INSTITUTE	**FACULTY OF TECHNOLOGY**
PROGRAM	**MASTER OF TECHNOLOGY in ELECTRICAL ENGINEERING**
SEMESTER	**2**
COURSE TITLE	**POWER ELECTRONIC ENERGY CONVERSION FOR SUSTAINABLE ENERGY SYSTEMS**
COURSE CODE	**01PE1204**
COURSE CREDITS	**4**

Objective:

1 The course is designed to impart knowledge related to power electronic converters employed in interface of distributed energy resources in sustainable energy systems.

Course Outcomes: After completion of this course, student will be able to:

1 Interface photovoltaic cell with power electronic converter.
2 Design converters for Wind power energy.
3 Apply DFIG for harvesting energy from wind sources
4 Fuel Cell Modelling for Integration with Power Electronics

Pre-requisite of course: Power Electronics, Electrical Machine, Alternative energy sources.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Fundamentals of Power Electronics** Power Semiconductor Devices, Electronic switches capable of handling high voltage,, Power Electronic Converter Topologies, Control of Power Converters	6
2	**Photovoltaic Power Electronics** PV Energy Basics, Power Curves, Determination of PV Panel Parameters,, Temperature Effects, Parameters of PV Cell Associations,, PV System Configurations, Power Electronic Topologies in PV Systems,, Recent Developments in Multilevel Inverter-Based PV Systems,, Grid- Connected PV System Configurations, Maximum Power Point Tracking	10

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Contents : Unit	Topics	Contact Hours
3	**Wind Power Generation** Wind Energy Basics, Power Electronics for Wind Power, Power Converters for Wind Turbines,, Controls for Power Electronics for Wind Power, AC Voltage Controllers, Interleaved Boost Converters,, Two-Level Voltage-Source Converters, Three-Level Neutral Point Clamped Converters,, Three- Level Neutral Point Clamped Converters, PWM Current Source Converters,, Control of Grid-Connected Inverter, Emerging Reliability Issues for Wind Power System	10
4	**Doubly Fed Induction Generator Based WECS** Introduction, Super-and Sub synchronous Operation of DFIG,, Unity Power Factor Operation of DFIG, Leading and Lagging Power Factor Operation,, Stator Voltage Oriented Control of DFIG WECS, DFIG WECS Start-Up and Experiments	8
5	**Fuel Cell System** Fuel Cell Basics, Power Characteristics,, Fuel Cell Modeling for Integration with Power Electronics Controls,, Power Electronic Converter for Fuel Cell, Soft-Switching Topologies	8
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment No. 01** Simulate a wind energy conversion system with maximum power point tracking.	2
2	**Experiment No. 02** To Simulate Maximum Power Point Tracking (MPPT) for Solar Power Systems	2
3	**Experiment No. 03** Inverter Design for Grid-Connected Solar Systems	2
4	**Experiment No. 04** Model a wind turbine generator and study its output under different wind speeds.	2
5	**Experiment No. 05** Simulate the correction for boost converer of the power factor under varying load conditions.	2
6	**Experiment No. 06** To study the design of a battery energy storage system (BESS) using power electronics for energy storage and release.	2
7	**Experiment No. 07** To design and test a grid-tied inverter that allows energy storage and conversion in a microgrid system.	4

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
8	**Experiment No. 08** o implement an AC-DC converter for wind energy systems to convert variable AC from wind generators into stable DC power for storage or further conversion.	4
Total Hours		**20**

Textbook :

1 Power Electronics for Renewable Energy Systems, Transportation And Industrial Applications, Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-Haddad, WILEY publication., NA

2 Power Conversion and Control of Wind Energy Systems, Bin Wu,Yongqiang Lang, Navid Zargari, Wiley Publication, NA

3 Power Electronics for Renewable and Distributed Energy Systems, Sudipta Chakraborty, Marcelo G. Simões William E. Kramer,, Springer, NA

References:

1 Power Conversion of Renewable Energy, Power Conversion of Renewable Energy, Ewald F. Fuchs, Mohammad A.S.Masoum, Springer, -

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
5.00	10.00	15.00	30.00	20.00	20.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and classroom.

3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

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Supplementary Resources:

1. https://elearn.nptel.ac.in/shop/iit-workshops/ongoing/modeling-and-digital-implementation-of-power-electronic-converters-for-renewable-applications/?v=c86ee0d9d7ed
2. https://onlinecourses.nptel.ac.in/noc23_ee127/preview
3. https://onlinecourses.nptel.ac.in/noc22_ee33/preview

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