**Name of the module: Magnesium Science and Technology**

**Number of module: 365-2-6581**

BGU Credits: 3

ECTS credits: 4

Academic year: 2012-2013

Semester: 2nd semester

Hours of instruction: 3 hours lecture per week

Location of instruction: will be defined

Language of instruction: Hebrew

Cycle: ?

Position: an advanced course for graduate students of Materials Engineering Department

Field of Education: Materials Engineering

Responsible department: Materials Engineering

General prerequisites: None

Grading scale: the grading scale would be determined on a scale of 0 – 100 (0 would indicate failure and 100 complete success 0 to 100), passing grade is 65.

Lecturer: Prof. Eli Aghion

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Office hours:

Tuesday, from 2 to 4 PM

Module evaluation: at the end of the semester the students will evaluate the module, in order to draw conclusions for the lecturer and university's internal needs.

Course Description:

The course will explore the links between the main three metallurgical phases of metal handling: extraction, processing and physical metallurgy. Magnesium as a light structural material for the transportation industry and 3C components (Computer, Communications and Customer electronics including notebook) will be selected as a demonstrating metal. The course will mainly focus on: characteristics of Mg alloys vs. other light materials, principals of magnesium extraction processes by electrolysis and thermal reduction, processing and physical metallurgy characteristics of cast and wrought Mg alloys, heat treatment, corrosion performance and recycling technologies of Mg alloys.

Aims of the module:

The intention of this module is to introduce the metallurgy of a conventional metal from the extraction process up to the final forming of a component. Magnesium was selected as a demonstrating metal due to it's beneficial effect on the environment as a light structural material and due to the existing of a large local industry that relates to Mg extraction and processing.

Objectives of the module:

To familiarize students with the metallurgy and applications of pure Mg and Mg alloys. In particular the use of Mg as a light structural material that have a beneficial impact in terms of environmental conservation.

Learning outcomes of the module:

On successful completion of the course the students should be able to:

1. Identify the characteristics of Mg and their properties vs. other light structural materials.
2. Understand the principals of magnesium extraction processes by electrolysis and thermal reduction.
3. Identify the applications of pure Mg and Mg alloys.
4. Understand the metallurgical and processing characteristics of cast and wrought Mg alloys.
5. Understand the principals of heat treatment, corrosion mechanism and recycling technologies of Mg alloys (3h).

Attendance regulation: attendance and participation in class is mandatory (at least 80%).

Confirmation: the syllabus was confirmed by the faculty academic advisory committee to be valid on 2012-2013.

Last update: 21.10.2012

Teaching arrangement and method of instruction: lectures and assignments.

Assessment:

Individual assignment 70%

Final Exam: 30%\_

100%

Work and assignments: Individual assignment and class presentation.

Time required for individual work: in addition to attendance in class, the students are expected to do their assignment and individual work: at least 3 hours per week.

Module Content\ schedule and outlines:

Magnesium characteristics and Mg properties vs. aluminum, plastics and steels, scale of Mg industry (3h).

Extraction technologies of pure Mg: Raw materials, electrolytic principals – MgCl2 preparation, dehydration and chlorination, electrolysis (3h).

Electrolytic processes with substitute and constant electrolytes (3h).

Thermal reduction processes: Siliconthermic, Carbothermic and Aluminothermic processes (3h).

Applications of pure Mg: Alloying element, cathodic protection, steel desulphurization, Cast iron nodulation, metal reduction, chemical applications (3h).

Applications of Mg alloys in various industries: Transportation, 3C components and biodegradable medical devices (3h).

Metallurgy of Mg alloys: Liquid solubility of elements in Mg, metallurgical characteristics of cast Mg alloys (3h).

Metallurgical characteristics of wrought Mg alloy (3h).

Metallurgical characteristics of special Mg systems such as Super light Mg-Li alloys, Rapid solidified alloys and MMC (3h).

Development of new Mg alloys with increased ductility or improved creep resistance (3h).

Heat treatment and corrosion performance of Mg alloys (3h).

Casting technologies of Mg alloys: Die casting, Sand casting, and permanent mold casting (3h).

Recycling technologies of Mg: Flux and Flux less processes (3h).

Required reading:

1. Magnesium alloys - Science Technology and applications, E. Aghion and D. Eliezer, Technion - S. Neaman Institute, 2004.
2. Magnesium Technology, H. Horst and B. Mordike, Springer, 2006.
3. Magnesium and Magnesium alloys, M. Avedesian and H. Baker, ASM International 1999.

Additional literature:

1. Magnesium 2000, 2nd Israeli Inter. Conf. on Magnesium Science and Technology, E. Aghion and D. Eliezer, Dead sea, Israel Feb. 2000.
2. Magnesium Technology 2012, TMS annual meeting, S.N. Mathaudhu, W.H. Sillekens, N.R. Neelameggham and N. Hort, Orlando, Florida, USA, March 2012.