SYLLABUS[1]

1. Information about the program

1.1 Higher education institution	Politehnica University of Timişoara (UPT)
1.2 Faculty[2] / Department[3]	Mechanical Engineering / Materials and Manufacturing Engineering
1.3 Chair	—
1.4 Field of study (name/code[4])	Industrial Engineering/10
1.5 Study cycle	Master
1.6 Study program (name/code/qualification)	Integrated Engineering

2. Information about the discipline

2.1 Name of discipline			**Manufacture of polymeric materials products**				
2.2 Coordinator (holder) of course activities			Assoc. professor STAN Daniel				
2.3 Coordinator (holder) of applied activities [5]			Assist. FERICIAN Florin				
2.4 Year of study[6]	2	**2.5** Semester	1	**2.6** Type of evaluation	E	**2.7** Type of discipline	DA/ compulsory

3. Total estimated time (hours / semester of didactic activities)

3.1 No. of hrs. / week	3 , of which:	**3.2** course	1,5	**3.3** seminar/laboratory/ project/training	1,5
3.4 Total no. of hrs. in the education curricula	42 , of which:	**3.5** course	21	**3.6** applied activities	21
3.7 Distribution of time for individual activities related to the discipline					hrs.
Study using a manual, course materials, bibliography and lecture notes					72
Additional documentation in the library, on specialized electronic platforms and on the field					14
Preparation for seminars / laboratories, homeworks, assignments, portfolios, and essays					42
Tutoring					
Examinations					3
Other activities					
Total hrs. of individual activities					131
3.8 Total hrs. / semester[7]	173				
3.9 No. of credits	7				

4. Prerequisites (where applicable)

4.1 Curriculum	• background knowledge in Chemistry, technical disciplines dealing with mechanics, materials science and/or basics of the manufacturing processes
4.2 Competencies	• engineering 2D and 3D technical drawing, knowledge and practice

5. Conditions (where applicable)

5.1 of the course	• room allocated by the Faculty of Mechanical Engineering
5.2 to conduct practical activities	• "Plastics and processing technologies" lab /SPM, ground floor/ and Multidisciplinary lab /SPM 126/

6. Specific competencies acquired

[1] The form corresponds to the Syllabus promoted by OMECTS 5703/18.12.2011 (Annex3).
[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] Fill in the code provided in GD no. 493/17.07.2013.
[5] The applied activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).
[6] The year of study to which the discipline is provided in the curriculum.
[7] It is obtained by summing up the number of hrs. from 3.4 and 3.7.

Professional competencies[8]	• acquiring knowledge of integrated design, collaborative products design and manufacturing technologies, as well as those necessary for project management • developing skills and ability to find and implement methods to improve the products's quality and work-flow of the manufacturing processes, to ensuring the proper maintenance and reliability of involved systems (http://www.anc.edu.ro/?page_id=610)
Transversal competencies	• knowledges, skills and abilities for planning, optimization and management of the manufacturing processes and production systems

7. Objectives of the discipline (based on the grid of specific competencies acquired)

7.1 General objective of the discipline	• the course introduces the student to concurrent engineering practices used in designing and manufacturing injection molded plastic products
7.2 Specific objectives	• practice of the technical drawings knowledge, use of a commercial computer aided design (CAD) and/or a computer aided engineering (CAE) software, comparing and evaluation of various scenarios (options) for part design, material selection, tool design and process parameters for injection molding, will be reviewed. It is anticipated that the students who complete the course will better understand and appreciate the various forming processing techniques, will be able to organize and to optimize the manufacturing and auxiliaries, and will successfully work in part and technological dies design.

8. Content

8.1 Course	No. of hours	Teaching methods
Polymeric materials & plastics. Definitions and basic concepts: **Nature and structure of polymers. Classification of Plastics:** Thermoplastics, Thermosets, Elastomers (Rubbers): Families Specific applications **Microstructure of the polymers:** Homopolymers, Copolymers (random, block, graft), Polyalloys (blends and alloys), Liquid crystalline polymers, Volumic architecture: „Linear" polymers, Cross-linked polymers, Branched polymers, Amorphous and crystalline polymers **Physical States and Transitions:** Transition from solid to melt, physical states of the polymers. Melt; solid & Crystalline state; Glassy and Rubbery states. Properties and rheological behavior of amorphous and crystalline polymers **Thermal Transitions:** Characteristic temperatures: Glass Transition Temp. Tg; Melting Temp. Tm (Tf). Influence of the molecular weight.	2	Presentation, questioning, guided debates, exercises, PowerPoint and video presentations
Additives and modifiers Types of additives Effect on properties. Polymeric composites / reinforcing fibers,	1	Presentation, questioning, PowerPoint presentations
Mechanical properties of the plastics **Time-Independent Properties (**"short-term Properties"): Tensile Properties; Stress-Strain Relations; Flexural, Compressive Properties, Impact Properties Factors Affecting Short-Term Properties: Temp, Strain Rate, MW,	1,5	Presentation, questioning, PowerPoint presentations

