3rd/4th Year

Track 8: Energy Techniques

1	55000058	Applied Mathematics
2	55000801	Structure of Matter
3	55000802	Heat and Industrial Refrigeration
4	55000803	Technical Thermodynamics
5	55000804	Nuclear Technology
6	55000805	Generation and Distribution of Electrical Energy
7	55000806	Nuclear Power Plants
8	55000807	Thermal Turbomachines
9	55000808	Volumetric Machines

55000058 - APPLIED MATHEMATICS

CREDITS:	4.5 ECTS
DEPARTMENT:	Industrial and Applied Mathematics (MAT)
COURSE COORDINATOR:	Pedro Galán del Sastre
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Spring

LIST OF TOPICS

MODULE 1. Interpolation

- 1) Numerical interpolation and approximation: Lagrange interpolation, Hermite interpolation.
- 2) Piecewise interpolation: the finite element interpolation.
- 3) Interpolation in 2D using conforming finite elements.

MODULE 2. Numerical quadrature

- 3) Numerical quadrature formulas: trapezoidal rule, Simpson, Gauss-Legendre.
- 4) Numerical quadratures in 2D.

MODULE 3. Introduction to Partial Differential Equations (PDEs)

- 5) Introduction, functional framework and classification of the second-order PDEs. Variational formulation.

MODULE 4. Second order linear elliptic PDEs

- 6) Numerical resolution by the finite element method (FEM). Formulation and implementation.

MODULE 5. Linear parabolic problems

- 7) Numerical resolution through FEM. The heat transmission.
- 8) The transport equation. Numerical resolution by the FEM

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: Calculus I, Calculus II, Algebra.

TOPIC: All the items on the above-mentioned courses are needed

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- A good command on mathematical language
- A knowledge of the rules of mathematical logic: implication, equivalence, necessary or sufficient condition, etc.
- An ability to make calculations with ease.
- A skill in the use of mathematical tools: a) Elementary techniques of Calculus: derivatives, chain rule, calculation of antiderivatives, differential calculus of real functions of several variables. b) Techniques of Linear Algebra: matrix calculus, diagonalization, eigenvalues and eigenvectors. c) Elementary handling of complex numbers: exponentials, plotting.
- Basic concepts of General Physics: velocity, acceleration, force fields, etc.
- A skill in the use of programming languages.
- Study and concentration skills.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- A capacity for abstraction and general concepts recognition in practical situations.
- A skill to formulate models of natural and engineering processes.
- A skill to interpret the results obtained and evaluate the models that have been used.
- An ability to apply the method of the finite elements to compute the numerical solution of a Partial Differential Equation, including the mathematical formulation and the implementation through a specific software

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

- S.C. Chapra, R.P. Canale. Numerical Methods for Engineers. McGraw Hill, 2010.
- D. Kincaid, E.W. Chenney. Numerical Analysis: Mathematics of Scientific Computing. American Mathematical Society, 2009.
- K.H. Huebner, E.A. Thornton, T.G. Byrom. The Finite Element Method for Engineers . John Wiley and Sons, 1995.
- T.J.R. Hughes. The Finite Element Method. Linear Static and Dynamic Finite Element Analysis . Prentice Hall, 1987.

OTHER MATERIALS

55000801 - STRUCTURE OF MATTER

CREDITS:	6 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE COORDINATOR:	Pedro Velarde Mayol
TYPE:	Track (Energy Techniques)
YEAR AND SEMESTER:	3rd Year / Spring

LIST OF TOPICS

MODULE 1. Quantum mechanics.

- 1) Historical introduction. Most relevant experiments.
- 2) Introduction to quantum mechanics.
- 3) Fixed problems with some characteristic potentials.
- 4) Approximate methods.

MODULE 2. Atomic physics

- 5) Hydrogen atom
- 6) System of identical particles
- 7) Multielectronic atoms.
- 8) Molecular bond.

MODULE 3. Structure of matter

- 9) Solid state
- 10) Electrical and magnetic properties of materials.
- 11) Computer simulation of the structure of matter.
- 12) Quantum phenomena in current applications.

