Course description

1 General information

Course name	**Advanced non-conventional and additive manufacturing processes**
Course code	
Level of study (B.Sc, M.Sc., Ph.D.)	B.Sc
ECTS	5
Course manager	Dominik Wyszynski, DSc, Eng.
Course length	One (1) semester
Coordinator for international programs	erasmus@mech.pk.edu.pl

2 Prerequisites

- Basic knowledge of physics, chemistry, machine building, computer aided design and manufacturing

2 Program

Type	Lectures	Classes	Labs	Computer labs	Project	Seminar
Hours	30		15		15	

3 Contents

Lectures		
No.		Hours
1	Conventional vs Unconventional machining	2
2	Pulse Electrochemical micro machining (PECM, μ-ECM)	2
3	Electrodischarge micromachining (μ-EDM)	2
4	Other thermal non-conventional processes (advanced laser beam processing, electron beam soldering and cladding, plasma beam machining and cladding electrical arc cladding)	5
5	Hybrid manufacturing processes (principles, electrochemically assisted machining, ultrasonic assisted machining, laser assisted machining, electrochemical-electrodischarge machining etc.)	4
6	Additive manufacturing processes (principles, solid-based, liquid-based and powder-based methods). Reverse engineering.	10
7	Idea of rapid prototyping, tooling and manufacturing, examples of application.	2
8	The role of advanced non-conventional manufacturing processes in modern manufacturing chain and Indusrty4.0.	1
9	Future trends in non-conventional machining, hybrid machining and additive manufacturing.	2
Σ		30

Labs		
No.		Hours
1	Electrochemical micro sinking (universal cylindrical and pipe electrode)	2
2	Electrodischarge sinking of microscale holes (universal cylindrical and pipe electrode)	2
3	Electrochemical-electrodischarge machining	2
4	Photogrammetry	2
5	Fused Deposition Modeling	2
6	Stereolitography (SLA)	2
7	Selective laser sintering	2
8	Final classes – test.	1
Σ		15

Projects		
No.		Hours
1	μ-EDM drilling	2
2	μ-ECM shape electrode sinking	2
3	Laser micro drilling and trepanning	2
4	Laser cleaning and art restauration	2
5	Laser bending	2
5	Non-nonventional parts and tool regeneration	2
6	Computed axial lithography	1
7	LaserProFusion (EOS)	1
8	3D organ printing	1
Σ		15

3 Learning Outcomes (skills and knowledge):

- Student knows pros and cons of non-conventional machining.
- Student understand physical principles of selected advanced non-conventional manufacturing processes
- Student can explain the role of advanced non-conventional manufacturing processes in manufacturing chain.
- Student can explain what is reverse engineering
- Student knows principles of additive manufacturing
- Student understands principles of additive manufacturing process planning and execution
- Student knows advantages and drawbacks of parts manufactured by additive methods
- Student can describe main methods of 3D scanning.

4 Assessment policy (examination):

- Understanding the merits of non-conventional manufacturing.
- Understanding the merits of hybrid machining.
- Understanding the merits of additive manufacturing.
- Ability to select the adequate advanced non-conventional, hybrid or additive manufacturing method for given part.

5 Literature

- Hassan El-Hofy. Advanced Machining Processes. Nontraditional and Hybrid Machining Processes, McGraw-Hill, 2005.
- Helmi A. Youssef, Hassan El-Hofy, Machining Technology: Machine Tools and Operations, CRC Press, 2008.
- Ian Gibson, · David Rosen, Brent Stucker. Additive Manufacturing Technologies - 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing , 2015
- Bert Huis in 't Veld, Micro additive manufacturing using ultra short laser pulses, CIRP Annals - Manufacturing Technology 64 (2015) 701–724