[8] The professional competencies and the transversal competencies will be treated according to the Methodology of OMECTS 5703/18.12.2011. The competencies listed in the National Register of Qualifications in Higher Education [Registrul Naţional al Calificărilor din Învăţământul Superior RNCIS] (http://www.rncis.ro/portal/page?_pageid=117,70218&_dad=portal&_schema=PORTAL) will be used for the field of study from 1.4 and the program of study from 1.6 of this form, involving the discipline.

Cross-Linking **Time-Dependent Properties** ("long Term Properties): Viscoelasticity and Theoretical models; Creep /Stress Relaxation; Fatigue **Non-mechanical properties:** Thermal Properties, Optical, Electrical and Environmental Properties. Water absorption		
Fundamentals of melt rheology: Classification of fluid behavior, Newton's Law of Viscosity and non-newtonian fluids, The effect of temperature and pressure on melt viscosity, The effect of molecular weight and crystallinity rate.	1,5	Presentation, questioning, guided debates, PowerPoint presentations
Processing guide a). Injection molding machines and techniques. The process Cycle: Mold Filling, Mold Packing, Cooling, Ejection, Flowability; Machine settings, quality requirements & failings of the thermoplastic injected parts Basic Mold Design: Basic Geometric Requirements, Gating (Gate Types, Location), Runners. Balancing the filling of the nests, Flow Length, Venting, Mold cooling. Moulded part design guidelines Other specific injection technologies : • Blow Molding, Compression Molding, Transfer Molding • Injection of the thin-wall plastic parts • Microinjection • Bi-material injection molding and overmolding • Injection-compression molding • Gas assisted injection molding, • Reaction injection molding (RIM) • Technologies for plastic parts with inserts b). Other manufacturing technologies Extrusion: materials, process, rheology, die design principles Thermoforming: materials, process, die design Rotational moulding Polymeric composites: materials and manufacturing techniques	7,5	Presentation, questioning, guided debates, exercises, PowerPoint and video presentations
Basics of injected parts design. Green design principles	3	Presentation, questioning, guided debates, exercises, PowerPoint presentations
Polymeric composites. Definition, types, properties, sources, processing technologies, environmental considerations	3	Presentation, questioning, PowerPoint and video presentations
Recycling of the plastics and composites wastes	1,5	Presentation, PowerPoint and video presentations

Bibliography[9]

STAN Daniel - Basics in polymeric materials, course module, UPT, 2011, http://www.eng.upt.ro/leonardo-051/polymers_EN/, **(*)**
HARPER Charles, PETRIE Edward - Plastics materials and processes. A concise encyclopedia, Wiley&Sons Inc., Hoboken, New Jersey, 2003, **(*)**
MALLOY Robert - Plastic part design for injection molding, Carl Hanser Verlag, 1994, **(*)**
SERES Ion - Materiale termoplastice pentru injectare. Tehnologie, Incercari. Date utile, Ed. Imprimeriei de Vest, Oradea 1997, **(**)**
ICLANZAN Tudor - Tehnologia prelucrarii materialelor plastice si composite, Ed. Politehnica, Timisoara, 2006, **(**)**
SERES Ion - Injectarea materialelor termoplastice, Ed Imprimeriei de Vest, Oradea, 1996, **(**)**

(*) = available on DVD, from professor
(**) = available at the Central Library of the UPT

[9] At least one title must belong to the department staff teaching the discipline, and at least 3 titles must refer to national and international works relevant for the discipline, and which can be found in the Politehnica University Library.