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Python programming
- Basic numerical methods for Linear Systems, ODEs and Fourier Transform

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Interpret the basic principles of quantum mechanics.
- Used for calculating basic tools to solve simple problems in MC.
- Determine the importance of the MC in some current technologies.
- To analyze some phenomena from their basic principles.
- Analyze systems consisting of many particles.
- Interpretation of some basic phenomena of matter.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_2. An ability to apply engineering design to produce solutions that meet specified needs with consideration fo public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXTBOOKS

A. A. F Levi, Applied Quantum Mechanics, Cambridge University Press, 2003
B. B.H Bransden & C. J. Joachain, Quantum Mechanics, Prentice Hall, 2000

OTHER MATERIALS

55000802 – Heat and Industrial Refrigeration

CREDITS:	4.5 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE COORDINATOR:	Juan Manuel Gonzalez
TYPE:	4th Year / Fall
YEAR AND SEMESTER:	

LIST OF TOPICS

MODULE 1. Heat exchanger/Thermal and hydraulic desing,.

MODULE 2. Psychrometry and Wetted Surface Heat Transfer

MODULE 3. Moist air Processes: Cooling and deshumidifying./ Heating and Humidifying/Space air conditioning

MODULE 4. Refrigeration/The vapor compression cycle/Compressors/Multipressures systems/ Refrigerant

MODULE 5. Combustion: Fuels, combustion efficiency

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC: Heat transfer Thermodinamic Fluid mechanics; Fluid mechanics; Chemistry

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Analytical capacity of thermal problems (temperature distributions and heat fluxes) • - Higher Mathematics: Differential Equations

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, students will have the basic knowledge necessary for the design of thermal installations in both the industrial and commercial sectors.

They will be able to design heat exchangers with thermal and hydraulic requirements. They will develop the calculation of an industrial heat exchanger by the Kern method and the Bell method.

Using design tools and thermal systems

They will carry out a project for a cold store for fruit and vegetable products. They dimension all the components of the refrigeration installation

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_2. An ability to apply engineering design to produce solutions that meet specified needs with consideration fo public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS: Refrigeration and air conditioning Stoecker.McGraw Hill

Kharagpur Mechanical engineering/Refrigeration and Air conditioning

OTHER MATERIALS: Software

- CoolPack CoolPack (Thermal Energy (TES) at the Technical University of Denmark (DTU)
- Coolselector (Danfoss)
- Software from bitzer: compressor.
- Software: Heat exchanger. Bell method.

Notes available to students on platforms such as Aulaweb or Moodle

55000803 - TECHNICAL THERMODYNAMICS

CREDITS:	4.5 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE COORDINATOR:	Celina González Fernández
TYPE:	Track (Energy Techniques)
YEAR AND SEMESTER:	4th Year / Fall

LIST OF TOPICS

MODULE 1. Multicomponent systems

- 1) Statistical thermodynamics. Application to equations of state for pure substances and mixtures
- 2) Ideal mixing models. Henry model. Colligative properties
- 3) Properties in multicomponent systems. Heat of solution. Diagram h-x-T
- 4) Thermal equations for mixtures. Calculation of properties in mixtures. Generalized departure functions.
- 5) Activity coefficients for liquid phase

MODULE 2. Multiphase multicomponent balance

- 6) Equations of multicomponent multiphase equilibrium. Liquid-vapor, liquid-liquid and solid phases balance
- 7) Phase equilibria in ternary systems

MODULE 3. Reactive systems

- 8) Calculation of properties in reactive systems. Tables of the Planck function and normal enthalpies from 0K.
- 9) Adiabatic flame temperature. Heterogeneous systems. Several reactions systems
- 10) Chemical exergy. Exergy balance

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Determining thermodynamic properties of ideal mixtures.
- Determining caloric effects in one-reaction systems.
- Solve chemical equilibrium in one-reaction one-phase systems.
- Relate macroscopic and microscopic properties.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Select the most appropriate operations for each case as a preliminary framework for designing basic operations of chemical engineering and energy production
- Determine thermochemical properties, equilibrium compositions and heat effects
- Determine thermodynamic properties in multicomponent and multiphase systems, from equations of state and tabular correlations
- Identify and evaluate exergy destruction in physical and chemical systems

STUDENT OUTCOMES

- ABET_1. An ability to identify,formulate,and solve complex engineering problems by applying principles of engineering,science,and mathematics
- ABET_2. An ability to apply engineering design to produce solutions that meet specified needs with consideration fo public health,safety,and welfare,as well as global,cultural,social,environmental,and economic factors
- ABET_4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments,which must consider the impact of engineering solutions in global,economic,environmental,and societal contexts

