A) COURSE

Course Id:	Course
5619	THERMAL MACHINES

Class Hours per Week	Lab hours per week	Complementary practices	Credits	Total hour course
5	1	5	11	80

B) GENERAL COURSE INFORMATION:

	EE (IEA)	ME (IM)	MME (IMA)	EME (IME)	MTE (IMT)
Level:		VI	V	V	
Course Type (Required/Elective)		Required	Required	Required	
Prerequisite Course:		Thermodynamics	Thermodynamics	Thermodynamics	
CACEI Classification:		ES	ES	ES	

C) COURSE OBJECTIVE

At the end of the course, the student will be capable of:
Recognize and manage the mathematical expressions, tables and graphs relevant and principles required for troubleshooting these applications. Learn to manage the basic principles of heat transfer.

D) TOPICS (CONTENTS AND METHODOLOGY)

1.- RETURNS		**5 hrs**
Specific Objective:	Students understand and manage the concepts and procedures for evaluating performance and efficiency and can solve problems on them.	
1.1. - Labour. Power. 1.2. - Heat output 1.3. - Thermal Performance. 1.4. - Performance machine and heat engine. 1.5. - Mechanical performance.		
Readings and other resources	Read the topics suggested bibliography.	
Teaching Methodologies	Exposition in classroom, students questioning, dialogue, solving typical problems, meet laboratory practices, clarification of doubts.	
Learning Activities	Do exercises of theme, taken from the suggested bibliography, lab practices and classroom discussion of the results obtained in the laboratory.	

2.- GAS COMPRESSORS	**12 hrs**

Specific Objective:	Students understand and manage the concepts, expressions and solve problems related to the topic.
2.1. - Types of compressors. Compression curves. 2.2. - Outdoors. Volumetric efficiency. Efficiency compressor. 2.3. - Multistage compression 2.4. - Gas Expanders	
Readings and other resources	Read the topics suggested bibliography.
Teaching Methodologies	Exposition in classroom, students questioning, dialogue, solving typical problems, meet laboratory practices, clarification of doubts.
Learning Activities	Do exercises of theme, taken from the suggested bibliography, lab practices and classroom discussion of the results obtained in the laboratory. And identifying compression curves.

3.- IGNITION ENGINES	**15 hrs**
Specific Objective:	Que el alumno compare, clasifique, interprete, los diferentes tipos de motores de combustión interna y sus características de operación comprenda y maneje los conceptos, expresiones y resuelva problemas relacionados con el tema.
3.1. - Otto Cycle. (Closed and open). 3.2. - Diesel Cycle (closed and open). 3.3. - Dual cycle.	
Readings and other resources	Read the topics suggested bibliography.
Teaching Methodologies	Exposition in classroom, students questioning, dialogue, solving typical problems, meet laboratory practices, clarification of doubts.
Learning Activities	Do exercises of theme, taken from the suggested bibliography, lab practices and classroom discussion of the results obtained in the laboratory. Analysis of real problems on internal combustion engines.

4.- GAS TURBINES	**15 hrs**
Specific Objective:	Students understand and manage concepts, expressions and solve problems related to the topic.
4.1. - Brayton Cycle. Ideal and friction. 4.2. - Regenerative heating. Efficiency regenerator. 4.3. - Combustors. Efficiency. 4.4. - Maximum. 4.5. - Multistage compression. 4.6. - Engines "Jet". 4.7. - Rocket engines.	
Readings and other resources	Read the topics suggested bibliography.
Teaching Methodologies	Exposition in classroom, students questioning, dialogue, solving typical problems, meet laboratory practices, clarification of doubts.
Learning Activities	Do exercises of theme, taken from the suggested bibliography, lab practices and classroom discussion of the results obtained in the laboratory. Analysis of problems related to gas turbines.

5.- DIFFUSERS AND NOZZLES.	**12 hrs**
Specific Objective:	To obtain design features for any nozzle.

5.1. - Properties of the fluids. 5.2. - Stalemate, acoustic velocity and number of Mach. 5.3. - Types of nozzles. 5.4. - Diffusers. 5.5. - Applications.	
Readings and other resources	Read the topics suggested bibliography.
Teaching Methodologies	Exposition in classroom, students questioning, dialogue, solving typical problems, meet laboratory practices, clarification of doubts.
Learning Activities	Do exercises of theme, taken from the suggested bibliography, lab practices and classroom discussion of the results obtained in the laboratory. Teamwork for obtaining the characteristics of nozzle design.

