



LANDMARK UNIVERSITY, OMU-ARAN

COURSE COMPACT TEMPLATE

COLLEGE: COLLEGE OF SCIENCE AND ENGINEERING
DEPARTMENT: ELECTRICAL AND INFORMATION ENGINEERING
PROGRAMME: 400 LEVEL
COURSE COMPACT for:

Course

Course code: EIE 416
Course title: Renewable Energy
Credit unit: 2 Units
Course status: Compulsory

Lecturer's Data

Name of the lecturer: Engr. DR. A.A. Esan, FNSE, FNIEEE
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College: College of Science and Engineering
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Consultation Hours: Weekdays, 11AM -4PM

Lecturer's Data

Name of the lecturer: Engr. Diarah Reuben Samuel (MNSE)
Qualifications obtained: B.Eng. R.ENG (COREN)
Department: Electrical and Information Engineering
College: College of Science and Engineering
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Consultation Hours: Weekdays, 10AM – 2PM

INTRODUCTION TO THE COURSE

COURSE CONTENT

Introduction: Definition, Sources Availability, Quantity, Advantages and Disadvantages of: solar, wind, water, Biomass, and Geothermal sources of Energy. Integration, Cost effectiveness, safety, and health hazards. Socio-Economic issues, FGN plans/programs, International collaboration/Networking.

COURSE DESCRIPTION

Renewable Energy is an Engineering course which introduces the students to a non-conventional sources of energy which are regenerative and inexhaustible in nature. The conventional sources which has some negative environmental impact of burning fossil fuel. This course introduces the students to the renewable sources of energy which includes: solar, wind, water, biomass and geothermal.

COURSE JUSTIFICATION

Renewable energy is part of the solution to current energy challenges this because its sources are dependable and are replenished by nature as they are being used as seen in the conversion of electricity from the sunlight through the photovoltaic cells. Renewable energy is the future energy reducing the dependence on fossil fuel and it is environmental friendly.

COURSE OBJECTIVE

At the end of the course the students should be able to

1. Differentiate between conventional and non-conventional sources of energy, its advantages and disadvantages.
2. To explain how Electricity is been generated using the renewable sources.
3. The components of Renewable Energy Systems (RES)
4. To explain the working principles of Renewable Energy Technologies

COURSE REQUIREMENT

To drive maximum benefit from Renewable energy, the students must be familiar with Electromagnetic fields & waves, energy forms, primary energy, secondary energy, physical Electronic, and Electrical Machines.

METHOD OF GRADING

Method of Grading- An example below

S/N	GRADING	SCORE (%)
1.	Continuous Assessments	
	• C.AI	7%
	• C.AII (Mid-Semester Test)	15%
	• C.AIII	8%
2.	Final Examination	70%
3.	Total	100%

COURSE DELIVERY STRATEGIES

- Lectures and active discussion
- Lectures delivery with explanation using lecture notes, real life examples, graphs and diagrams.
- The use of the university's intranet, e-platform for quizzes, assignments, group discussion etc.
- With each module comes a variety of class work to aid students comprehend the concepts discussed.
- Uploading the lecture materials on the e-learning platform
- Giving online assignments
- Having practical discussion sessions and relevant assignments at the end of the lecture.

COURSE DURATION:

2hrs P/Week for 15 weeks (30hrs)

LECTURE CONTENT

Week 1: Solar, Wind, Hydro, Biomass, Geothermal, Ocean; Municipal Waste, Incineration, Nuclear Fusion

❖ Objectives

The students at the end of the lecture for the week should be able to:

- (i) Be familiarized with the basic knowledge of Energy.
- (ii) Differentiate between conventional and non-conventional sources of Energy.
- (iii) Discuss and distinguish between Renewable and non-Renewable sources of Energy and impact on the environment.
- (iv) Discuss and elaborate more on different sources of Energy and their transformation and conversion processes.

❖ **Description**

First hour: Introduction to the basic concept of energy, types and energy resources available.

Second hour: Energy types and sources are then group into Renewable and non-Renewable with detail discussion on solar, wind, hydro, biomass and geothermal. Non-Renewable/ convention sources of Energy are also introduced which includes fossil fuels: coal natural gas etc.