BIBLIOGRAPHY

TEXT BOOKS

Termodinámica
R. Nieto, M.C. González, I. López, Á. Jiménez, J. Rodríguez Editorial Sección de Publicaciones de la E.T.S.I.I., 2013

Fisicoquímica
I.N. Levine Editorial McGraw-Hill, 2014

The properties of gases and liquids
B.E.Poling, J.M. Prausnitz, J.P. O´Connell Editorial McGraw Hill, 2000

Equilibrio químico
Denbigh Editorial AC, 1966

OTHER MATERIALS

55000804 - NUCLEAR TECHNOLOGY

CREDITS:	6 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE COORDINATOR:	N. García
TYPE:	Track (Energy Techniques)
YEAR AND SEMESTER:	4th Year / Fall

LIST OF TOPICS

MODULE 1. Basic concepts

- 0) Introduction
- 1) Basic structure of the atom and nucleus
- 2) Radioactive decay
- 3) Interaction of charged particles with matter
- 4) Interaction of electromagnetic radiation with matter
- 5) Principles of Radiological Protection
- 6) Applications of ionizing radiations
- 7) Detection and measurement of radiation
- 8) Nuclear reactions
- 9) Cross sections of neutron reactions

MODULE 2. Reactor physics

- 10) Nuclear fission reaction
- 11) Neutron chain reaction. Criticality
- 12) Concept of nuclear fission reactor
- 13) Neutron slowing down
- 14) Neutron diffusion
- 15) Introduction to nuclear reactor kinetics
- 16) Introduction to nuclear reactor dynamics

MODULE 3. Nuclear fusion technology

- 17) Fundamentals of nuclear fusion: conditions and basic concepts
- 18) Magnetic confinement fusion
- 19) Inertial confinement fusion
- 20) Technology of nuclear fusion systems

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:	
TOPIC:	Basic knowledge of related disciplines: calculus, physics, chemistry, electromagnetic fields, thermodynamics, heat transfer.

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Those acquired in previous courses and at the same time in the semester.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- General fundamentals of the physics and technology of the nuclear fission and fusion, nuclear fuel cycle and nuclear reactors.
- Ability to pursue a more in-depth study of other related Nuclear Engineering subjects for the bachelor's degree: applications of radiation, nuclear power plants.
- Ability to synthesize, necessary for learning a subject of such different contents.

STUDENT OUTCOMES

- ABET_1. An ability to identify,formulate,and solve complex engineering problems by applying principles of engineering,science,and mathematics
- ABET_4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments,which must consider the impact of engineering solutions in global,economic,environmental,and societal contexts
- ABET_5. An ability to function effectively on a team whose members together provide leadership,create a collaborative and inclusive environment,establish goals,plan tasks,and meet objectives
- ABET_6. An ability to develop and conduct appropriate experimentation,analyse and interpret data,and use engineering judgment to draw conclusions
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

Nuclear Engineering, An Introduction
Almenas K., Lee R. Editorial Springer-Verlag, 1992

Ingeniería de Reactores Nucleares
Glasstone S., Sesonske A. Editorial Editorial Reverté, 1989

Teoría de Reactores y elementos de Ingeniería Nuclear
Goded f., Serradell V., Martínez-Val J.M., Oltrá F. Editorial Editorial J.E.N., Madrid, 1975 (Tomo I), 1981 (Tomo II)

Introduction to Nuclear Engineering
Lamarsh J.R. Editorial Editorial Addison-Wesley Publishing Co., Reading Massachusetts, 1982

Radiaciones Ionizantes, Vol. I
Ortega X., Jorba J. Editorial Editorial Ediciones UPC, 1996

OTHER MATERIALS

The following materials will be available to students in Moodle platform:
- Lecture presentations and complementary course notes
- Exercises and home assignments
- Manuals for laboratory practice (characterization of Geiger radiation counters)

55000805 - GENERATION AND DISTRIBUTION OF ELECTRICAL ENERGY

CREDITS:	4.5 ECTS
DEPARTMENT:	Automatic Control, Electrical and Electronics Engineering and Industrial Informatics (AUT)
COURSE COORDINATOR:	RM Castro
TYPE:	Track (Energy Techniques)
YEAR AND SEMESTER:	4th Year / Spring