6.- Steam turbines., calorimetric pump and cooling systems.		**21 hrs**
Specific Objective:	From water vapor through a heat engine, the student gets working and then their applications. From the work the student obtains heat (heating and / or cooling) and their applications.	
6.1 Rankine Cycle. 6.2 Changes in the Rankine cycle. 6.3 Binary Cycle. 6.4 Calorimetry Bomb. 6.5 Features bomb calorimeter. 6.6 Cycles of cooling and heating vapor compression 6.7 Cycle gas compression refrigeration 6.8 Vacuum Cooling. 6.9 Refrigerations.		
Readings and other resources	Read the topics suggested bibliography.	
Teaching Methodologies	Exposition in classroom, students questioning, dialogue, solving typical problems, meet laboratory practices, clarification of doubts.	
Learning Activities	Do exercises of theme, taken from the suggested bibliography, lab practices. Presentation of topics related to the subject.	

E) TEACHING AND LEARNING METHODOLOGIES

a) Conventional exposure of each subject by the teacher.
b) Problem-based learning.
c) Cooperative learning.
d) Study of cases.
e) Experiments.

PRACTICES:

For the experiments, they are considered a total of 16 one-hour sessions. Practices to be performed are listed below:

1. Safety in the laboratory.
2. Determination of characteristic curves of a gasoline engine test bench.
3. Changes of Energy.
4. Compressors.
5. Role of the main parts of the internal combustion engine.
6. Adjusting the air-fuel mixture in a gasoline engine through the carburetor.
7. General knowledge of equipment and measuring instruments for internal combustion equipment.

8. Measure the fuel consumption of a diesel engine and its moment of friction.
9. Determination of characteristic curves of a diesel engine on a test bench.
10. Measure fuel consumption and friction moment.
11. Steam turbines.
12. Heat transfer in a boiler.
13. Failure Analysis and operation of a diesel engine.
14. Project.

F) EVALUATION CRITERIA:

Evaluation:	Schedule	Suggested Form of Evaluation and weighing	Topics
1st. Partial Evaluation	16 Sessions	Exam 80%, Tasks 20%	1 y 2
2nd Partial Evaluation	16 Sessions	Exam 80%, Tasks 20%	3
3rd. Partial Evaluation	16 Sessions	Exam 80%, Tasks 20	4
4th. Partial Evaluation	16 Sessions	Exam 80%, Tasks 20	5
5th. Partial Evaluation	16 Sessions	Exam 80%, Tasks 20	6
Final Ordinary Evaluation		100% (Average of the Partial Evaluations)	
Other activities:			
Extraordinary Exam	Week 17 of the semester in course	Exam 100%	Topics 100%
Title Exam	According to the program of the School Secretary.	Exam 100%	Topics 100%
Regularization Exam	According to the program of the School Secretary.	Exam 100%	Topics 100%

G) BIBLIOGRAPHY AND ELECTRONIC RESOURCES

Main Books

1. FAIRES V. M., Thermodynamics, Macmillan, 6th. ed.
2. FAIRES V. M., Problems on thermodynamics, Macmillan, 6th. ed.
3. CENGEL, YUNUS A. & BOLES, MICHAEL A. Termodinamica , mc. Graw Hill, 6ª. Ed.
4. MORAN, MICHAEL J. & SHAPIRO, HOWARD N. Fundamentos de Termodinámica Tecnica Editorial Reverte 2ª. Edición.
5. KENNETH WARK, Termodinámica, McGraw-Hill, 4a. ed.

Complementary Books

1. BURGHARDT M. DAVID. Ingeniería Termodinámica, Harper & Row Latinoamericana, 2ª. Ed.
2. CARROLL M. L. & MALEEV V. L. Heat Power Fundamentals, Pitman.
3. VAN WYLEN, GORDON. Fundamentos de termodinámica. Limusa ,2ª. Ed.
4. JONES J. B. & DUGAN R.E. , Ingeniería Termodinámica , Prentice Hall
5. LEVENSPIEL O., Fundamentos de termodinamica, Pretntice Hall, 1997.
6. ZEMANSKY VAN & NESS, Basic engineering thermodynamics, Mc Graw Hill.

Internet Links