❖ **Study Question:**

1. What are renewable energy resources?
2. Differentiate between Renewable and non-Renewable energy Resources.

❖ **Reading List - Books and materials students can read. Illustration below:**

1. Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
2. Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
3. G15 Project on Solar Energy Application Report of the Meeting of National Focal Point New Delhi, September, 1993.
4. Solar – Powered Electricity – A survey of PV power in Developing Countries by B. McNelis, A Derrick & M. Starr
5. Energy for Rural Development – Bhagavan and Karekezi
6. The Energy Dimension – Christopher Hurst and Andrew Barnett, IT Publications.
7. Burning Issues: Implementing Pilot Stove Programs: A Guide for Eastern Africa by S. Joseph and P. Hassrick.
8. Introduction to Renewable Energy by Nelson, Vaughn
9. Solar Energy: Renewable Energy and the environment by Foster, Robert
10. FGN, Federal Republic of Nigeria, Sustainable Energy for ALL, Action Agenda (SE4ALL), August 2015.
11. FGN, Federal Republic of Nigeria, National Renewable Energy & Energy Efficiency Policy (NREEEP) for Electricity Sector, 2015.
12. Internet Sources.

Week 2: RES mapping for Nigeria

❖ Objectives

The students at the end of the lecture for the week should be able to:

- (i.) Discuss different energy sources and their availability.
- (ii.) Differentiate between conventional and non-conventional sources with examples.
- (iii.) Discuss the process involved in energy conversion.
- (iv.) Discuss and elaborate more on different sources of Energy and their transformation and conversion processes.

❖ Description

First hour: The students will be introduced to conventional and non-conventional energy sources, with detail illustrations of each with examples and their benefits and applications.

Second hour: The availability of conventional and non-conventional energy resources will be discussed in details and its impact on our environment.

❖ Study Question:

- (i.) Differentiate between Renewable and non-Renewable energy Resources.
- (ii.) Discuss in detail the conventional and non-conventional energy sources and their impact on the environment.

❖ Reading List - Books and materials students can read. Illustration below:

- 1) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 3) G15 Project on Solar Energy Application Report of the Meeting of National Focal Point New Delhi, September, 1993.
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Week 3:

- a. Advantages of RES Power Plants.
- b. Energy Requirements and CO₂ emission.

❖ Objectives

The students at the end of the lecture for the week should be able to:

- (i) Be familiarized with the basic knowledge and the quantities of Energy.
- (ii) Differentiate between benefits and applications of renewable sources of Energy.
- (iii) Discuss and distinguish between Renewable and non-Renewable sources of Energy and their availability.

❖ Description

First hour: Introduction to different quantities of renewable energy.

Second hour: Advantages and disadvantages of renewable energy resources

❖ Study Question:

- (i) What are the disadvantages of renewable energy resources?
- (ii) Discuss in details the quantities of different renewable energy available.

❖ Reading List - Books and materials students can read. Illustration below:

- (1.) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- (2.) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- (3.) G15 Project on Solar Energy Application Report of the Meeting of National Focal Point New Delhi, September, 1993.
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- (11.) FGN, Federal Republic of Nigeria, National Renewable Energy & Energy Efficiency Policy (NREEEP) for Electricity Sector, 2015.
- (12.) Internet Sources.

Week 4:

- a. Energy Conversion Methods
- b. Primary to Secondary Energy
- c. Areas of Application

❖ Objectives

The students at the end of the lecture for the week should be able to:

- (i) Explain how sunlight (solar) is used to generate electricity using photo voltaic principle.
- (ii) Discuss the phenomenon behind photo voltaic effect.
- (iii) Explain/Discuss active solar energy system (PV) in our home
- (iv) Know the effect of temperature on a PV system

❖ Description

First hour: Introduction of solar energy and the basic concept of photo voltaic principle.
Second hour: Illustration and explanation of solar voltaic principle and active

❖ Study Question:

- (i) Discuss the principle of photo-voltaic effect in converting sunlight to electricity.
- (ii) List the materials used in the construction of a PV solar panel.
- (iii) List and discuss the processes involved in using direct sunlight to boil hot water

❖ Reading List - Books and materials students can read. Illustration below:

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- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
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- 12) Internet Sources.

