SPECIFIED GAP							
Verification of breakdown potential with reference to empirical formula.								

Expt. 3	DETERMINATION OF BREAKDOWN VOLTAGE OF AIR BY ROD GAP APPARATUS
Determination of breakdown voltage of atmospheric air using rod gap apparatus.	
Expt. 4	DETERMINATION OF BREAKDOWN VOLTAGE OF AIR USING SPHERE GAP APPARATUS
Determination of breakdown voltage of atmospheric air using sphere gap apparatus.	
Expt. 5	DETERMINATION OF BREAKDOWN VOLTAGE OF SOLID INSULATOR
Determination of breakdown of solid insulators such as paper, thermocol and glass.	
Expt. 6	DETERMINATION OF BREAKDOWN VOLTAGE OF LIQUID INSULATOR
Determination of breakdown of liquid insulator using oil insulation tester.	
Expt. 7	CHARACTERISTICS OF SOLAR PANEL
Determination of IV characteristics of solar panel and calculation of equivalent circuit parameters of a PV array in PACAD.	
Expt. 8	SOLAR INVERTER
Study of off-grid solar inverter with battery charging controller.	
Expt. 9	EFFECT OF SHADING ON SOLAR PANEL PERFORMANCE
Study of <ul style="list-style-type: none"> a) Series parallel connections of solar panels and effect of shading. b) Improvement in power efficiency of photovoltaic array under shading conditions using bypass diode with PSCAD. 	
Expt. 10	EFFECT OF TEMPERATURE AND TILT ANGLE ON SOLAR PANEL
Study of effect of surrounding temperature and tilt angle on the performance solar PV panel.	
Expt. 11	DESIGN OF SOLAR PANEL
Study of solar panel manufacturing using solar cells by interconnecting them to get desired voltage and power rating.	
Expt. 12	DATA ACQUISITION USING DIGITAL SIMULATION
Data acquisition using temperature, voltage and irradiation with sensors of solar panel using digital simulation.	
Expt. 13	MAXIMUM POWER POINT TRACKER USING DIGITAL SIMULATION / PSCAD
<ul style="list-style-type: none"> a) Implementation of maximum power point tracker using Perturb and observe algorithm using digital simulation. b) Determine the mathematical model of PV cell, ensure MPPT algorithm using PSCAD. 	
Expt. 14	DETERMINATION OF PARAMETERS OF SOLAR CELL USING DIGITAL SIMULATION
Study of characteristics and determination of parameters of solar cell using digital simulation.	

Text Books:

1. S Naidu, V Kamaraju, "High Voltage Engineering", Tata McGraw-Hill, 5th Edition, 2013.
2. S P Sukhatme, J K Nayak., "Solar Energy", Tata McGraw-Hill Education Private Limited, New Delhi 1st Edition, 2010..
3. Subir Ray, "An Introduction to High Voltage Engineering", PHI Learning Private Limited, New Delhi, 2nd Edition, 2013

Reference Books:

1. L L Alston, "High Voltage Technology", Oxford University Press, 1st Indian Edition, 2011.
2. C L Wadhwa, "High Voltage Engineering", New Age International Publishers, 3rd Edition, 2010
3. E Kuffel, W S Zaengl, J Kuffel, "High voltage Engineering fundamentals", Newnes, 2nd Edition
4. Elsevier, New Delhi, 2005.
5. Mukund R. Patel, "Wind and Solar Power Systems: Design, Analysis, and Operation", 2nd Edition, CRC, 2005.