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## 2<sup>nd</sup> Day Symposium - 22<sup>nd</sup> Sept 2021

**Topic: Renewable energy technologies and decentralization  
of energy production**

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# Course description

Code	Title
PH 2211	Renewable energy technologies and decentralization of electricity
University	
The University of Dodoma	
Faculty	Department
CNMS	Physics
Year of delivery	Semester
2	2
ECTS/Credits	Language
9.0	English
<p><b>The final grade of the student depends on the following metrics:</b>  <b>Course Work: Test, quizzes and assignments (40 %)</b>  <b>Final Exam: (60%)</b></p>	



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# Course description

- This course gives a strong understanding of the renewable energy and technologies by highlighting the working principles of solar PV and thermal, hydro, biomass, wind as well as other renewable energy sources that are available in Tanzania.
- It appreciate of the local context in relation to the renewable energies, reflecting on the current status and intended future projects will be handled , giving an understanding of the available resources and energy production phase.
- It focuses on power systems, their operation and control and particularly to the integration and distribution of renewable energy grid or stand-alone decentralized systems (mini grids) applications in Tanzania.



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## Course description Contin.....

- The content emphasize on technical aspects of traditional and renewable electrical power generation, power transmission and distribution, power network stability, management and control, electricity market operations and smart grid technologies
- A solid basis in understanding of future power networks with distributed generation, storage and smart grid technology are given.



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# Knowledge Expected

**At the end of the course, students should be able to:**

- Understand the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels;
- Demonstrate the process of generation/conversion of renewable energy;
- Examine the various types of renewable technologies;
- Design basic concept of renewable energy plants;
- Discuss how energy efficiency can be enhanced;
- Understand the meaning of decentralization and how it relates to Electricity;



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# Applying knowledge and understanding

**At the end of the course, students should be able to:**

- Estimate the potential and availability of the different renewable energy sources;
- Identify the main components for a renewable energy plant;
- design a renewable energy plant for specific energy needs, sizing components, calculated the production of energy, simulate the operation;
- Estimate the costs and the break even point of the investment;
- Apply the national regulation, norms and incentives.



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# Making Judgements

**At the end of the course, students should be able to:**

- Compare the different forms of renewable energy and non-renewable energy sources;
- Exam the environmental implications of the different forms of energy;
- Determine the different models of energy generation from different energy resources.



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# EXPECTED LEARNING SKILLS

**At the end of the course, students should be able to:**

- i. Enhance learning skills through application of knowledge attained in case studies, projects work assignments;
- ii. Use platform as Moodle and Google class.





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# Main topics

## 1. Photovoltaic System

Solar radiation, angles, The cell, the photoelectric effect, Photovoltaic cells: Inverter, Grid-Connected and Stand-Alone systems, Switchboards, fuse string diodes, electric connections, Design of Photovoltaic plants, Evaluation of the economical sustainability etc .

## 2. Thermal Solar Collectors

Solar radiation, efficiency, Small systems, Solar collectors, heat accumulators, solar circuit and controllers, Main solutions and configurations for low temperature applications, Medium / high enthalpy plants, Conditioning, Solar Concentrators etc



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# Main topics Cont.....

## **3. Biomass and Bioenergy**

Characterization of biomass, Thermochemical and Biochemical conversion processes, Thermochemical systems, Biochemical systems and biofuels, Urban waste, Drivers of biomass development and application, challenges and barriers, Trends in biomass energy utilisation, Economics of biomass.

## **4. Wind Energy**

Global trends and wind energy potential, Wind source, Theoretical limit of the efficiency, Aerodynamic Theory applied to a blade's section, Components of a wind turbine, Sizing of a wind turbine, Environmental impacts, IEC standard and certification.



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# Main topics Cont.....

## 5. Hydro

The hydro resource in the Countries, exploitation, flow and leap assessment.  
classification of turbines, Classification of Hydro energy plants, Incentives and regulations.

## 6. Geothermal

Steam diagrams, Exploitation of geothermal energy, Classification of geothermal systems, Medium & low enthalpy geothermal systems, Heat pumps. Geothermal probes and type of plants.



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## Equipment available for the Course



1. Solar/wind Training kit



2. A compact solar PV tester  
with I-V curve tracing (kit)



3. Solar simulator

4. A 2KW hybrid power system :1Kw solar +1Kw wind



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# Available Professors/Lectures

<b>S/N</b>	<b>Tipics</b>	<b>Professors/Lectures</b>
1	Photovoltaic System	Adriano Pamain/Bernard Samael
2	Thermal Solar Collectors	Bernard Samael/Adriano Pamain
3	Biomass and Bioenergy	Cephas Lyobha
4	Wind Energy	Godbless Shao
5	Hydro	Adriano Pamain
6	Geothermal	Benatus Mville



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# Teaching books & Literatures

- John Twidell and Tony Weir, *Renewable Energy Resources*, 2<sup>nd</sup> Edition, Taylor & Francis, 2006
- M. A. Green, *Solar Cells: Operating Principles, Technology and system Applications*, Published by the University of New South Wales, 1998.
- D. Y. Goswami, *Principles of Solar Engineering*, Taylor and Francis, 2000.
- S.t Wenham, M. Green, and M. Watt, *Applied Photovoltaics*, Earthscan, 2007
- Jenny Nelson, *The Physics of Solar Cells*. Imperial College Press, 2007.
- Boyle, G (2004) *Renewable Energy - Power for a Sustainable Future*. Oxford University Press.
- Burton, T., Jenkins, N., Sharpe, D., & Bossanyi, E. (2011). *Wind energy handbook*. John Wiley & Sons.
- Johnson, G. L. (2006). *Wind energy systems*. Gary L. Johnson.
- Peter L. Payne, *The Hydro*, Aberdeen University Press (ISBN 0-08-036584-1)
- Johansson, T. B., & Burnham, L. (Eds.). (1993). *Renewable energy: sources for fuels and electricity*. Island press.
- Sathyajith Mathew, *Wind Energy: Fundamentals, Resource Analysis and Economics*, Springer, 2006.



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Thank you