UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2018/2019
MASTER'S DEGREE (MSC)	MECHANICAL ENGINEERING
SUBJECT	COMPLEMENTS OF MECHANIC TECHNOLOGY
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50370-Ingegneria meccanica
CODE	02123
SCIENTIFIC SECTOR(S)	ING-IND/16
HEAD PROFESSOR(S)	INGARAO GIUSEPPE Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**INGARAO GIUSEPPE** Monday 12:00 16:00 Dipartimento di Ingegneria, Universita degli Studi di Palermo - Viale delle Scienze - 90128 PALERMO (ITALY) Thursday 14:00 18:00 Dipartimento di Ingegneria, Universita degli Studi di Palermo - Viale delle Scienze - 90128 PALERMO (ITALY)

DOCENTE: Prof. GIUSEPPE INGARAO

PREREQUISITES	knowledge of manufacturing processes; specifically, expertise concerning metal shaping processes is highly recommended. •Mechanical as well technological properties of engineering materials •Mechanical as well technological properties of engineering materials
LEARNING OUTCOMES	Knowlendge and comprehension skills. Students will have acquired knowledge concerning several manufacturing processes. Specifically they will be expert in metal shaping processes, as they will have a proper knowledge concerning conventional, non conventional as well as additive manufacturing processes. They will be able to both design such processes and indentify the most suitable manufacturing technology with varying the production scenario. In fact, they will know the effect of the main process parameters on product quality for each studied process. In addition to technological knowledge the course will provide the students with topics and techniques concerning the environmental impact of manufacturing processes. As a results, the student will be able to identify suitable manufacturing processes for product/component manufacturing considering both technological and environmental design objectives. Students will be aware about environmental impact arising from the different steps of a product/component life cycle: material consumption, manufacturing stage, use phase and end of life options. Ability to apply the acquired knowledge. The student will be able to identify the proper metal manufacturing process as well as the related process parameters. Students will identify the best manufacturing approach considering both technological and environmental design objectives. Specifically, during practical classes the students can apply the acquired knowledge to real case studies. Moreover the course envisages some practical classes to be held in the manufacturing technology workshop, during such practical classes the students can apply what learned in frontal classes to practical manufacturing processes. Also, during oral examination two extra questions will be asked to foster the student reasoning and to test his/her problem solving skills. Independent thinking skills. The students will have learned techniques aimed at analyzing the environmental impact well as technological performance of processes. The students, will be able to both identify the main issues and to propose innovative strategies to minimize the environmental impact of a given process Communication skills. Students will be able to proper communicate the acquired contents, specifically they will be able to take part to technical discussions concerning the topics dealt with during the course. Communication skills will be fostered by case studies analysis developed within the practical classes as well as by the project work presentation. Learning skills. Students, at the end of the course, can analyze the technological and environmental performance of several metal shaping processes . Students should be able to independently implement technological and ecological analyses of an assigned case study. Moreover they have to prove they can propose new design strategies to improve technological and ecological performances of a processes. The acquired knowledge will allow the students to continue engineering degree course with a better awareness.
ASSESSMENT METHODS	The evaluation procedure consists of a written test will take place. The written test will be made of 5/6 questions. The questions will cover all the main topics of the courses and will concern both theoretical as well as experimental aspects of the course. Three questions will aim at covering all the main topics dealt with within the course. Subsequently, the remaining (2/3) questions will be asked to evaluate both the level of personal reinterpretation of the learned contents as well as the ability to apply the acquired knowledge to real case studies. Such extra questions will be properly structured and will be also less specific to foster the student reasoning and to test his/her problem-solving skills. Students will receive a mark (on a scale of 30) for the written test. Each question will have an its own score and the final vote will be the sum of the score the student got in each question. The student will be positively evaluated only if they prove to have at least an acceptable knowledge of the topics provided during the course. The mark will rise as the level of knowledge, the ability of personal reinterpretation of as well as the aptitude to apply acquired knowledge to real case studies improve. After the written test the student will be proposed a vote. The student can either accept the proposed vote or undertake a further oral examination. The oral examination will be made of three questions. Two of them will need to discuss about possible knowledge issues rose in the written test , the last one will be also less specific to foster the student reasoning and to test his/her problem solving skills. This further examination step can either improve or worsen the score previously obtained by the student. In fact the final new (on a scale of 30) score, will be given by the arithmetic mean between the written test (on a scale of 30) and the

	oral examination marks (on a scale of 30).
EDUCATIONAL OBJECTIVES	The course aims at providing the students with knowledge concerning metal shaping manufacturing processes. The course deals with conventional, non conventional as well as additive manufacturing processes. Overall the course aims to increase the awareness of young engineers concerning innovative manufacturing processes, analyzing the effect of process parameters on technological and environmental design objectives.
TEACHING METHODS	Frontal classes, practical session to be held both in classes and in the workshop
SUGGESTED BIBLIOGRAPHY	F. GABRIELLI, R. IPPOLITO, F. MICARI – Analisi e Tecnologia delle Lavorazioni Meccaniche – McGraw-Hill, 2008. Material and the Environment (Ecoinformed Material Choice) Micheal F. Ashby Elsevier, second edition,2012; Tecnologia meccanica: le lavorazioni non convenzionali Monno, Previtali, Strano CittaStudi Ed.,2012.

SYLLABUS

Hrs	Frontal teaching
3	Sheet metal forming proceses: the basics
3	complex sheet metal stamping processes design
4	Light-Weight materials-Advanced High Strength Steel (AHSS)-Tailored Blanks
2	Forming Limit Stress Diagram (FLSD)
8	nnovative sheet metal forming processes (Incremental forming, Hydroforming, hot stamping and heat assisted processes)
4	Laser based processes
3	Plasm Arc processes
2	Electro Discharge Machining
1	Electrochemical machining
1	Electron beam processes
2	Water Jet/Abrasive Water jet processes
6	Additive Manufacturing processes
4	Environmental impact of materials production, Concept of embodied energy, Life Cycle Engineering (LCA) techniques.
3	End of life strategies and innovative recycling processes
2	Environmental impact analysis at unit process level
3	Environmental comparative analyses of different manufacturing approaches
1	Ultrasonic processes

Hrs	Practice
3	Practical classes on F.E.M assisted Sheet metal forming design
3	Analysis of industrial sheet stamping processes. from the reverse engineering to the FEM based engineering design
3	ARAMIS supported FLD development
3	Cold SPIF processes with strain analyses through ARAMIS
3	Warm SPIF processes
3	CAD/CAM integration for tool path generation in SPIF processes
3	Innovative (solid bonding based) recycling processes
3	practical class on environmental impact analyses of product/process
2	Practical class on Additive Manufacturing