8.2 Applied activities[10]	No. of hours	Teaching methods
DESIGN PROJECT Choose a product that could be manufactured by injection moulding. Design the part on paper or using a CAD software. Analyze the functionality of the surfaces and volumes of the part; draw a list of basic requirements (specifications) in order to be taken into consideration for the material selection and mould design. With the aid of the internet and auxiliary sources of information, determine the factors that are of primary, secondary, or minor importance to be considered in selecting a polymer for the product. Write a raport carrying out the following tasks: - Design of the part. - Presentation of the material to be injected: reasoning and possible options (see previous hints). - Evaluation of the part design (or virtual computer model) for its moldability. - Establish the part line, the number of the nests in the mould and ejector system type. - Make a critical analyze of the the geometric configuration of the part with reference to various scenarios customized by number and position of the injection points and vents. - Complete the presentation with your opinions about the nest filling & post-filling behavior of the material, possibility of getting injection faults such as: weld line and air traps, warpage of the part. Argumentation with results of CAE flow analysis (MoldFlow, SolidWorks, Catia) will be appreciated. - Analyze of the assembly features and functionality of the parts. - Optimization of the product design (if the case)	21	questioning, guided debates, data base use and CAE simulations assisted work at class Individual study & work

Bibliography [11]

STAN Daniel - Basics in polymeric materials, course module, UPT, 2011, http://www.eng.upt.ro/leonardo-051/polymers_EN/, **(*)**

HARPER Charles, PETRIE Edward - Plastics materials and processes. A concise encyclopedia, Wiley&Sons Inc., Hoboken, New Jersey, 2003, **(*)**

MALLOY Robert - Plastic part design for injection molding, Carl Hanser Verlag, 1994, **(*)**

SERES Ion - Materiale termoplastice pentru injectare. Tehnologie, Incercari. Date utile, Ed. Imprimeriei de Vest, Oradea 1997, **(**)**

ICLANZAN Tudor - Tehnologia prelucrarii materialelor plastice si composite, Ed. Politehnica, Timisoara, 2006, **(**)**

SERES Ion - Injectarea materialelor termoplastice, Ed Imprimeriei de Vest, Oradea, 1996, **(**)**

+ course notes from the current year

(*) = available on DVD, from professor
(**) = available at the UPT Library

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

Periodically, the representatives of industrial units from the west side of the country that hire Manufacturing Engineering (TCM) graduates are asked about the preferences on knowledge and skills appreciated at hiring. The results were discussed at the TCM Board meetings and the curriculum of TCM specialization, also the content of disciplines, were modified to meet the requirements of employers.

International references:

- Ecole de Mines de Paris, Franta, /Mines ParisTech, https://sgs.mines2paristech.fr/prod/sgs/ensmp/catalog/course/detail.php?code=MP6825&lang=EN , accesat 20 mar.2014
- KTH Royal Institute of Technology, Stockholm, Sweden, http://www.kth.se/student/kurser/kurs/KF2290?l=en , accesat: 26 mar. 2014

[10] The types of applied activities are those specified in footnote 5. If the discipline contains several types of applied activities, then these will be written consecutively in the lines of the table below. The type of activity will be written in a distinct line, as „Seminar:", „Laboratory:", „Project:" and/or „Practice/Training:".

[11] At least one title must belong to the staff teaching the discipline.

- Lulea University of Technology, Lulea, Sweden, http://www.ltu.se/edu/course/T70/T7010T?l=en&kursView=kursplan , accesat: 26 mar. 2013
- KU Leuven, Faculty of Engineering Science, http://onderwijsaanbod.kuleuven.be/syllabi/e/H09F7AE.htm#activetab=plaatsen , accesat: 26 mar. 2014

10. Evaluation

Type of activity	**10.1** Evaluation criteria	**10.2** Evaluation methods	**10.3** Share of the final grade
10.4 Course	Engineering content of the presentation and viable technical arguments for the content of this. Good engineering reaction at the questions from the audience.	Each student will develop a design project for a plastic (polymer) article. The design will include specifications about recommended material, processing method and mould design, expected faults. The student will prepare and advocate an open class presentation. Each affirmation must be argued at engineering level. Computer solutions (CAD, CAE, simulations,...) are encouraged when appropriate.	60 %
10.5 Applied activities	**S:**		
	L:		
	P: The class activity is reflected by the content of the presentation and technical arguments		40 %
	Pr:		
10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified)			
• engineering level of the presentation • appropriate and viable technical solutions • prompt reactions at the questions from the audience			

Date of completion 02.09.2015	**Course coordinator (signature)** ……	**Coordinator of applied activities (signature)** ……
Head of Department (signature) ……	**Date of approval in the Faculty Council**[12]	**Dean (signature)** ……

[12] Avizarea este precedată de discutarea punctului de vedere al board-ului de care aparţine programul de studiu cu privire la fişa disciplinei.