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| **Course code** | CC3 |
| **Type and description** | CC - Core Curriculum for the Mechanical Engineering Discipline |
| **ECTS credit** | 1 |
| **Course name** | **Advanced Manufacturing** |
| **Course name in Polish** | **Zaawansowane Techniki Wytwarzania** |
| **Language of instruction** | English |
| **Course level** | 8 PRK |
| **Course coordinator**  | **Ph.D. D.Sc. Bogusław Pisarek, prof. LUT,** |
| **Course instructors** | **Ph.D. D.Sc. Bogusław Pisarek, prof. LUT, Ph.D. D.Sc inż. Ryszard Władysiak, prof. LUT, Ph.D. D.Sc Grzegorz Gumienny, prof. LUT, Ph.D. D.Sc.. Wojciech Stachurski** |
| **Delivery methods and course duration** |

|  | **Lecture** | **Tutorials** | **Laboratory** | **Project** | **Seminar** | **Other** | **Total of teaching hours during semester** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Contact hours | 12 |  | 8 |  |  |  | 20 |
| E-learning | No | No | No | No | No | No |  |
| Assessment criteria (weightage) | 0,70 |  | 0,30 |  |  |  |  |

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| **Course objective** | 1. The aim of the course is to enable PhD students to get advanced knowledge about modern casting and machining processes.2. The aim of the course is to familiarize PhD students with cutting tools and process condition monitoring. |
| **Learning outcomes** | A PhD student after completing the course can:1. characterize processes that modify the physicochemical state of a liquid alloy – W1, U4, K3;
2. characterize advanced casting techniques and processes occurring during pouring moulds, solidification and crystallization of the alloy in the mould – W1, U4, K3;
3. evaluate and choose the right casting technique depending on the requirements of the product and production seriality – W1, U1, K1–K3;
4. characterize unconventional material removal processes – W1, U4, K1;
5. describe modern technologies used in machining processes – W1, U4, K1;
6. interpret and evaluate the influence of machining conditions on the surface integrity of the workpiece – W1, U1, U4, K1;
7. describe and apply measuring systems in the monitoring of the tool and cutting process – W1, U1, U4, K1.
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| **Assessment methods** | Verification methods of learning outcomes:learning outcome 1–7 – written examlearning outcome 1, 2, 6, 7 – reports from laboratory exercisesThe final grade consists of:the grade of the written exam – 70%the grade of the laboratory exercise reports – 30% |
| **Prerequisites** |  |
| **Course content with delivery methods** | LECTURE1. Advanced techniques of feeding castings and liquid alloys treatments.
2. Manufacturing castings with directional and monocrystalline structure; cast composites; pressing in a liquid state; casting in semi-solid state; 3D printing of moulds, 3D printing of metal parts of machines and devices.
3. Application of computer techniques in advanced foundry processes.
4. Unconventional material removal processes: erosion machining, concentrated energy beam machining, hybrid machining.
5. Machining of difficult-to-cut materials. Machining of hard and hardened materials.
6. High speed machining (HSM). High performance machining (HPM).
7. Ultraprecision machining (UPM). Micromachining and nanomachining.
8. Machining with modular, multi-task and mechatronic tools.
9. Unconventional methods of coolant (cutting fluid) supply in the machining processes: dry machining, minimum quantity lubrication (MQL), cryogenic cooling. Unconventional coolants: vegetable oils, nanofluids.
10. Surface integrity in machining. Technological surface layer. Surface layer parameters. Surface texture (ST).
11. Tool and process condition monitoring.

LABORATORY1. In-mould spheroidization technique of cast iron.
2. Casting of aluminium metal matrix composites.
3. Monitoring of machining process condition – measurement of vibration signal, acoustic emission (AE) and cutting force.
4. Surface layer condition after machining – measurements of surface texture parameters.
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| **Basic reference materials** | 1. Mahi Sahoo, Ph.D., Sudhari "Sam" Sahu, Ph.D: Principles of Metal Casting, Third Edition, 2014, Publisher: McGraw-Hill Education: New York, ISBN: 9780071789752.
2. Grzesik W., 2016. Advanced Machining Processes of Metallic Materials: Theory, Modelling and Applications. 2nd Edition. Elsevier.
3. Davim J.P. (ed.), 2010. Surface Integrity in Machining. Springer.
4. Teti R., Jemielniak K., O'Donnell G., Dornfeld D., 2010. Advanced monitoring of machining operations. CIRP Annals - Manufacturing Technology, vol. 59/2, pp. 717-739.
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| **Other reference materials** | 1. Campbell, J.: Complete Casting Handbook, 2011. Published by Elsevier Ltd.
2. Groover, M.P., 2008. Automation, Production Systems, and Computer-Integrated Manufacturing. Prentice Hall Int. Edition, 2008.
3. Kruszyński B., 2001. Surface integrity in grinding. A Series of Monographs, The Technical University Press, Łódź, Poland.
4. Groover M.P., 2010. Fundamentals of Modern Manufacturing: Materials, Processes and Systems. 4th edition. John Wiley &Sons, Inc., USA.
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| **Average student workload outside classroom** | 10h |
| **Comments** |  |
| **Last update** |  |