Week 5: Energy Conversion Methods

- a. Turbine generation
- b. Direct conversion

❖ Objectives

The students at the end of the lecture for the week should be able to:

- (i) Know the benefits and applications of solar energy as a source of renewable energy.
- (ii) Discuss the uses of direct sunlight (solar thermal) in domestic applications
- (iii) Understand and explain how a solar panel can be connected to generate electricity.

❖ Description

First hour: The basic components of a solar powered plant will be introduced, and their functions as relates to power generation.

Second hour: The components of a solar power plant will be discussed in details: solar arrays, charger controller, battery and converter.

Solar thermal technology /direct use of sunlight will be discussed with different examples.

❖ Study Question:

- (i.) List and explain the functions all the components of a solar power plant.
- (ii.) Discuss in details five applications of solar thermal technology.

❖ Reading List - Books and materials students can read. Illustration below:

- 1) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.

- 3) G15 Project on Solar Energy Application Report of the Meeting of National Focal Point New Delhi, September, 1993.
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Week 6:

- a. RES Conversion Stages.
- b. Energy Storage Systems.

❖ Objectives

The students at the end of the lecture for the week should be able to

- (i) Know and discuss the concept of wind as a source of renewable energy.
- (ii) Know the components of a wind turbine and their functions as it relates to green electricity generation.
- (iii) Know different parts of a wind turbine and how they are interconnected with each other.

❖ Description

First hour: Introduction of wind as a source of renewable energy. The concept of wind energy/power.

Second hour: Wind turbine and its basic components will introduced

❖ Study Question:

- (i.) Wind farm concept.
- (ii.) List six parts of a wind turbine and explain its functions as relates to renewable energy generation.
- (iii.) Discuss in details how the power of wind is converted to electricity.

❖ Reading List - Books and materials students can read. Illustration below:

- 1) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
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- 10) FGN, Federal Republic of Nigeria, Sustainable Energy for ALL, Action Agenda (SE4ALL), August 2015.
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Week 7:

- a. Economic activities and power consumption
- b. Energy needs in rural areas

❖ Objectives

The students at the end of the lecture for the week should be able to

- (i) Know the different economic activities prevalent in households and power consumption.
- (ii) Know the RET best suited for different economic activities.
- (iii) Know basic energy needs in rural areas.

❖ Description

First hour: Basic economic activities and their power consumption will be introduced.

Second hour: Basic energy needs/demand and appropriate RET will be deduced.

❖ Study Question:

- (i) What is economic activity?
- (ii) List economic activities in rural areas.
- (iii) Determine basic energy consumption for a rural household.

❖ Reading List - Books and materials students can read. Illustration below:

- 1) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
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Week 8:

- a. RET Technologies and Environmental Issues.
- b. Barriers to RES adoption and scale-up.

❖ Objectives

The students at the end of the lecture for the week should be able to:

- (i) Know the RET and process of generating electricity.
- (ii) Know the impact of each RET on the environment.
- (iii) Know the factors militating against RES adoption and scale-up.

❖ Description

First hour: Different methods of Energy conversion for RET will be explained.

Second hour: Environmental issues as relates to RES adoption and scale-up for each RES will be discussed.

❖ Study Question:

- (i) Write components for each RET.
- (ii) Discuss the different methods of energy conversion for each RET.
- (iii) Write short notes on adverse effects for each RET on the environment.

❖ **Reading List - Books and materials students can read. Illustration below:**

- 1) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 3) G15 Project on Solar Energy Application Report of the Meeting of National Focal Point New Delhi, September, 1993.
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Week 9:

- a. Electricity Industry in Nigeria and Pricing Issues.
- b. Safety Management.

❖ **Objective**

Have an overview of the structure of the electricity market.

Know the basic elements built into electricity pricing/tariff.

Basic elements of Engineering safety and management vis-à-vis electricity generation.

❖ **Description**

First hour: Nature and type of electricity market in Nigeria and tariff setting.

