SYLLABUS [1]

THIS COURSE UNIT IS TAUGHT IN ROMANIAN LANGUAGE

1. Information about the program

1.1 Higher education institution	POLITEHNICA UNIVERSITY TIMISOARA
1.2 Faculty[2]/ Department [3]	MECHANICAL ENGINEERING / MECHANICAL MACHINES, TECHNOLOGY AND TRANSPORTATION
1.3 Chair	—
1.4 Field of study (name/code[4])	Material Science Engineering/170
1.5 Study cycle	Bachelor
1.6 Study program (name/code/qualification)	Materials Science/ 10/Engineer

2. Information about the discipline

2.1 Name of discipline/ formative category[5]	Engineering Thermodynamics/ Domain Discipline						
2.2 Coordinator (holder) of course activities	Prof. Dr. Eng. Floriana – Daniela STOIAN						
2.3 Coordinator (holder) of applied activities[6]	Assoc. Prof. Dr. Eng. Virgil STOICA						
2.4 Year of study[7]	2	**2.5** Semester	I	**2.6** Type of evaluation	Ex	**2.7** Type of discipline[8]	DI

3. Total estimated time – hours / semester: direct teaching activities (fully assisted or partly assisted) and individual training activities (unassisted) [9]

3.1 Number of fully assisted hours / week	4 of which:	**3.2** course	2	**3.3** seminar / laboratory / project	2
3.1* Total number of fully assisted hours / semester	56 of which:	**3.2*** course	28	**3.3*** seminar / laboratory / project	28
3.4 Number of hours partially assisted / week	of which:	**3.5** training		**3.6** hours for diploma project elaboration	
3.4* Total number of hours partially assisted / semester	of which:	**3.5*** training		**3.6*** hours for diploma project elaboration	
3.7 Number of hours of unassisted activities / week	50/ 14 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			4/ 14
		hours of individual study after manual, course support, bibliography and notes			30/ 14
		training seminars / laboratories, homework and papers, portfolios and essays			16/ 14
3.7* Number of hours of unassisted activities / semester	50 of which:	additional documentary hours in the library, on the specialized electronic platforms and on the field			4
		hours of individual study after manual, course support, bibliography and notes			30
		training seminars / laboratories, homework and papers, portfolios and essays			16
3.8 Total hours / week [10]	4+50/14				
3.8* Total hours /semester	106				
3.9 Number of credits	4				

---

[1] The form corresponds to the Discipline File promoted by OMECTS 5703 / 18.12.2011 and to the requirements of the ARACIS Specific Standards valid from 01.10.2017.
[2] The name of the faculty which manages the educational curriculum to which the discipline belongs
[3] The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs.
[4] The code provided in HG no.140 / 16.03.2017 or similar HGs updated annually shall be entered.
[5] Discipline falls under the educational curriculum in one of the following formative disciplines: Basic Discipline (DF), Domain Discipline (DD), Specialist Discipline (DS) or Complementary Discipline (DC).
[6] Application activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).
[7] Year of studies in which the discipline is provided in the curriculum.
[8] Discipline may have one of the following regimes: imposed discipline (DI), optional discipline (DO) or optional discipline (Df).
[9] The number of hours in the headings 3.1 *, 3.2 *, ..., 3.8 * is obtained by multiplying by 14 (weeks) the number of hours in headings 3.1, 3.2, ..., 3.8. The information in sections 3.1, 3.4 and 3.7 is the verification keys used by ARACIS as: (3.1) + (3.4) ≥ 28 hours / wk. and (3.8) ≤ 40 hours / wk.
[10] The total number of hours / week is obtained by summing up the number of hours in points 3.1, 3.4 and 3.7.

4. **Prerequisites** (where applicable)

4.1 Curriculum	• Courses: Calculus, Physics, Chemistry
4.2 Competencies	• Use of concepts, principles and methods from the fundamental courses

5. **Conditions** (where applicable)

5.1 of the course	• Rules according to the UPT regulations
5.2 to conduct practical activities	• For laboratory classes, the students must study the scope and work plan prior to the meeting. • During seminary classes, the students will use the calculator. Also, the students must solve the homework.

6. **Specific competencies** acquired through this discipline

Specific competencies	• Capacity to use the Thermodynamics Laws to perform energy balances and energy conversion efficiency analyses. • Use of thermodynamic models to explain the operation principles of thermal machines and equipment used in the field of study • Use of specific measurement methods to determine thermal properties of substances used in the field of study • •
Professional competencies ascribed to the specific competencies	• Use of requisite fundamental criteria and models to identify, model, analyze and assess quantitatively and qualitatively phenomena, processes and characteristic theories, as well as to process and interpret the results of specific processes in the field of study • Explanation of the structure and operation of the components of various types of equipments, using specific theories and instruments (schemes, mathematical, physical, chemical models). • Elaboration of professional models and projects, by selection and use of principles, methods and established solutions from the fundamental and domain courses of the field of study.
Transversal competencies ascribed to the specific competencies	• Use of the engineer profession values and ethics, as well as responsible realization of professional duties in conditions of limited autonomy and qualified assistance. • Advancement of logic reasoning, convergent and divergent, of applied use, of evaluation and self-evaluation in decision-making. • Capacity to realize the specific team work activities and promote initiative, dialogue, a positive attitude and respect toward others.