LIST OF TOPICS

MODULE 1. Electrical generation

MODULE 2. Lines and transformers

MODULE 3. Steady-state network analysis

MODULE 4. Balanced shortcircuit analysis of power system

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

• Capacity for abstraction and representation of engineering problems. Critical sense in the analysis of results and the notion of the orders of magnitude. Ability to establish relationships between different physical phenomena. Capacity for analysis of electrical circuits. Understanding the basic operation of electrical machines

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

• Knowledge of different power generation technologies. - Understanding the operation of the electrical system from generation to consumption. - Ability to design and calculate the various elements of a plant. - Ability to calculate the various elements of the networks of high and low voltage

STUDENT OUTCOMES

• ABET_1. An ability to identify,formulate,and solve complex engineering problems by applying principles of engineering,science,and mathematics

• ABET_4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments,which must consider the impact of engineering solutions in global,economic,environmental,and societal contexts

• ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

Sistemas de energía eléctrica Fermín Barrero. Ed. Thomson 2004.
Análisis de Sistemas de Potencia John J. Grainger y William D. Stevenson Jr. Ed. McGraw Hill 1996

OTHER MATERIALS

Documentación en Aulaweb.

55000806 - NUCLEAR POWER PLANTS

CREDITS:	4.5 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE COORDINATOR:	G. Jiménez
TYPE:	Track (Energy Techniques)
YEAR AND SEMESTER:	4th Year / Spring

LIST OF TOPICS

MODULE 1. Introduction to nuclear power plants

1.1. Introduction to nuclear power generation.
1.2. Types of nuclear fission plants
1.3. Nuclear fuel cycle

MODULE 2. Neutron, thermal hydraulic and reactor control

2.1. Reactivity
2.2. Xenon and Samarium poisoning
2.3 Reactivity control
2.4 Power generation
2.5 Nuclear thermal hydraulics

MODULE 3. Light water nuclear power plants

3.1. PWR. Nuclear fuel.
3.2. PWR. Reactor vessel.
3.3. PWR. Reactor core.
3.4. PWR. Reactor Cooling System.
3.5. PWR. Balance of Plant.
3.6. PWR. Fluid systems.
3.7. PWR. Technological safeguards.
3.8. PWR. Instrumentation and control.
3.9. PWR. Loss of coolant accident (LOCA).
3.10. PWR. Reactor operation.
3.11. PWR. Nuclear containment. Ultimate heat sink.
3.12. BWR. Reactor cooling system.
3.13. BWR. Fluids and safeguard systems.

MODULE 4. Nuclear safety

4.1. Introduction to Nuclear Safety.
4.2. Introduction to Radiation Protection.
4.3. Historical severe accidents.

MODULE 5. Advanced and future reactors

5.1. Introduction to Generation III/III+ reactors.
5.2. Construction of a Generation III/III+ reactor.
5.3. Introduction to Generation IV reactors.

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: Fluid Mechanics I, Heat transfer, Nuclear Technology.

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Acquired in previous courses and simultaneously in the semester

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Knowing the thermohydraulic and neutron operation of a light water nuclear reactor during operation
- Knowing the performance of the systems during a transitional safeguard a light water nuclear reactor
- Understand the main processes of management of radioactive waste at a nuclear plant

STUDENT OUTCOMES

- ABET_1. An ability to identify,formulate,and solve complex engineering problems by applying principles of engineering,science,and mathematics
- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_5. An ability to function effectively on a team whose members together provide leadership,create a collaborative and inclusive environment,establish goals,plan tasks,and meet objectives
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

OTHER MATERIALS

The students will have the necessary resources for the correct learning of the subject in the Moodle page.

