NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF SCIENCES

ENGINEERING PHYSICS PROGRAM

IF492 – SOLAR ENGINEERING

I. GENERAL INFORMATION

CODE	**:**	IF492 Solar Engineering
SEMESTER	**:**	8
CREDITS	**:**	5
HOURS PER WEEK	**:**	6 (Theory–Practice)
PREREQUISITES	**:**	IF451 Heat Transfer and Fluid Mechanics
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Engineering Physics

II. COURSE DESCRIPTION

The course prepares the student in the analysis and application of solar energy and radiation as a vast and renewable energy resource to satisfy human energy needs. The transformations of solar energy are analyzed, as well as their interactions with different types of matter. Application of solar energy for heating, lighting and electricity transformation in rural areas are analyzed.

III. COURSE OUTCOMES

At the end of the course, students:

1. Understand human energy needs and their possible solutions by the use of solar energy.
2. Study the characteristics of solar radiation and the effects of the atmosphere on solar radiation.
3. Measure solar radiation using different instruments.
4. Study the different applications of solar energy as a solution to energy problems.

IV. LEARNING UNITS

1. INTRODUCTION

Human energy needs / Development and energy / Climate change. / Different forms of solar energy / Energy conversion / Renewable energy sources / Wind energy / Hydraulic energy / Biomass energy.

2. SOLAR RADIATION AS ENERGY RESOURCE

Basic characteristics of solar radiation / The Sun, solar constant / Solar spectrum / Heat radiation / Celestial mechanics: motion of Earth / Measurement of time / Coordinate systems / Declination / Apparent movement of the Sun / Equation of time / Day length / Effect of atmosphere on solar radiation / Direct and diffused radiation / Climate / Clear and clouded sky / Turbidity / Solar shine / Irradiation and irradiance on different surfaces / Estimation of solar energy resources on Earth: availability of data / Different formulas for estimating empirical average values of global and diffuse radiation / Solar radiation measurement: different methods and instruments / Solar map of Peru.

3. INTERACTION OF SOLAR RADIATION WITH MATERIALS

Optical properties of materials / Light reflection and refraction / Photovoltaic effect.

4. SOLAR ENERGY APPLICATIONS

Photothermal applications at low temperatures: flat collectors, heating water, solar dryers, greenhouses, solar cookers, solar cooling and air conditioning / Evaporative and radioactive cooling / Distillation and purification of water / Room heating / Passive applications: bioclimatic architecture / Photothermal applications at high temperatures: hub collectors and thermal machines / Photovoltaic applications: water pumping, lighting,

telecommunications, rural electrification and industrial applications / Storage of energy / Thermal energy, electric power and other forms of energy.

V. METHODOLOGY

The course takes place in theory, practice and laboratory sessions. In theory sessions, faculty presents concepts, theorems, methods and applications. In the practice sessions, students solve different problems related solar energy transformation and applications. In laboratory sessions, students carry out diverse experiments to analyze and measure solar energy radiation in different applications. Student active participation is promoted.

VI. GRADING FORMULA

The Final Grade PF is calculated as follow:

PF = (EP + EF + PP) / 3

EP: Mid-term Exam EF: Final Exam
PP: Average of practice grades.

VII. BIBLIOGRAPHY

1. BERNARD, MENGUY, SCHWARZ.
   Solar Radiation, Lavoisier Ed, Paris, France, 2006.
2. IQBAL, M.
   Solar Radiation, Academic Press, 2009.
3. COLLARES-PEREIRA, MANEL.
   Solar Drying Engineering, CYTED-D, Santiago, Chile, 2006.