7. **Objectives of the discipline** (based on the grid of specific competencies acquired - pct.6)

7.1 The general objective of the discipline	• The general objective of the course is represented by the knowledge of phenomena and laws of Thermodynamics applied in engineering field, the knowledge of thermal properties of technical fluids in view of their use in processes specific to energy transfer and conversion applications, as well as the efficiency analysis for energy conversion processes.
7.2 Specific objectives	• Development of the skills regarding the calculation and analyses of energy fluxes corresponding to thermodynamic processes and thermal processes, as well as to perform quantitative thermodynamic analyses (energy balances) regarding the energy conversion efficiency in engineering applications. • To gain skills regarding the theoretical and experimental determination of certain thermal properties that are important for technical fluids. • The knowledge of thermodynamic processes specific to the thermodynamic cycles characteristic for heat engines, heat pumps and refrigeration machines.

8. **Content** [11]

[11] It details all the didactic activities foreseen in the curriculum (lectures and seminar themes, the list of laboratory works, the content of the stages of project preparation, the theme of each practice stage). The titles of the laboratory work carried out on the stands shall be accompanied by the notation "(*)".

8.1 Course	Number of hours	Teaching methods [12]
CONCEPTS AND DEFINITIONS: thermodynamic systems and their interaction with the environment; definition and classification of thermal systems; thermodynamic state variables and reference states; types of thermodynamic processes; definition of thermodynamic analysis.	3	- lecture, using the multimedia technique; - the explanation and debate on notions introduced in the course.
ZEROTH LAW OF THERMODYNAMICS: thermodynamic equilibrium; statement of the Zeroth Law, thermal equilibrium, thermal contact and temperature; temperature scales; methods and instruments for measuring temperature.	3	
ENERGY AND THE FIRST LAW: work in thermodynamic processes; heat and definition of heat exchange modes; equivalence work – heat; enthalpy; statements and mathematical expressions for the First Law (closed systems, open system, isolated system).	3	
THERMODYNAMIC PROPERTIES OF PURE SUBSTANCES: ideal gas model laws; perfect gases and their thermodynamic processes (isobaric, isochoric, isothermal, adiabatic and polytropic); models of characterization for non-reacting gas mixtures (Dalton, Amagat); real gases (Boyle temperature, compressibility factor); the van der Waals model; vapor- liquid equilibrium; thermodynamic properties of humid air.	8	
ANALYSES OF THERMODYNAMIC CYCLIC PROCESSES USING THE FIRST LAW: classification of thermal machines (definitions for heat engines, refrigerators and heat pumps) and calculation of their energy conversion efficiency; Carnot cycle, cycle thermal efficiency calculation and definition of exergy and anergy.	3	
SECOND LAW AND ENTROPY: Second Law: reversible and irreversible processes; Kelvin scale; statements of the Second Law; Clausius inequality. Entropy: definition, entropy change for an ideal gas, entropy balance for closed systems.	4	
IDEAL CYCLES: Otto and Diesel cycles of internal combustion engines; Clausius – Rankine cycle; Joule – Brayton cycle.	4	
COURSE TOTAL	28	

Bibliography [13]

1. Floriana Daniela Stoian – Termotehnica (lecture course in Romanian), Politehnica Publishing House, Timisoara, 2016, ISBN 978-606-35-0091-6, 243 pages
2. M.J. Moran, H.N. Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley & Sons, 5th Edition, 2006
3. Yunus A. Cengel, Introduction to Thermodynamics and Heat Transfer, McGraw-Hill, 1997
4. J.M. Powers, Lecture Notes on Thermodynamics, https://www3.nd.edu/~powers/ame.20231/notes.pdf (accesed Dec. 9th, 2020)

8.2 Applied activities [14]	Number of hours	Teaching methods
SEMINARY	14	- calculation of numerical examples and debate of the results; - individual homework - testing of the acquired knowledge.
1. Thermodynamic parameters and their unit measures. 2. The equation of state and the use of the ideal gas model. 3. Simple reversible thermodynamic processes for perfect gases. 4. The thermodynamic analysis of thermodynamic cycles specific to heat engines.	2 2 4 6	
LABORATORY	14	- performing experiments in the laboratory; - data analyses;

[12] Presentation of the teaching methods will include the use of new technologies (e-mail, personalized web page, electronic resources etc.).
[13] At least one title must belong to the discipline team and at least one title should refer to a reference work for discipline, national and international circulation, existing in the UPT library.
[14] Types of application activities are those specified in footnote 5. If the discipline contains several types of applicative activities then they are sequentially in the lines of the table below. The type of activity will be in a distinct line as: "Seminar:", "Laboratory:", "Project:" and / or "Practice/training".

