



UNIVERSITY OF MISKOLC

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**FACULTY OF  
EARTH AND ENVIRONMENTAL  
SCIENCE AND ENGINEERING**

**Subject name:  
Recycling of Metallic and Rubber Wastes**

**FACULTY OF EARTH AND ENVIRONMENTAL SCIENCES & ENGINEERING  
MSc education**

**Course communication dossier**

**UNIVERSITY OF MISKOLC  
FACULTY OF EARTH AND ENVIRONMENTAL SCIENCES & ENGINEERING  
Institute of Raw Materials Preparation and Environmental Technology**

**Recommended semester: 3**

## **Contents**

1. Course description (Content, Lecturer, Number of classes, Credits)
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3. Example for written examination (Sample classroom test)
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## 1. COURSE DESCRIPTION

<b>Course Title: Recycling of Metallic and Rubber Wastes</b>		<b>Credits: 3</b>
Type of course: compulsory	Neptun code: MFEET730018	
Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: 2 <b>sem</b>		
<b>Type of Assessment</b> (exam. / pr. mark. / other): <b>pr. mark</b>		
<b>Assessment and grading</b> Requirements of the practical mark: Less than 20 % class missing; Presenting the laboratory measurements reports; Writing the classroom test successfully		
<b>Assessment:</b> Five grades scale Assessment according to a five grade scale: <ul style="list-style-type: none"> <li>Missing basic knowledge – unacceptable</li> <li>Student demonstrates basic knowledge – acceptable</li> <li>Student demonstrates basic knowledge and can apply it in practice – intermediate</li> <li>Student demonstrates system level knowledge in contexts – good</li> <li>Student demonstrates outstanding system level knowledge in contexts - excellent</li> </ul>		
<b>Assessment:</b> 88 – 100: excellent (5), 75 – 87: good (4), 63 – 74: intermediate (3), 51 – 62: acceptable (2), ≤50: unacceptable (1).		
Position in Curriculum (which semester): 3		
Pre-requisites ( <i>if any</i> ): -		
<b>Course Description:</b>		
<p><b>Aim of the course:</b> Understand the importance of metallic and rubber waste management for recovery of structural materials. Get acquainted with metallic and rubber waste material flows, compositions, and the possible recycling technologies.</p> <p><b>Course description:</b> Technologies of processing and utilization of metal and rubber containing wastes. Main groups of introduced wastes: electronic wastes, end of life vehicle wastes. Mechanical, chemical and thermal processes of preparation. Knowledge of quality related to products. Detailed topics: Introduction of waste types. Waste amounts (absolute and specific). Technological backgrounds 1: Comminution. Technological backgrounds 2: Separators. Processing of waste cables, wires. Processing of WEEE: Computer, laptop. Processing of WEEE: TVs and monitors. Calculation: determination of yield, mass ratio, product quality. Processing of large household equipment. Used tyre recycling. EoLV recycling, accumulator recycling. Laboratory experiment and evaluation of results.</p>		
The 3-5 most important compulsory, or recommended <b>literature</b> (textbook, book) <b>resources:</b>		
<p>V. Goodship: Waste Electrical and Electronic Equipment (WEEE) handbook. Woodhead Publishing Limited, 2012.</p> <p>M. E. Schlesinger: Aluminium Recycling. CRC Press</p> <p>R. E. Hester: Electronic Waste Management, RSC Publishing, 2009.</p>		

J. Földessy: Critical Monography Series 10: Research of Strategic Raw Materials in Hungary. Miskolc, 2014.

Alexandre Chagnes, Gérard Cote, Christian Ekberg, Mikael Nilsson, Teodora Retegan: WEEE Recycling: Research, Development, and Policies. Elsevier, 2016.

Schönmayr, David: Automotive Recycling, Plastics, and Sustainability: The Recycling Renaissance

Sally Morgan: Waste, Recycling and Reuse. White-Thomson Publishing Ltd. 2006.

**Competencies to evolve:**

***Knowledge***

Knows and applies scientific and technical theory and practice related to the profession of environmental engineering.

