Vidya Pratishthan's Kamalnayan Bajaj Institute of Engineering and Technology, Baramati.

Faculty of Science and Technology

Board of Studies

Electrical Engineering

Syllabus

Multidisciplinary Minor (MDM)

(Pattern: 2024)

(w.e.f. AY: 2025-26)

Syllabus: Multidisciplinary Minor courses offered by Electrical Engineering Departement Pattern (2024) w.e.f. AY:2024-2025																
SEMESTER-III, IV, V, VI, VII																
Course Code	NEP Category	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	Activity	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
EL24051	MDM	Photovoltaic Technology and Solar Power System	3	2	-	10	30	60	30			130	3	1	-	4

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VPKBIET BARAMATI
Affiliated to
S.P.P.U. Pune
Id No./PU/PN/
Engg/152/2000
PUNE (MS.)

EL24051 : Photovoltaic Technology and Solar Power Systems		
Teaching Scheme:	**Credits:04**	**Examination Scheme**
TH: 03 Hrs/Week		**Course Activity: 10 Marks**
PR: 02 Hrs/Week		**In-Semester Exam: 30 Marks**
		End-Semester Exam: 60 Marks
		Term Work: 30 Marks

Prerequisite Courses:

Knowledge of fundamentals of Engineering Physics, basics of Electrical Engineering and Engineering Chemistry.

Course Objectives:

1. To summarize concept of solar cell, its connections and solar PV Technology
2. To understand the concepts related to solar thermal energy and its applications
3. To study designing of PV system
4. To study different power converters, charge controller, MPPT and inverter required in solar technology
5. To understand types, and components of solar hybrid systems (Diesel-PV, Battery-PV, Wind-PV, Fuel cell-PV)
6. To study emerging technologies, ongoing research, and future directions in Solar technology

Course Outcomes

On completion of the course, learner will be able to:

CO-1: Explain the concept of solar cell structure, solar electric power generation and PV technology

CO-2: Understand the solar thermal energy conversion and associated applications

CO-3: Understand the designing of standalone and grid connected PV system

CO-4: Explain the working principle of maximum power tracking and power electronics interface.

CO-5: Understand the different types of Solar hybrid energy systems and their configurations.

CO-6: Explain the future trends and innovations in Solar Energy Systems.

Course Contents

Unit I: Solar Photovoltaic Energy **(7 Hrs)**

Overview of global and Indian energy scenario, need of solar energy, basics of p-n junction, p-n junction exposure to light, photovoltaic cell/module/array characteristics, effects of light intensity and temperature variations, solar cell connecting arrangements, solar electric power generation, conversion efficiency and power output, fill factor, PV applications (domestic loads, battery storage and irrigation)

Unit II: Solar Thermal Energy **(6 Hrs)**

Introduction, solar thermal energy storage systems, fundamentals of thermal collectors, flat plate collectors, analysis of liquid flat plate solar collectors (LFPC), concentrating collectors (parabolic and paraboloid), solar air heaters, solar pond, solar cooker, solar thermal application in power production (stand alone and grid), advances in solar thermal collectors

Unit III: PV System Design **(6 Hrs)**

Different thin film PV technologies, solar energy measuring instruments, Standalone PV system: Components and design of standalone system, fundamentals of battery system, Grid connected PV system: components and design of grid connected PV systems

Unit IV: Power Electronics Interface for Solar PV **(7 Hrs)**

Power MOSFET and IGBT, buck Converter, boost converter, fly back Converter, inverters, DC to DC converter, AC to DC Converter, battery charge controller, maximum power point tracking algorithms.

