FACULTY OF **ENGINEERING**

DEGREE COURSE: **COMPUTER AND CONTROL ENGINEERING BS**

**SUBJECT**: THERMAL SCIENCE

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## OBJECTIVES

The course aims at:

1) providing a general framework of the phenomena of applied thermodynamics and heat transfer
2) providing tools to understand processes of heat and work transfert, in order to identify its crucial aspects and to choose the level of modeling required to describe it properly.

## CONTENTS

Introductory concepts
1 Elements of mathematical analysis
2 The properties of substances (liquids, gases and vapors)
3 Thermodynamic Diagrams
4 Temperature and principle 0

Applied Thermodynamics

- Heat and Work
- I and II law of Thermodynamics
- The concept of entropy
- The thermodynamic transformations and their representation on the diagrams
- The Carnot cycle and other cycles Thermodynamic direct
- Inverse Cycles

Heat Transfer

- General information on the mechanisms of heat exchange
- Fourier's law of Conduction
- Newton's Law of Convection
- Boltzmann's law of radiation
- Heat transfer combined mechanisms

Conduction

- One and two-dimensional problems
- Steady and unsteady conduction

Convection

- The concept of kinematic and thermal boundary layer

- Forced convection
- Natural Convection
- dimensionless parameters

Radiation
- Planck's law
- Wien's law
- Stefan-Boltzmann law
- Black bodies and gray bodies, the concept of emissivity
- The solar radiation and the greenhouse effect
- Form Factor

Finned Bodies and Heat Exchangers
- Efficiency of the fin
- Sinks
- Cooling of Electronic Devices
- Heat Exchanger classification and sizing methods

Thermodynamics of moist air
- Absolute and Relative Humidity
- Wet-bulb temperature and adiabatic saturation
- Transformations of moist air and psychrometric chart
- HVAC treatment
- Evaporative Cooling

Thermo-hygrometric comfort
- Equation of comfort and parameters
- PMV and PPD
- Local and global Discomfort

## LEARNING OUTCOMES

At the end of the course, students will:

- have acquired the basic tools of the analysis of thermodynamic phenomena and mechanisms of heat transfer
- have the ability to formulate mathematical models and achieve solutions of simple differential problems, with particular reference to the stationary case one- and two-dimensional
- be able to solve in a simplified manner common problems related to the thermodynamic cycle and heat transfer in mechanical applications and buildings.

## ASSESSMENT

Written exam: multiple choice and open questions

## RECOMMENDED TEXTBOOKS

*Introduction to Thermodynamics and Heat Transfer*, Yunus A. Cengel Mc Graw Hill Companies

*Introduction to thermal systems engineering: Thermodynamics, Fluid Mechanics and Heat Transfer*, John Wiley and Sons Inc.