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

Faculty of Science & Technology

Board of Studies

Electrical Engineering

Honor Degree in

Renewable Energy and E Mobility

(Pattern: 2024)

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

Syllabus: Honor Degree in Renewable Energy and E Mobility (BoS: Department of Electrical Engineering)
2024 Pattern w.e.f. AY:2025-2026

Course Code	NEP Category	Sem	Courses Name	Teaching Scheme			Examination Scheme and Marks							Credits			
				TH	PR	TUT	Activity	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
EL24281	HON	III	Solar Thermal and PV system	2	2	-	10		60	30			100	2	1	-	3
EL24291	HON	IV	Hybrid and Electric Vehicle	2	2	-	10		60	30			100	2	1	-	3
EL24381	HON	V	Energy storage system for EV	3	2	-	10	30	60	30			130	3	1	-	4
EL24391	HON	VI	Electrical Machines and Drives for EV	3	2	-	10	30	60	30			130	3	1	-	4
EL24481	HON	VII	Standalone and Grid connected PV systems	3	2	-	10	30	60	30			130	3	1	-	4
Total				13	10	0	50	90	300	150	0	0	590	13	5	0	18

Mrs. I.S. Kulkarni
Dept. Autonomy Coordinator
Electrical Engg Dept.

Mrs. S. D. Rokade
Dept. Academic Coordinator
Electrical Engg Dept.

Mrs. P. N. Jaiswal
Head
Electrical Engg Dept.

Dr. C. B. Nayak
Dean Autonomy
VPKBIET, Baramati

Dr. S. M. Bhosle
Dean Academics
VPKBIET, Baramati

Dr. S. B. Lande
Principal
VPKBIET, Baramati

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

Principal
Vidya Pratishthan's
Kamalnayan Bajaj Institute of
Engineering & Technology, Baramati
Vidyanagari, Baramati-413133

EL24281: Solar Thermal and PV system		
Teaching Scheme: **TH: 02 Hrs/Week** **PR: 02 Hrs/Week**	**Credits:03**	**Examination Scheme:** **Course Activity: 10 Mar** **End-Semester Exam: 60 Marks** **Term Work Exam: 30 Marks**

Prerequisite Courses:

Knowledge of fundamentals of Engineering Physics and Engineering Chemistry.

Course Objectives: provide

1. To understand the concepts of solar energy.
2. To understand the fundamental principles and application of the solar thermal system.
3. To understand the concepts of solar PV Technology.
4. To study the various components of PV systems.

Course Outcomes

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

CO-1: Discuss the principles of solar radiation, energy conversion, and solar thermal System.

CO-2: Explain the fundamental principles and application of the solar thermal system.

CO-3: Define the concepts of solar PV Technology.

CO-4: Explain components of Solar PV Systems.

Course Contents

Unit I: Introduction to Solar Energy **(7 Hrs)**

Scenario of solar energy in India, Solar Radiation: Basics of Solar Radiation, instruments for measuring solar radiation, Basics of heat transfer absorption, reflection and transmission of radiation , solar radiation geometry, empirical equations, solar radiation on tilted surfaces. Estimation of solar radiation under different climatic conditions, solar energy conversion

Unit II: Solar Thermal System **(7 Hrs)**

Solar Collectors: Types of solar collectors, Flat-Plate Collectors, Evacuated Tube Collectors, Parabolic Trough Collectors, Parabolic Dish Collectors, Fresnel Reflectors, Concentrating Linear Fresnel Reflectors (CLFR) working principles. Types of Solar thermal systems Basic design of different types of systems, Applications of solar thermal systems and their economics . Control systems for solar tracking Concentrating solar thermal (CSP).

Unit III : Solar Photovoltaic technology **(7 Hrs)**

Photovoltaic effect and its significance, Basic structure of a solar PV cell, Types of solar PV cells, I-V characteristics of a solar cell, Power-voltage (P-V) and current-voltage (I-V) curves, Efficiency of solar PV cells and its measurement. Solar PV Module, Rating of Solar PV Module, its connections and efficiency , Measuring Module Parameters, arrangements of array according to the voltage.

Unit IV: Solar PV System **(6 Hrs)**

PV arrays, inverters, charge controllers, batteries, Site selection Factors affecting performance on solar PV systems, and shading analysis, Basics of load estimation, energy consumption analysis, and sizing of PV systems.

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. A Text book of Power System Engineering, A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, Dhanpat Rai Publication

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 study the current status, growth trends, and potential of solar energy in India
2. To prepare solar survey report for the installation of a photovoltaic (PV) system based on Site Selection Criteria, Solar Resource Assessment, Shading Analysis, Load Assessment and Energy Demand Analysis, PV System Sizing and Design Considerations.
3. To obtain I-V and P-V characteristics of PV modules for single PV module.
4. To obtain I-V and P-V characteristics of PV modules: for series and parallel connection of PV modules.
5. To observe the I-V and P-V curve of a solar cell/module with different operating temperatures.
6. To plot I-V and P-V characteristics of the Solar cell and PV array in Matlab Simulink.

7. To calculate load estimation based on electricity bill.
8. To draw a preview of solar system installation using Sketchup.
9. To design solar PV system for residential / commercial consumer.
10. To survey various apps for solar installation, operation and maintenance.
11. To study of Various Types of Photovoltaic (PV) Cells and Their Characteristics.
12. To study solar PV success story / case study.