Unit V: Solar Hybrid Energy Systems **(7 Hrs)**

Need for Solar hybrid energy systems, types, and components of solar hybrid systems (Diesel-PV, Battery-PV, Wind-PV, Fuel cell-PV), limitations of solar hybrid systems, Case Studies, and Practical Applications

Unit VI: Future Trends and Innovations in Solar Energy **(7 Hrs)**

Integration of solar energy with IoT and AI for optimized performance, Advances in solar energy storage (batteries, thermal storage), Emerging photovoltaic technologies, Cyber Security in Solar powered smart grids and microgrids, Environmental and policy trends driving solar adoption Challenges and opportunities for large-scale solar deployment.

Books & Other Resources:

Text Books:

1. Non-conventional Sources of Energy , G.D Rai, Khanna Publishers, Delhi -2008

2. Solar Power Hand Book, Dr. H. Naganagouda (2014)
3. Chetan Singh Solanki, "Solar Photovoltaics: Fundamental, Technologies and applications", 2nd Edition, PHI Learning Pvt. Limited, New Delhi, 2011.
4. Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Signal K.C New Arrivals –PHI; 2 Edition (2011)
5. A Text book of Power System Engineering, A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, Dhanpat Rai Publication

Reference Books:

1. Renewable Energy Technologies; A Practical Guide for Beginners
2. S. P. Sukhatme, "Solar Energy - Principles of thermal collection and storage", TMH, 2008
3. NPTEL Solar Photovoltaics: Fundamental Technology and Applications by Prof. SoumitraSatapathi Department of Physics Indian Institute of Technology-Roorkee.

Guidelines for Laboratory - Term work Assessment:

1. The distribution of weightage of term work marks should be informed to students before the start of the semester.
2. Term work assessment should be on a continuous basis. At frequent intervals students are expected to inform about their progress/lagging.

Guidelines for Laboratory Conduction:

1. DO's and DON'TS, along with precautions, are needed to be displayed at prominent locations in the laboratory.
2. Students should be informed about DO'S and DON'T and precautions before performing.

Guidelines for Students Lab Journal:

The Student's Lab Journal should contain following related to every experiment

1. Theory related to the experiment.
2. Apparatus with their detailed specifications.

3. Connection diagram /circuit diagram.
4. Observation table/ simulation waveforms.
5. Sample calculations for one/two readings.
6. Result table.
7. Graph and Conclusions.
8. There should be continuous assessment for the TW.
9. Assessment must be based on understanding of theory, attentiveness during practical, understanding Session, how efficiently the student is able to make connections and get the results, and timely submission of journals.

LIST OF PRACTICALS (Any 08 to be performed by the student)

1. To plot Static VI characteristic of SCR / GTO
2. To plot Static VI characteristic of TRIAC
3. To study and measure Voc and Isc of a Solar PV Panel
4. To obtain I-V and P-V characteristics of PV modules: for single PV module
5. To obtain I-V and P-V characteristics of PV modules: for series connection of PV modules
6. To obtain I-V and P-V characteristics of PV modules: for parallel connection of PV modules.
7. To observe the I-V and P-V curve of a solar cell/module with different light intensities
8. To observe the I-V and P-V curve of a solar cell/module with different operating temperatures
9. To design PV system for residential and commercial applications
10. To develop MATLAB simulation model of Perturb & Observe MPPT algorithm for a PV panel connected with DC-DC Boost converter through a resistive load.
11. To develop MATLAB simulation model of Incremental conductance MPPT algorithm for a PV panel connected with DC-DC Boost converter through a resistive load.
12. To design Solar PV system for Department Laboratory.

NOTE: The list of experiments is not limited to the above, but a course coordinator may design few new experiments based on recent technologies/trends in the relevant Engineering Domain. However, the course coordinatorneeds to get approval by the Program Assessment Committee and Chairman BOS/HOD well in time.

Course Activity (Any one of the following)

For the assessment of course activity students must complete at least ONE activity out of the following:

1. Design of residential/commercial solar PV System
2. Power Point Presentation on recent trends in solar technology

Mr. Rohit S. Tarade	Mr. A. V. Golande	Mr. S. K. Raskar
PAC member 1	PAC member 2	PAC member 3