DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

COURSE OUTLINE TEMPLATE			
Course Title	Phase Transformation and Heat Treatment		
Course Code	MTPC18	**No. of Credits**	4
Department	MME	**Faculty**	Dr S KUMARAN
Pre-requisites Course Code	Physical Metallurgy		
Course Coordinator(s) (if, applicable)	Dr S JEROME		
Other Course Teacher(s)/Tutor(s) E-mail	--	**Telephone No.**	9944434705 Intercom : 3482
Course Type	☑ **Core course**	☐ **lective course**	

COURSE OVERVIEW

Introduction and classification of phase transformations. Diffusion in solids: phenomenological approach and atomistic approach. Nucleation and growth theories of vapour to liquid, liquid to solid, and solid to solid transformations; homogeneous and heterogeneous strain energy effect during nucleation; interface-controlled growth and diffusion controlled growth; overall transformation kinetics.

Principles of solidification, evolution of microstructures in pure metals and alloys. Precipitation from solid solution: types of precipitation reactions, crystallographic description of precipitates, precipitation sequence and age hardening, spinoidal decomposition.

Iron-carbon alloy system: iron-carbon diagram, nucleation and growth of pearlite, cooling of hypo-eutectoid, eutectoid, and hyper-eutectoid steels, development of microstructures in cast irons. Heat treatment of steels: TTT and CCT diagrams, bainitic transformation, martensitic transformation, hardenability, role of alloying elements in steels

Conventional heat treatment of steels. Massive transformation. Order-disorder transformation. Phase transformations in and heat treatment of some common non-ferrous metals and alloys

Types of furnaces and furnace atmospheres; quenching media; types of quenching, mechanism of quenching, quenching characteristics, choice of quenchants; surface hardening of steels- carburizing, nitriding, carbonitriding and others.. Various thermo-mechanical treatments; Designing for heat treatment, defects in heat treated parts, causes for the defects in heat-treated parts and remedies

COURSE OBJECTIVES

To study the phase changes that occurs during both thermal and thermo mechanical treatments

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
1. Describe the mechanisms responsible for atomic and molecular movements in condensed phases	[1, 2]
2. Understand the heat treatment of steels using TTT and CCT	[1, 2]
3. Determine the heat treatment conditions required to obtain a given microstructure using TTT diagrams	[1, 2, 8, 11]
4. Relate solid state atomic mobility to transport phenomena in materials	[5, 8, 11]
5. Understand the different kinds surface hardening of steels	[2, 11]

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1	2nd to 4th week, January	Liquid to Solid Transformation	Chalk and Board
2	1st to 3rd week February	Structural Evolution and Precipitation	Chalk and Board, Power Point
3	4th week Feb., to 3rd week March	Fe-C Phase Diagram and TTT	Chalk and Board
4	4th week March to 2nd week April	Heat Treatment processes	Chalk and Board, Power Point

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Month (s)	Duration	% Weightage
1	Assignment	2nd week February	--	10
2	Mid-term test	2nd week March	1hr 30min	30
3	Seminar / Term Paper	1st week April	15min/student	10
4	End Semester	3rd /4th week April	3hrs	50

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc
1. Avner S.H., 'Introduction to Physical Metallurgy', 2nd edition, Tata McGraw Hill, 1984
2. Lakhtin Y., 'Engineering Physical Metallurgy', 2nd Edition, MIR Publishers, 1979
3. Prabhu Dev K. H., 'Handbook of Heat Treatment of Steel', TMH, 1988

COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)
Student's feedback
COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)
Minimum attendance 75%. If less than 75% attendance, He /She will be prevented from writing End Semester Exam and re-do the course. Students secured F grade will re-appear the examination as per Institute norms
ADDITIONAL COURSE INFORMATION
Nil
FOR SENATE'S CONSIDERATION
Course Faculty **CC-Chairperson** **HOD**