Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	AY2024-2025
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Tang Yi
Course Author Email	yitang@ntu.edu.sg
Course Title	Design of Clean Energy Systems
Course Code	EE4524
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	Before AY2021-22 Sem2: EE3010 Electrical Devices & Machines and EE3015 Power Systems & Conversion, AY2021-22 Sem2 and onwards EE3010 Electrical Devices & Machines and EE3015 Power Systems & Conversion or EE2005 Electrical Devices & Machines and EE3015 Power Systems & Conversion
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	EE4504 Design of Clean Energy Systems
Remarks (if any)	

Course Aims

The main objective of this design course is to familiarize the students with engineering design and analysis techniques for two most popular clean energy systems. The course consists of two modules namely, (i) Design of Wind Energy Systems and (ii) Design of Solar Photovoltaic Systems. As an active learner, one is expected to learn how to Develop Models of typical wind & solar circuit systems based on a given power rating. It starts from modelling of source to Converters, to some typical loads. Having developed the model, one is expected to study it for Power flow, component rating, Efficiency etc. and compare them to existing commercial systems.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Explain the types of Renewable Energies, sources and their applications.
ILO 2	Study the nature of Renewable Energies through modeling.
ILO 3	Explain the role of power converters in changing their forms. This includes AC-DC controlled/uncontrolled converters, DC-DC converters with energy storage, DC-AC inverters with PWM technique for energy efficiency & reduced harmonics.
ILO 4	Interpret various performance parameters used to assess the success of renewable energy applications.
ILO 5	Design, implement and demonstrate a real-time renewable energy system.

Course Content

Clean and renewable energy sources. Wind energy turbines and systems. Solar photovoltaic devices and systems. System-level designs. Analytical design and analysis. Modeling and simulation. Hands-on sessions using commercial software. Comprehensive case studies on wind and solar energy systems.

Reading and References (if applicable)

TEXTBOOKS

1. Simões Marcelo Godoy and Farret Felix A, Renewable Energy Systems – Design and Analysis with Induction Generators, 2nd Edition, CRC Press, 2007. (TJ808.S593 2007)
2. Green M A, Third Generation Photovoltaics Advanced Solar Energy Conversion, Springer, 2006. (TK8322.G797 & e-book)

REFERENCE

1. Thomas Ackemann, Wind Power in Power Systems, 2nd Edition, John Wiley, 2013. (TK1541.W763 2012)

Note: The above listing comprises the foundational readings for the course and more up-to-date relevant readings will be provided when they become available.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Introduction of renewable generation systems	1,2	Lecture Notes	In-person	1 Design lecture + 2 Design practical
2	Key Components of a Wind Power Conversion System & Introduction of PLECS	1,2	Lecture Notes	In-person	1 Design lecture + 2 Design practical
3	Steady-State Analysis of Power Converters	3,4	Lecture Notes	In-person	1 Design lecture + 2 Design practical
4	Modelling and Control of Power Converters	3,4	Lecture Notes	In-person	1 Design lecture + 2 Design practical
5	Analysis of Three-Phase DC/AC Inverters	3,4	Lecture Notes	In-person	1 Design lecture + 2 Design practical
6	Modelling and Control of Three-Phase DC/AC Inverters	3,4	Lecture Notes	In-person	1 Design lecture + 2 Design practical
7	Design of Three-Phase Back-to-Back AC/DC/AC Power Converters for Wind Power Generation	3,4	NIL	In-person	1 Design lecture + 2 Design practical

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
8	Study & Modeling of Solar panel systems (SPS)	3,4	Lecture Notes	In-person	1 Design lecture + 2 Design Practical
9	Design of DC-DC converters, MPPT circuits	3,4	NIL	In-person	1 Design lecture + 2 Design practical
10	Design of Maximum power point circuits (MPPT)	3,4	NIL	In-person	1 Design lecture + 2 Design practical
11	Integration of MPPT to SPS and Max. power Extraction	3,4	Lecture Notes	In-person	1 Design lecture + 2 Design Practical
12	Design & modeling of a Lead acid Battery	3,4	NIL	In-person	1 Design lecture + 2 Design practical
13	Integration of the entire system & Battery Charging operation Through SPS & MPPT	3,4,5	Lecture Notes	In-person	1 Design lecture + 2 Design practical

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Course materials covering all topics.
Laboratory	Classroom discussions and Hands-on exercises on related topics.
Tutorial	NA

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Final exam(Final Examination)	1,2,3,4	EAB SLO* (a), (b), (c), (d)	50	Individual	Analytic	Multistructural
2	Continuous Assessment (CA): Project(CA2: Computation Laboratory Project)	1,2,3,4,5	EAB SLO* (a), (b), (c), (d), (e), (j), (l)	50	Individual	Analytic	Multistructural

Description of Assessment Components (if applicable)

The project comprises of designing a wind power or solar photovoltaic generation system using PLECS circuit simulation tool.

Formative Feedback

Examination results; Design report (CA); CA scores and answers through NTU Learn. Markers' report on overall examination performance.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Care for Environment	Basic
Care for Society	Basic
Collaboration	Intermediate
Creative Thinking	Intermediate
Problem Solving	Intermediate

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are expected to complete all online activities and take all scheduled assignments and tests by due dates if any. You are expected to take responsibility to follow up with course notes, assignments and course related announcements. You are expected to participate in all laboratory discussions and activities.

Policy (Absenteeism)

Hands on activities in laboratories make up a significant portion of your course grade. Absence from continuous assessments and laboratories without officially approved leave will result in no marks and affect your overall course grade.

Policy (Others, if applicable)

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