Suggested Industrial Visit to a Solar PV Plant / Solar System Industry – Study of Installation, Operation, and Performance.

Course Activity (Any one of the following) :

1. MCQ Test.
2. Survey on solar system installation schemes .

Mrs. Pooja N. Jaswal
PAC Member 1

Mr. R. S. Tarade
PAC Member 2

Mr. S. K. Raskar
PAC Member 3

VPKBIET BARAMATI
PUNE (MS)

EL24291: Hybrid & Electrical vehicles		
Teaching Scheme: **TH: 02 Hrs/Week** **PR: 02 Hrs/Week**	**Credits:03**	**Examination Scheme:** **Course Activity: 10 Marks** **In-Semester Exam: 30 Marks** **End-Semester Exam: 60 Marks** **Term work: 30 Marks**

Prerequisite Courses:

Basic Electrical Engineering and Energy and EV Technology

Course Objectives:

1. To understand the basic working and characteristic performance of Electric and Hybrid vehicles.
2. To study and understand the basic functioning of both Electric and Hybrid vehicles and the drivetrain topologies.
3. To understand the different concepts of charging related to both Electric and Hybrid vehicles operation & energy management.
4. To design different battery components in consideration with issues of Electric and Hybrid vehicles.

Course Outcomes

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

CO-1: Get a good understanding of the basic functioning of both Electric and Hybrid vehicles and their performance

CO-2: To understand the fundamentals of chargers related to both electric & hybrid vehicle operation & energy management.

CO-3: To understand electric propulsion systems, types of motors and the other important subsystems in Electric vehicles.

CO-4: To design various components in Electric and Hybrid vehicles with design considerations.

Course Contents

Unit 1:Introduction & Architecture of EV **(07 Hrs.)**

A] Introduction To EV: (03 Hrs.)

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, Classification of EV.

B] Architecture Of HEV: (04 Hrs.)

Series HEV, Parallel HEV and Series-Parallel HEV, Power flow control in hybrid drive train topologies: Series hybrid drivetrain, Parallel hybrid drivetrain and Series-Parallel hybrid drivetrain.

Unit 2: Plug-In Hybrid Electric Vehicles & Fundamentals of Chargers (07 Hrs.)

A] Plug-In Hybrid Electric Vehicles: (04 Hrs.) Introduction, Functions and Benefits of PHEV, Operating Principles of Plug- in Hybrid Vehicle: Charge-Depleting Mode, Charge Sustaining Mode, AER Mode, Engine-Maintenance Mode, Control Strategy of PHEV, PHEV-Related Technologies and Challenges

B] Fundamentals of Chargers: (03 Hrs.)

Charger Classification and Standards, Charger Requirements, Topology Selection for Level 1 and 2 AC Chargers: Front-End AC–DC Converter Topologies, Isolated DC–DC Converter Topologies, Wireless Chargers.

Unit 3 :Electric Propulsion Systems & motor drives (07 Hrs.)

A] Electric Propulsion Systems: (04 Hrs.)

Introduction to electric components used in HEV's, DC motor drives: Combined armature and Field control method, Chopper control DC drives, Multi quadrant control of Chopper fed DC drive.

B] Permanent Magnet BLDC & SRM Motor Drives: (04 Hrs.)

Closed loop Torque control of BLDC motor drive and sensor less Control of BLDC Motor drive using Back EMF method, Switched Reluctance Motor drives: basic magnetic structure, modes of operation, different inverter topologies of SRM drives.

Unit 4 : Components & Design Considerations of EV & HEV: (06 Hrs.)

Design parameters of batteries, ultra-capacitors and fuel cells, aerodynamic considerations, calculation of the rolling resistance and the grade resistance, calculation of the acceleration force, total tractive effort, torque required on the drive wheel, transmission efficiency, consideration of vehicle mass, electric vehicle chassis & body design, general issues in design, specifications and sizing of components.

Books & Other Resources:

Text Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.

2. Ali Emadi, "Advanced Electrical Hybrid Vehicles" CRC Press, 2015, Taylor & Francis Group.

3. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.

Reference Books:

1.T. Denton, "Electric and Hybrid Vehicles", Routledge,2016.

2.S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies",Springer, 2015.

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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. Study of fundamentals of Electric Vehicle.
2. MATLAB simulation study of a SOC control of lithium-ion battery.
3. MATLAB simulation study of a battery protection.
4. MATLAB simulation study of a BMS.
5. MATLAB simulation study of a BMS for passive cell balancing.
6. MATLAB simulation study of a battery controller based on SOC for charging of EV charging.
7. MATLAB simulation study of a battery controller based on SOC for charging of EV discharging.
8. Study of discharging characteristic of BMS.
9. Study of charging characteristic of BMS.
10. Study of cell balancing phenomenon of BMS.
11. MATLAB simulation study of a battery pack with cell balancing circuits in Simscape.
12. MATLAB simulation study of battery passive cell balancing to plot SOC.
13. MATLAB Simulation study of PEM Electrolysis System.
14. MATLAB simulation study of PEM fuel cell system.

Note:

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

Course Activity (Any one of the following) :

1. Concept test
2. PowerPoint presentation

Mrs.V.V.Deokate	Mrs.P.N.Jaiswal	Mr.P.D. Upadhye
PAC Member 1	PAC Member 2	PAC Member 3