CREDITS:	3 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE	M. Valdés

55000807 - THERMAL TURBOMACHINERY

LIST OF TOPICS

- 1) Reminder of thermodynamics and fluid mechanics concepts
- 2) Euler's turbomachinery equation
- 3) Thermodynamic principles of compressors and turbines
- 4) Axial Turbocompressors
- 5) Axial Turbines
- 6) Radial flow turbomachinery
- 7) Off-design performances

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: Thermodynamics I,II. Fluid Mechanics I,II

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Thermodynamic and fluid mechanics calculation skills

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Perform calculations related with the main design and operating parameters of thermal turbomachinery
- Ability to select, operate and maintain thermal turbomachinery
- Basic knowledge of steam turbines, gas turbines, compressors and its operating principles

STUDENT OUTCOMES

- ABET_1. An ability to identify,formulate,and solve complex engineering problems by applying principles of engineering,science,and mathematics
- ABET_2. An ability to apply engineering design to produce solutions that meet specified needs with consideration fo public health,safety,and welfare,as well as global,cultural,social,environmental,and economic factors
- ABET_3. An ability to communicate effectively with a range of audiences

BIBLIOGRAPHY

TEXT BOOKS

Turbomáquinas Térmicas. Fundamentos del diseño Termodinámico
Manuel Muñoz, Manuel Valdés, Marta Muñoz Editorial Servicio de Publicaciones ETSII. UPM, 2001

Principles of Turbomachinery
Seppo A. Korpela. Wiley

Fluid Mechanics and Thermodynamics of Turbomachinery
Sam L. Dixon. Elsevier

OTHER MATERIALS

Thermal engines laboratory, with several turbocompressors and turbines as well as turbomachinery components.

55000808 - VOLUMETRIC MACHINES

CREDITS:	3 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE COORDINATOR:	JM. Burón
TYPE:	Track (Energy Techniques)
YEAR AND SEMESTER:	4th Year / Spring

LIST OF TOPICS

MODULE 1. Fundamentals of Heat Engines

- 1) Fundamentals of Heat Engines

MODULE 2. Fundamentals of Reciprocating Internal Combustion Engines

- 2) Fundamentals of Reciprocating Internal Combustion Engines

MODULE 3. Theoretical air cycles for Reciprocating Internal Combustion Engines

- 3) Theoretical air cycles for Reciprocating Internal Combustion Engines

MODULE 4. Heat loss and mechanical loss of Reciprocating Internal Combustion Engines

- 4) Heat loss and mechanical loss of Reciprocating Internal Combustion Engines

MODULE 5. Renewal of charge Reciprocating Internal Combustion Engines

- 5) Gas cycle in four times Reciprocating Internal Combustion Engines
- 6) Gas cycle in two-stroke Reciprocating Internal Combustion Engines

MODULE 6. Combustion in the Reciprocating Internal Combustion Engines

- 7) Combustion in spark ignition engines
- 8) Combustion in compression ignition engines

MODULE 7. Systems of mixture formation in the Reciprocating Internal Combustion Engines

- 9) Systems of mixture formation in the Reciprocating Internal Combustion Engines

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Multidisciplinary phenomenological reasoning
- Critical interpretation of results

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Abstract reasoning and in the field of expandable Reciprocating Internal Combustion Engines multiple fields of technology
- Connect and properly apply multiple skills fundamental branches of science and technology
- Develop a sharp critical sense concerning the consistency of the numerical results obtained for application in the field of Reciprocating Internal Combustion Engines, expandable to all fields oftechnology

STUDENT OUTCOMES

- ABET_1. An ability to identify,formulate,and solve complex engineering problems by applying principles of engineering,science,and mathematics
- ABET_2. An ability to apply engineering design to produce solutions that meet specified needs with consideration fo public health,safety,and welfare,as well as global,cultural,social,environmental,and economic factors
- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments,which must consider the impact of engineering solutions in global,economic,environmental,and societal contexts
- ABET_5. An ability to function effectively on a team whose members together provide leadership,create a collaborative and inclusive environment,establish goals,plan tasks,and meet objectives
- ABET_6. An ability to develop and conduct appropriate experimentation,analyse and interpret data,and use engineering judgment to draw conclusions
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

OTHER MATERIALS

Laboratorio de Motores Térmicos (Personal especializado, Bancos de ensayos, Maquetas, Instrumentación, Programas informáticos, Piezas, etc.). Material didáctico: Diapositivas de cada tema, Guiones de cada práctica. Libros de consulta: MUÑOZ TORRALBO, M. y otros: Motores de combustión interna alternativos. Servicio de Publicaciones de la ETS de Ingenieros Industriales; VALDÉS, M. y otros: Problemas resueltos de máquinas y motores térmicos. Servicio de Publicaciones de la ETS de Ingenieros Industriales.