Second hour: Engineering safety and management of green electricity generation.

❖ **Study Question.**

- (i.) Electricity Reform Act 2005 and its contribution to Electricity industry in Nigeria – Discuss briefly.
- (ii.) Measures in safety management for Engineering projects. – Discuss for a typical RET plant.

❖ **Reading List - Books and materials students can read. Illustration below:**

- 1) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.

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- 12) Internet Sources.

Week 10: FGN Plans/Programs

- a. NREEEP
- b. SE4ALL
- c. E-30-30-30

❖ Objectives:

- (i.) Familiarize with FGN policies on Renewable systems.
- (ii.) Know global plans/programs in energy for sustainable human development.
- (iii.) Introduce projected Action Agenda of FGN in promoting/scaling up RET.

❖ Description:

First Hour: Introduces the NREEEP for each RET

Second Hour: Discuss the Green Electricity programs in small, medium and long term.

❖ Reading List - Books and materials students can read. Illustration below:

- 1) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.

- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 3) G15 Project on Solar Energy Application Report of the Meeting of National Focal Point New Delhi, September, 1993.
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- 12) Internet Sources.

Week 11: FGN Plans/Policy contd.

❖ **Objectives:** Same as Wk. 10.

❖ **Description:**

First Hour: Introduce the SE4ALL program.

Second Hour: Present the Action Agenda.

❖ **Study Questions:**

- (i.) For any RES in the NREEEP, discuss some shortfalls/barriers in the actualization of the plan.
- (ii.) Itemize the Local content for any of the RET in the Action Agenda for SE4ALL.

❖ **Reading List - Books and materials students can read. Illustration below:**

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- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 3) G15 Project on Solar Energy Application Report of the Meeting of National Focal Point New Delhi, September, 1993.
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- 12) Internet Sources.

Week 12:

- a. Mini/Micro grids – Embedded generation.
- b. E Vision 30-30-30 fuel mix

❖ **Objectives:** Same as Wk. 10

❖ **Description:**

First Hour: Introduce and explain the concepts – Mini/Micro grids.

Second Hour: Introduce the fuel mix projection for E-30-30-30.

❖ **Study Questions:**

- a. Define Mini/Micro grid
- b. What RES are applicable for embedded generation - Discuss

❖ **Reading List - Books and materials students can read. Illustration below:**

- 1) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
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- 12) Internet Sources.

Week 13: FGN Policy/Plans Contd.

- ❖ **Objectives:** Same as Wk. 10.
- ❖ **Description:**

First Hour: Introducing the contribution of RES in the fuel mix plan up to 2030

Second Hour: Spot listing viable options.

- ❖ **Study Questions:**

- a. What states in Nigeria are endowed with Res for contribution to the fuel mix?
- b. What are the capabilities existing for such contributions?

- ❖ **Reading List - Books and materials students can read. Illustration below:**

- 1) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 2) Solar Photovoltaic Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
- 3) G15 Project on Solar Energy Application Report of the Meeting of National Focal Point New Delhi, September, 1993.
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Week 14: International Collaborations and Opportunities.

- a. Replace firewood with electricity.
- b. Environmental Concerns.
- c. Technology transfer.
- d. Strengthening Capacity Building.
- e. Renewable Energy networks: IRENA, ITASA, UNIDO etc.

❖ **Objectives:**

- (i.) To know about developmental programs of Donor agencies – multi-lateral/bilateral agencies.
- (ii.) Introduce global conventions and agreements.
- (iii.) Introduce Renewable Energy networks.

❖ **Description:**

First Hour: Introduce the global conventions in which Nigeria is a party.

Second Hour: Introduce the global renewable networks.

❖ **Study Questions:**

- a. What are bilateral/multilateral agreements to which Nigeria is a party?
- b. What opportunities are there for capacity building from Int. Renewable Energy networks?

❖ **Reading List - Books and materials students can read. Illustration below:**

- (1.) Biogas Technology and Application Training Manual Sokoto Energy Research Centre. Usmanu Danfodiyo University.
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(12.) Internet Sources.

Week 15: Examination

❖ **Objectives:**

To examine the students on all that has been taught during the semester.