

Engineering Program

Specialization Production and Computer Aided Manufacturing Technology

Course Number **020202211**

Course Title **Metallurgical Treatment**

Credit Hours (2)

Theoretical Hours (2)

Practical Hours (0)

Brief Course Description:

Property change due to heat treatment. Iron-carbon system. Surface hardening. Powder metallurgy, metal surface treatment. Composite materials. Electro plating. Chemical and mechanical treatment of ferrous materials and alloys. Destructive and non-destructive evaluation.

Course Objectives:

At the end of this course student will be able to:

1. Distinguish between the different phases of iron and steel
2. Create heat treatment regime for steel alloys
3. Analyze the metal properties due to the heat treatment

Detailed Course Description:

Number	Title	Content	Time
	Introduction	Ferrous metals, non-ferrous metals (copper, aluminum, nickel...) Effect of treatment on ferrous and non-ferrous metals/alloys	
	Atomic and crystallographic properties of metals	Metallic crystal structures (Stacking) Stacking fault (defects) in metallic structures Diffusion	
	Metallic crystallization and metallic casts structure	Metallic crystallization Metallic casts structure Phase transformations	
	Effect of heating on structure and properties of cold worked metals	Recovery of properties Re-crystallization Cold working and hot working	
	Phases in metallic alloys	Solid solutions Chemical compounds Non-homogenous structures	
	Equilibrium Phase diagrams	Phase rule Binary equilibrium phase diagrams for alloys of completely soluble in the liquid and solid state solid solutions Binary equilibrium phase diagrams for alloys of partially soluble solid solutions Binary equilibrium phase diagrams for alloys of solid solutions forming chemical compounds Binary equilibrium phase diagrams for alloys of allotropic solid solutions Equilibrium phase diagrams and metallic structures and properties	
	Iron-carbon system and ferrous alloys	Definition of the structure Carbon solubility in iron	

		<p>The critical temperature lines</p> <p>Iron-carbon phase diagram:</p> <ul style="list-style-type: none"> • Iron-carbide phase diagram • Iron-graphite phase diagram <p>Effect of carbon and trace elements on steel properties</p> <p>Effect of alloying elements on alloy steel properties</p> <p>Metallographic Structures of alloy steels</p>	
	Cast iron	<p>Grey cast iron and white cast iron</p> <p>Ductile cast iron</p> <p>Spherodite</p> <p>Malleable cast iron ...</p> <p>Effect of additives</p>	
	Phase transformations in ferrous alloys	<p>Phase transformation by heating</p> <p>Grain growth</p> <p>Austenitic transformation</p> <p>Martensitic transformation</p> <p>Aging in ferrous alloys</p>	
	Steels heat treatment technology	<p>steel transformation diagram;</p> <p>Isothermal transformation,</p> <p>Continuous cooling transformation</p> <p>Effect of alloying elements on transformation diagrams</p> <p>Annealing, Full annealing</p> <p>Normalizing</p> <p>Hardening, Quenching</p> <p>Hardenability (Jominy test)</p> <p>Tempering</p> <p>Stress relieving</p> <p>Mechanical heat treatment of steel</p> <p>Heat treatment defects</p> <p>Surface hardening, treatment</p>	
	Chemical heat treatment of steel	<p>Carbiding</p> <p>Nitriding</p> <p>Carbon-nitriding</p> <p>Diffusion case hardening</p>	
	Cast iron heat treatment technology		

Evaluation Strategies:

Evaluation		Percentage	Date
Exams	Midterm	40%	
	Final Exam	50%	
Projects and Assignments		10%	

Teaching Methodology:

- Lecturing
- Technical videos watching

Text Books & References:

Text Books:

- Introduction to physical metallurgy, Avner
- علم المعادن والمعاملة الحرارية للمعادن، يو. لاختين

References:

- الميتالورجيا الفيزيائية (الفلزات)، أحمد سالم الصباغ