ADVANCED MATERIALS TECHNOLOGY

(2+1; Signature, Practical mark, Credits 3)

(Annotation)

Primary shaping technologies. Fundamentals of powder metallurgy. Characteristic P/M product of metals, ceramics and composites. Modern casting processes for metal parts. Properties of metal castings. Design principles of cast product. Theoretical principles of metal forming. Production of seamless and welded pipes. Introduction to welding theory. The most important fuse and pressure welding processes. Welding relatives: thermal cutting, brazing, soldering and thermal spray. Primary heat treating processes for mechanical engineering. Heat and material transport. Annealing processes. Strengthening and hardening. Toughening. Surface modification using thermal, physical and chemical methods.

References

AMS Metals Handbook, Vol. 4 Heat Treating

AMS Metals Handbook, Vol. 6 Welding, Brazing and Soldering

AMS Metals Handbook, Vol. 7 Powder Metal Technologies

AMS Metals Handbook, Vol. 15 Casting

ADVANCED MATERIALS TECHNOLOGY

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(Lecture programme)

1st week Introduction to materials technology. Shaping and forming technologies. Primary shaping processes. Powder metallurgy. Powder making. Mixing. Compacting. Sintering. Secondary operations. Typical P/M products of metals, ceramics and composites.

2nd week Casting. Freedom and limitations of shaping. Classification of casting processes. Properties of castings. Casting into sand mould. Pattern making. Moulding. Casting. Cleaning of castings. Advanced mould materials and moulding procedures. Pressure casting. Design principles for metal castings.

3rd week Sport holiday

4th week Fundamentals of heat treating processes for mechanical engineering. Temperature - time diagrams. Newton's law of cooling. Classification of heat treating processes on the basis of volume and desired properties. Volumetric an surface heat treating. Softening with and without austenitising. Annealing other goals than softening.

5th week Strengthening/Hardening. Quenching with continuous cooling. Quenching conditions. Cooling operation of quenching (CCT diagram). Quenchants. Martensite ratio in hardened condition. Mass effect. Hardened volume. Surface quenching. Tempering after quenching: LTT and HTT. Toughening processes. Q+T, austempering, normalising.

6th week Strengthening/Hardening with precipitation. Precipitation hardening of aluminium alloys. Application of precipitation hardening for cold and hot forming and high speed tool steels. Conditions of precipitation hardening. Testing of heat treated conditions.

7th week Surface alloying technologies. Carburisation. Structure and properties of hard layer. Case hardening. Quality assurance. Nitriding in gaseous atmosphere. Technology. Comparison of case hardened layers to nitrided ones. Microscopic and mechanical testing of hardened layers.

8th week Thermal joining and cutting processes. Definition of welding. Classification of welding processes. Widely applied manual welding processes: GTAW and SMAW. Principles, advantages, limitations, welding equipments, filler materials, economical application possibilities.

9th week Popular welding processes, suitable for mechanisation: GMAW, SAW. Wire feeders. Principles, advantages, limitations, welding equipments, filler materials, economical application possibilities. Mechanisation and numerical control.

10th week Advanced welding processes. Radiation welding processes: laser and electron beam welding. Economical application possibilities. Conditions affecting joint quality. Solid state pressure welding processes. Cold, friction, ultrasonic and detonation welding.

11th week Brazing and soldering as welding relatives. Weld brazing. Process of brazing. Fillers for brazing. Fluxes. Heat sources. Manual and automatic processes. Application fields. Properties of brazed joints. Soldering.

12th week Theoretical bases of pressure welding. Role of pressure force. Surface cleaning before welding. Resistance welding of sheets, bars and pipes. Heat sources for resistance welding. Flow diagram of spot welding. Direct and indirect spot welding. Multi-spot welding.

13th week Welding machines. Electrodes: shapes, dimensions and materials. Flow diagram. Weldability lobe with constant electrode force. Spot welding of steels other than low carbon ones and non-ferrous metals. Destructive testing of spot welded joints. Projection welding. Seam welding without and with foil. HF resistance welding.

14th week Fundamentals of rolling. Rolling of bars, shapes, plates, pipes and tubes. Piercing. Wall reducing with forging and rolling. Extrusion of pipes. Seamless pipes. Welded pipes. Longitudinal and helical welds. Welding of pipe joints with fuse and resistant processes.

Miskolc, September 01 2015

Dr. Balogh András
Associate Professor, Lecturer

ADVANCED MATERIALS PROCESSING

(2+1; Signature, Practical mark, Credits 3)

(Programme of Practical Lessons)

Week	Topic	Room
1-4th	Review of the basics of materials sciences, materials testing and materials engineering.	C/2 202
5th	Introduction to typical P/M and casted products. Precision casting.	C/2 202
6th	Introduction to heat treatment technologies. Furnaces. Plasma nitriding equipment.	C/2 Heat Treatment Laboratory
7th	Finite element modelling of materials processes.	C/2 202
8-9th	Introduction of fusion welding equipment. Welding monitoring system.	C/2 Welding Laboratory
10th	Introduction of pressure welding equipment.	C/2 Welding Laboratory
11th	Shielded metal arc welding (SMAW). Gas metal arc welding (GMAW). Practical lesson.	C/2 Welding Laboratory
12th	Gas tungsten arc welding (GTAW). Oxy-acetylene flame welding. Practical lesson.	C/2 Welding Laboratory
13-14th	Students' presentations about their project work	C/2 202

Miskolc, September 01 2015

Gáspár Marcell
Subject coordinator