DESIGN OF PV SYSTEMS

Course Code	23EE4702C	Year	IV	Semester	I
Course Category	Professional Elective-V	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Electrical Circuit Analysis, Power Systems, Renewable Energy Resources.
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the fundamentals of solar radiation, photovoltaic cell technologies, system components, design principles, and installation practices of PV systems. (L2)
CO2	**Analyze** solar radiation data and photovoltaic cell types, operation, characteristics, and MPPT techniques to evaluate site suitability and performance of PV systems. (L4)
CO3	**Select** appropriate PV modules, balance of system components, and storage options for different photovoltaic system applications. (L3)
CO4	**Analyze** load requirements and sizing of standalone, grid-connected, and hybrid PV systems including sizing of array, battery, and inverter. (L4)
CO5	**Apply** standards and practices for the installation, testing, maintenance, and economic evaluation of PV systems. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2										2	
CO2	3	3	3								2	3	
CO3	3		2								2	3	
CO4	3	3	3	2	2						2	3	2
CO5	2		2	2	2	2					2	2	2

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Solar Energy Basics:**	**CO1**

	Solar radiation – Extraterrestrial and terrestrial, Solar geometry – Declination, altitude angle, hour angle, air mass Radiation measurement and estimation, Effect of tilt angle on radiation, Overview of solar energy conversion technologies, Introduction to PV effect and materials used	**CO2**
II	**Solar Photovoltaic Cell Technologies** Types of solar cells: Crystalline silicon, thin-film, multi-junction, emerging technologies, Cell structure and working principle, I-V characteristics of solar cells – Effect of irradiance and temperature, Efficiency, fill factor, and performance parameters, Maximum Power Point Tracking (MPPT) – Algorithms and techniques	**CO1** **CO2**
III	**PV Module and System Components** PV module characteristics and rating, Module interconnections – Series and parallel configurations, Balance of System (BoS): Batteries, charge controllers, inverters, protection devices PV system configurations: Standalone, grid-connected, hybrid Energy storage options-– Battery types and characteristics	**CO1** **CO3**
IV	**PV System Design** Load estimation and energy requirement analysis-Sizing of PV array, battery bank, and inverter-Shadow analysis and tilt optimization -Wiring, cabling, earthing, and protection design-Simulation tools (e.g., PVsyst, HOMER, SAM) – Basic introduction	**CO1** **CO4**
V	**Installation, Operation & Maintenance** Installation guidelines and standards (e.g., MNRE, IEC codes)-Testing, Commissioning, and troubleshooting of PV systems Maintenance strategies and fault diagnostics-Performance evaluation and economic analysis (Payback period, LCOE)-Environmental and safety considerations	**CO1** **CO5**

Learning Resources
Textbooks:
1. Chetan Singh Solanki, 'Solar Photovoltaics: Fundamentals, Technologies and Applications', PHI Learning, 3rd Edition (or latest). 2. James P. Dunlop, 'Photovoltaic Systems', American Technical Publishers.
Reference Books:
1. Mohanlal Kolhe, Pradip Bansal, T. K. Mallick, 'Design and Installation of Photovoltaic Systems', Springer. 2. John A. Duffie and William A. Beckman, 'Solar Engineering of Thermal Processes', Wiley. 3. B.H. Khan, 'Renewable Energy Systems', McGraw Hill Education. 4. S.P. Sukhatme and J.K. Nayak, 'Solar Energy: Principles of Thermal Collection and Storage', Tata McGraw Hill.