		- testing of the acquired knowledge
1. Temperature measurement using thermometers (with thermometric probe – liquid) and evaluation of the measurement errors. 2. Calibration of a temperature sensor (thermocouple, thermistor) and measurement of the temperature using it. 3. Determination of the specific heat of a solid probe 4. Determination of the specific heat of a liquid probe 5. The analysis of a gas mixture (flue gas) and determination of its characteristic properties 6. Determination of the relative humidity of humid air	2 2 2 2 4 2	

Bibliography [15] M. Jadaneant, Ioana Ionel, Floriana D. Stoian, Gh. Pop, D. Lelea, V. Stoica, A. Negoitescu, Termotehnica si masini termice in experimente (lucrari de laborator), Ed. Politehnica, 2001
2. M. Nagi, L. Mihon, G. Padure, Floriana D. Stoian, Termotehnica – culegere de probleme, Litografia UPT, Timisoara, 1996.
3. Termotehnica si masini termice, culegere de probleme, Litografia UPT, Timisoara, 1982

9. Corroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program

- The content of the curriculum was established in accordance with the specific of the field of study and specialization, with the consultation of the teaching staff of this discipline. Also, the international compatibility with similar courses for the same field of study, taught in worldwide recognized universities, was envisaged.

10. Evaluation

Type of activity	**10.1** Evaluation criteria [16]	**10.2** Evaluation methods	**10.3** Share of the final grade
10.4 Course	1. The knowledge of the course technical terms, the thermodynamic laws and thermodynamic processes applied in engineering. 2. The capacity to adequately use the concepts of Engineering Thermodynamics, and their use to explain and discuss the thermodynamic processes specific to thermodynamic systems and thermal systems.	Written exam (during the examination session) and Participation at the course and at the debate during the course meetings	40%
10.5 Applied activities	**S:** 1. The knowledge of the topics analyzed during the seminars. 2. The capacity to use the thermodynamic laws to evaluate the efficiency of energy conversion in a thermodynamic cycle.	Participation at the seminar activities, presentation of the homework as scheduled, test results and Written exam with 2 exercise subjects (during the examination session)	40 %
	L: The knowledge of experimental methods used during the laboratory activities	Participation at the laboratory activities and evaluation of the knowledge of the experimental methods by scheduled tests. Hand-on report with the experimental data analyses for each lab theme, to be delivered as scheduled before the end of the semester.	20%

[15] At least one title must belong to the discipline team.
[16] Syllabus must contain the procedure for assessing the discipline, specifying the criteria, methods and forms of assessment, as well as specifying the weightings assigned to them in the final grade. The evaluation criteria shall be formulated separately for each activity foreseen in the curriculum (course, seminar, laboratory, project). They will also refer to the forms of verification (homework, papers, etc.)

	P[17]:		
	Pr:		

10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified [18])

- The minimum standard of performance: the knowledge of basic concepts used in Engineering Thermodynamics and the capacity to use the ideal gas model to analyze simple reversible thermodynamic processes.
- The minimum standard (grade 5 out of 10) for the written exam needs to accomplish: a) correct answers at 50% of the theoretical questions; b) to solve correctly an exercise with numerical data, which uses the ideal gas model to analyze a reversible thermodynamic process. The exam grade is the average between the theory and exercise grades, conditioned that each are graded at least 5.
- The calculation of the grade for the activity during the semester: the average between the seminary evaluation grade, the laboratory evaluation grade and the lecture course participation grade (grade 5 – participation at a 2 hours course meeting, grade 10 – at least 20 hours of course meetings).
- The final average is calculated according to the university's regulations, with the coefficients k1 = 2/3 and k2 = 1/3.

Date of completion 09.12.2020	**Course coordinator (signature)** ………………………………	**Coordinator of applied activities (signature)** ………………………………
Head of Department (signature) ………………………………	**Date of approval in the Faculty Council [19]**	**Dean (signature)** ………………………………

---

[17] In the case where the project is not a distinct discipline, this section also specifies how the outcome of the project evaluation makes the admission of the student conditional on the final assessment within the discipline.
[18] It will not explain how the promotion mark is awarded.
[19] The endorsement is preceded by the discussion of the board's view of the study program on the discipline record.