Course-Plan

School : School of Engineering
Department : Mechanical Engineering Dept.
Course Code : ME 582
Course Name : Heat Treatment Technology

Instructor: Dr. Sanjib Banerjee

1. Abstract:

- The course offers the basic details of Heat Treatment Technologies used in manufacturing industries.
- The general topics like principle, process variables, advantages and applications of various heat treatment techniques for industrial and specialized applications are covered.
- Different heat treatment practices separately on various ferrous and non-ferrous materials are discussed in detail.
- The significance of the course lies on the in depth knowledge, to increase interest on contemporary and automated heat treatment techniques, and to correlate processing-structure-property of prospective materials.

2. Objectives:

- To understand the principle, process variables, advantages and applications of various heat treatment techniques.
- To give detailed knowledge in different heat treatment practices for industrial and specialized applications.
- To increase interest on contemporary and automated heat treatment techniques.
- To correlate processing-structure-property of prospective materials.

3. Prerequisites of the course:

Basic knowledge on Material Science is preferable.

4. Course outline:

- **Significance of heat treatment in material processing for manufacturing industries:** Concepts of processing-structure-property co-relation **(5 lectures)**

- **Phase diagrams:**
  Binary and ternary equilibrium diagrams; Phase rule and Lever rule; Nucleation and growth of phases; Determination of grain size; Fe-C phase diagrams; Decomposition of

austenite: Diffusion controlled and diffusionless transformations; Pearlitic and Bainitic and Martensitic transformations; TTT and CCT curves **(10 lectures)**

- **Heat treatment processes:**
  Recrystallization annealing: Effect of working on structure and properties of metals and alloys; Microstructural evolution and control; Recovery, Recrystallization and Grain growth; Recrystallization temperature, Critical deformation; Annealing and its classifications: Full annealing, Isothermal annealing, Diffusion annealing, Partial annealing, Subcritical annealing; Normalizing, Hardening, Tempering, Thermo-mechanical treatment; Surface Hardening: Carburizing, Nitriding, Electron Beam Hardening, Laser Hardening Heat Treatment of tool and alloy steels, cast irons; Heat treatment of weldments **(15 lectures)**

- **Heat treatment of non-ferrous metals and alloys:**
  Cast and heat-treatable alloys; Theory of age-hardening and precipitation; Aging time and precipitation temperature on mechanical properties of alloys **(5 lectures)**

- **Heat Treatment defects and their remedial measures (3 lectures)**

- **Heat treating furnace atmosphere:** Automation and computerization of heat treating process & equipments **(2 lectures)**
  (Total: 40 lectures)

5. (a) Time-Plan

Topic	Content	Contact Hours	
		L	T
	• **Significance of heat treatment in material processing for manufacturing industries:** Concepts of processing-structure-property co-relation	5	
	• **Phase diagrams:** Binary and ternary equilibrium diagrams; Phase rule and Lever rule; Nucleation and growth of phases; Determination of grain size; Fe-C phase diagrams; Decomposition of austenite: Diffusion controlled and diffusionless transformations; Pearlitic and Bainitic and Martensitic transformations; TTT and CCT curves	10	
	• **Heat treatment processes:** Recrystallization annealing: Effect of working on structure and properties of metals and alloys; Microstructural evolution and control; Recovery, Recrystallization and Grain growth; Recrystallization temperature, Critical deformation; Annealing and its classifications: Full annealing, Isothermal annealing, Diffusion annealing, Partial annealing, Subcritical annealing; Normalizing,	15	

	Hardening, Tempering, Thermo-mechanical treatment; Surface Hardening: Carburizing, Nitriding, Electron Beam Hardening, Laser Hardening Heat Treatment of tool and alloy steels, cast irons; Heat treatment of weldments		
	• **Heat treatment of non-ferrous metals and alloys:** Cast and heat-treatable alloys; Theory of age-hardening and precipitation; Aging time and precipitation temperature on mechanical properties of alloys	5	
	• **Heat Treatment defects and their remedial measures**	3	
	• **Heat treating furnace atmosphere:** Automation and computerization of heat treating process & equipments	2	
	Total contact hours	40	

Text Books:

a. W. D. Callister, Material Science and Engineering - An Introduction, Wiley, 2002.
b. Rajan, T.V., Sharma, C.P., and Sharma, A. Heat Treatment Technology. PHI learning Pvt. Ltd. publication, Revised edition, 1997.
c. Sharma, R.C. Principles of Heat Treatment of Steels. New Age Int. (P) Ltd., 1996.

Reference Books:

a. Totten, G.E. Steel Heat Treatment: Equipment and Process Design. Taylor & Francis, 1st edition, 2006.
b. Chandler, H. Heat Treater's Guide: Practice and Procedures of Iron and Steels, ASM International, 2nd edition, 6th Printing, 2010.
c. Brooks, C.R. Heat Treatment, Structure and Properties of Nonferrous Alloys. ASM, 1982, Reprinted 1984.
d. Ostwald, P.F. Manufacturing Processes and Systems. John Wiley & Sons. 9th edition, 2008.

5. (b) Evaluation Plan:

Test No.	Marks	Duration (minutes)
I	25	45
II (Mid Term)	40	120
III (Assignment type)	25	-
IV (End Term)	60	180
Total Marks	150	

All the tests will be held as per the schedule and protocol notified by the Controller of Examinations, Tezpur University

6. Pedagogy:

Students should correlate material properties with different heat treating techniques used in the manufacturing industries.

7. Expected outcome:

Towards the end of the course the student would be able to:

- Gain detailed knowledge on different heat treatment practices for industrial and specialized applications.
- Gain interest on contemporary and automated processing systems.
- Identify problem and initiate projects on heat treatment technology.
- Correlate processing-structure-property of prospective materials.
- Correlate material properties with heat treating techniques.