

Discipline: <b>Metallurgical Engineering</b>		Semester: <b>5<sup>th</sup> Semester</b>	Name of the Teaching Faculty: <b>Ms. Sitanjali Khuntia</b>
Subject: <b>Heat Treatment of metal &amp; alloys</b> Sub code: <b>(Th-3)</b>		No of days /week class allotted: <b>04</b>	Semester from Date: <b>05-10-2021 to 28-01-2022</b>
<i>Month</i>	<i>week</i>	<i>Class Day</i>	<b><i>Theory topics</i></b>
Oct	2nd	1 <sup>st</sup>	Introduction to heat treatment, Solid state phase transformation
		2 <sup>nd</sup>	Introduction to diffusion, Fick's law of diffusion: 1 <sup>st</sup> law
		3 <sup>rd</sup>	Fick's second law
	3 <sup>rd</sup>	1 <sup>st</sup>	Discuss the formation of austenite, austenite grain growth on heating
		2 <sup>nd</sup>	Explaining the mechanism of formation of austenite
	4th	1 <sup>st</sup>	Discuss austenite grain size, importance of austenite grain size
		2 <sup>nd</sup>	Explaining the methods of determination of austenitic grain size: ASTM methods
		3 <sup>rd</sup>	Explaining the methods of determination of austenitic grain size: Heyn's intercept method
	5th	1 <sup>st</sup>	Discuss the methods of control austenite grain size
		2 <sup>nd</sup>	Discussion decomposition of austenite and pearlite transformation
		3 <sup>rd</sup>	Introduction of TTT diagram, study of isothermal transformation
		4 <sup>th</sup>	Construction of TTT curve
Nov	1 <sup>st</sup>	1 <sup>st</sup>	Critical cooling rate, Different TTT diagram for hypo- eutectoid, eutectoid and hyper-eutectoid steel, factors affecting TTT-curve
		2 <sup>nd</sup>	Applications of TTT diagram, limitations of TTT curve
		3 <sup>rd</sup>	Introduction of CCT curve, construction of CCT diagram
	2nd	1 <sup>st</sup>	Different cooling rate for eutectoid steel in CCT curve
		2 <sup>nd</sup>	Explaining pearlitic, bainitic transformation
		3 <sup>rd</sup>	Explaining martensitic transformation
		4 <sup>th</sup>	Different heat treatment processes in steels: Annealing
	3 <sup>rd</sup>	1 <sup>st</sup>	Different types of annealing: full annealing
		2 <sup>nd</sup>	Explaining homogenizing annealing, recrystallisation annealing, isothermal annealing, process annealing
		3 <sup>rd</sup>	Explaining spheroidization annealing, stress relieving annealing
		4 <sup>th</sup>	Explaining the process of normalization, comparison between annealing and normalization
	4 <sup>th</sup>	1 <sup>st</sup>	Discuss the process of hardening, Describe the factors affecting hardening
		2 <sup>nd</sup>	Different methods of hardening: Process of quenching

		3 <sup>rd</sup>	Different kinds of quenching medium: water, oil, brine, polymer quenchant, salt bath	
		4 <sup>th</sup>	Quenching methods, retained austenite	
	5 <sup>th</sup>	1 <sup>st</sup>	Elimination of retained austenite: tempering process for steel and sub-zero treatment	
		2 <sup>nd</sup>	Discuss thermo-mechanical treatment of steel	
D e c	1 <sup>st</sup>	1 <sup>st</sup>	Explaining tempering process of steel	
		2 <sup>nd</sup>	Define hardening, methods of determination of hardening (Grossman's critical diameter method)	
	2 <sup>nd</sup>	1 <sup>st</sup>	Jomney end quench method	
		2 <sup>nd</sup>	Discuss the method of estimation of hardenability from chemical composition and fracture test	
		3 <sup>rd</sup>	Discuss the factors affecting hardenability: effect of austenite grain size, carbon content and alloying elements	
		4 <sup>th</sup>	Surface hardening methods: introduction, induction hardening	
	3 <sup>rd</sup>	1 <sup>st</sup>	High frequency induction hardening	
		2 <sup>nd</sup>	Flame hardening, electron beam hardening	
		3 <sup>rd</sup>	Laser hardening	
		4 <sup>th</sup>	Explaining different carburizing processes of steel, pack carburizing	
	4 <sup>th</sup>	1 <sup>st</sup>	Liquid carburizing, gas carburizing and vacuum carburizing	
		2 <sup>nd</sup>	Liquid carburizing, gas carburizing and vacuum carburizing	
		3 <sup>rd</sup>	Discuss post carburizing heat treatment	
	5 <sup>th</sup>	1 <sup>st</sup>	Explaining the process of nitriding	
		2 <sup>nd</sup>	Explaining the process of cyaniding, carbonitriding of steel	
		3 <sup>rd</sup>	Explaining the plasma nitriding	
	J a n	1 <sup>st</sup>	1 <sup>st</sup>	Explaining salt bath nitro carburizing
		2 <sup>nd</sup>	1 <sup>st</sup>	Explaining the process boronizing, chromizing & Toyota diffusion
2 <sup>nd</sup>			Explaining the process chromizing & Toyota diffusion	
3 <sup>rd</sup>			Discuss the method of case depth measurement in steel	
4 <sup>th</sup>			Heat treatment of non-ferrous alloys: introduction	
3 <sup>rd</sup>		1 <sup>st</sup>	Age hardening or precipitation hardening of Al-Cu alloys	
		2 <sup>nd</sup>	Age hardening or precipitation hardening of Al-Cu alloys, types of precipitates	
		3 <sup>rd</sup>	Alloy steels: different alloy steels- low alloy and high alloy steel	
		4 <sup>th</sup>	Discussing the effect of alloying elements in steel	
4 <sup>th</sup>		1 <sup>st</sup>	Discussing die steel, high speed steel	
		2 <sup>nd</sup>	High strength low alloy steel, stain-less steel	
		3 <sup>rd</sup>	Discussing heat treatment of tool steel	
		4 <sup>th</sup>	Discussing heat treatment of tool steel	
5 <sup>th</sup>		1 <sup>st</sup>	Heat treatment of stain-less steel	
		2 <sup>nd</sup>	Quiz test	
		3 <sup>rd</sup>	Quiz test	