Has a comprehensive knowledge of measurement technology and measurement theory related to the field of environmental engineering.

Knows the promotion and opinion-forming methods related to environmental engineering.

***Skills***

Can apply the acquired general and specific mathematical, natural and social science principles, rules, connections and procedures in solving problems arising in the field of environmental protection.

Able to perform environmental management tasks.

Able to plan in a complex way, implement and maintain engineering interventions in the fields of soil, subsurface, water, air, noise and vibration protection, wildlife protection, remediation and waste reduction, treatment, and processing.

Able to design, implement and operate environment-focused management systems.

***Competence in terms of attitude***

Open and receptive to the knowledge and acceptance of professional, technological development and innovation in the field of environmental protection, and its authentic mediation.

Strives to carry out the required work in a complex approach based on a systems-based and process-oriented way of thinking.

***Competence in terms of autonomy and responsibility***

Takes the initiative in solving environmental problems, identifies the shortcomings of the applied technologies, the risks of the processes and initiates the measures to reduce them.

Evaluates the work of subordinated employees, promotes their professional development by sharing critical remarks, educates employees and subordinates on responsible and moral professional practice.

Monitors legislative, technical, technological and administrative changes in the field of profession.

**Responsible Instructor** (*name, position, scientific degree*): Sándor NAGY (PhD)

**Other Faculty Member(s) Involved in Teaching**, if any (*name, position, scientific degree*):

## 2. COURSE TOPICS

### Recycling of Metallic and Rubber Wastes Course topics (WEEKLY SCHEDULE)

Hét	Dátum - <i>Date</i>	Practical Classes
1.		Introduction of waste types
2.		Waste amounts (absolute and specific)
3.		Technological backgrounds 1: Comminution
4.		Technological backgrounds 2: Separators
5.		Processing of waste cables
6.		Processing of WEEE: Computer, laptop
7.		Processing of WEEE: TVs and monitors
8.		Calculation: determination of yield, mass ratio, product quality
9.		Processing of large household equipment
10.		Used tyre recycling
11.		ELV recycling, accumulator recycling
12.		Laboratory experiment and evaluation of results
13.		Written examination
14.		Written examination

### 3. SAMPLE Written examination example

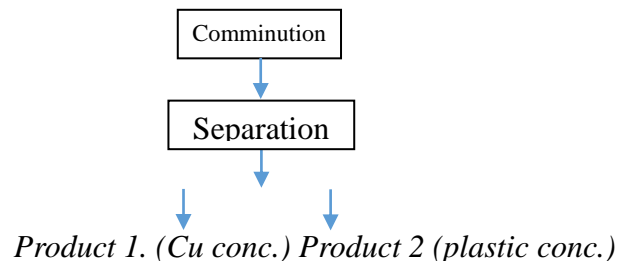
1. Introduce the waste cable processing technology (short description and flowsheet)!

*Seminar ppt includes the answers.*

2. Introduce ELV processing (amount of waste, material composition of ELV, processing technology)!

*Seminar ppt includes the answers.*

3. Determinate the mass ratio and yield of the products!



Product	Cu content (%)	Plastic content (%)	SUM (%)
Cu concentrate	b=95,5	4,5	100,0
Plastic concentrate	c=0,5	99,5	100,0
Feed	a=22,5	77,5	100,0

Product	Cu content (%)	Mass ratio (%)	Yield (Cu) (%)
Cu concentrate	95,5	$m_b = (a-c)/(b-c) = 23,16\%$	$k_b = m_b b/a = 98,30$
Plastic concentrate	0,5	$m_c = (a-b)/(c-b) = 100 - m_b = 76,84\%$	$k_c = m_c c/a = 100 - k_b = 1,70\%$
Feed	22,5	100,00	100,00

#### **4. EXAM QUESTIONS**

#### **5. OTHER REQUIREMENTS**

*Using mobile phones during the exam is forbidden.*

Miskolc, 04/01/2023

Dr. Sándor Nagy  
Head of Institute, Associate Professor