# Satuan Acara Pengajaran

MMM8120801 - Perlakuan Panas & Rekayasa Permukaan

Pengajar
*Nofrijon Bin Imam Sofyan Ph.D*

## Tujuan Perkuliahan

Peserta ajar mampu menjelaskan fenomena perubahan sifat bahan logam dan mikrostrukturnya yang terkait dengan rangkaian proses perlakuan panas. Menguasai dan mampu memilih berbagai metoda perlakuan panas dan rekayasa permukaan beserta aplikasinya, menganalisis, serta melakukan pemecahan masalah atas penyimpangan dan kegagalan yang terjadi pada proses perlakuan panas dan rekayasa permukaan.

## Minggu 1

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| **Materi** | - Class introduction and information<br>- Course content<br>- Grading<br>- General introduction to Heat Treatment and Surface Engineering |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. ASM Handbook Vol. 4: Heat Treating, ASM International, Ohio, USA, 1991.<br>2. ASM Handbook Vol. 5: Surface Engineering, ASM International, Ohio, USA, 1994.<br>3. Karl-Erik Thelning: "Steel and its heat treatment," Butterworths, 1984. |
| **Aktivitas** | |

## Minggu 2

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| **Materi** | Fundamental of heat treatment #1<br>Fe-Fe3C phase diagram<br>Heating<br>Cooling<br>Formation of pealite<br>Formation of bainite<br>Formation of martensite<br>TTT and CCT diagrams. |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. ASM Handbook Vol 4: Heat Treating, ASM International, Ohio, USA, 1991.<br>2. ASM Handbook Vol 5: Surface Engineering, ASM International, Ohio, USA, 1994.<br>3. Karl-Erik Thelning: "Steel and its heat treatment," Butterworths, 1984. |
| **Aktivitas** | |

## Minggu 3

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| **Materi** | Fundamental of heat treatment # 2<br>- Decomposition of martensite<br>- Retained austenite on tempering<br>- The role of diffusion<br>- The role of dislocation<br>- Hardening mechanism in steel. |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. ASM Handbook Vol 4: Heat Treating, ASM International, Ohio, USA, 1991.<br>2. ASM Handbook Vol 5: Surface Engineering, ASM International, Ohio, USA, 1994.<br>3. Karl-Erik Thelning: "Steel and its heat treatment," Butterworths, 1984. |
| **Aktivitas** | |

## Minggu 4

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| **Materi** | Fundamental of heat treatment #3<br>The role of grain<br>- Grain boundary<br>- Grain size<br>- Grain growth |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. ASM Handbook Vol 4: Heat Treating, ASM International, Ohio, USA, 1991.<br>2. ASM Handbook Vol 5: Surface Engineering, ASM International, Ohio, USA, 1994.<br>3. Karl-Erik Thelning" "Steel and its heat treatment,"<br>Butterworths, 1984. |
| **Aktivitas** | |

## Minggu 5

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| **Materi** | Effect of alloying elements in steel<br>- Austenite-forming elements<br>- Ferrite-forming elements<br>- Carbide-forming elements<br>- Nitride-forming elements<br>- Multi-alloyed steels and carbide stabilizer<br>- Effect of temperature on martensite formation<br>- Effect on the formation of pearlite and bainite during isothermal transformation. |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. ASM Handbook Vol 4: Heat Treating, ASM International, Ohio, USA, 1991.<br>2. ASM Handbook Vol 5: Surface Engineering, ASM International, Ohio, USA, 1994.<br>3. Karl-Erik Thelning: "Steel and its heat treatment," Butterworths,<br>1984. |
| **Aktivitas** | |

## Minggu 6

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| **Materi** | Hardenability (1)<br>- Hardenability concept<br>- The Grossmann hardenability test<br>- Calculation of Di-values from the Grossmann curves<br>- The Jominy end-quench hardenability test<br>- Practical applications of Jominy curves. |
| **Media** | LCD Projectors<br>E-learning |
| **Referensi** | 1. Karl-Erik Thelning: Steel and its heat treatment, Butterworths, 1984.<br>2. ASM Handbook: Vol 4, Heat Treating, ASM International, Ohio, USA, 1991.<br>3. G.E. Totten: Steel Heat Treatment, Metallurgy and Technologies, Taylor & Francis, Boca Raton, 2006. |
| **Aktivitas** | |

## Minggu 7

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| **Materi** | Hardenability (2)<br>- Practical application of the TTT and the CCT diagrams<br>- Practical applications of hardenability<br>- The influence of the depth of hardening on the stress pattern. |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. Karl-Erik Thelning: Steel and its heat treatment, Butterworths, 1984.<br>2. ASM Handbook: Vol 4, Heat Treating, ASM International, Ohio, USA, 1991.<br>3. G.E. Totten: Steel Heat Treatment, Metallurgy and Technologies, Taylor & Francis, Boca Raton, 2006. |
| **Aktivitas** | |

## Minggu 8

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| **Materi** | Midterm |
| **Media** | |
| **Referensi** | |
| **Aktivitas** | |

## Minggu 9

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| **Materi** | General Heat Treatment (1)<br>- Annealing: spheroidizing, recrystallization, stress-relief, isothermal, quench, and homogenizing annealing; normalizing;<br>- Hardening: heating media, rate of heating, hardening temperature, holding time, methods of cooling and quenching media |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. Karl-Erik Thelning: Steel and its heat treatment, Butterworths, 1984.<br>2. ASM Handbook: Vol 4, Heat Treating, ASM International, Ohio, USA, 1991.<br>3. G.E. Totten: Steel Heat Treatment, Metallurgy and Technologies, Taylor & Francis, Boca Raton, 2006. |
| **Aktivitas** | |

## Minggu 10

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| **Materi** | General Heat Treatment (2)<br>Tempering:<br>- Heating to temperature,<br>- Rate of heating,<br>- Holding time,<br>- Double tempering,<br>- Self-tempering, and<br>- Temper brittleness |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. Karl-Erik Thelning: Steel and its heat treatment, Butterworths, 1984.<br>2. ASM Handbook: Vol 4, Heat Treating, ASM International, Ohio, USA, 1991.<br>3. G.E. Totten: Steel Heat Treatment, Metallurgy and Technologies, Taylor & Francis, Boca Raton, 2006. |
| **Aktivitas** | |

## Minggu 11

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| **Materi** | Special Heat Treatment<br>- Hardening and tempering of tools steels;<br>- Heat treatment of HSLA steels;<br>- Hardening and tempering of conventional constructional steels;<br>- Hardening and tempering of boron-alloyed steels. |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. Karl-Erik Thelning: Steel and its heat treatment, Butterworths, 1984.<br>2. ASM Handbook: Vol 4, Heat Treating, ASM International, Ohio, USA, 1991.<br>3. G.E. Totten: Steel Heat Treatment, Metallurgy and Technologies, Taylor & Francis, Boca Raton, 2006. |
| **Aktivitas** | |

## Minggu 12

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| **Materi** | Surface treatment:<br>- Carbonitriding;<br>- Nitriding;<br>- Boriding;<br>- Induction hardening;<br>- Flame hardening;<br>- Laser and electron beam surface hardening |
| **Media** | LCD Projector |
| **Referensi** | 1. Karl-Erik Thelning: Steel and its heat treatment, Butterworths, 1984.<br>2. ASM Handbook: Vol 4, Heat Treating, ASM International, Ohio, USA, 1991.<br>3. ASM Handbook Vol 5: Surface Engineering, ASM International, Ohio, USA, 1994.<br>4. G.E. Totten: Steel Heat Treatment, Metallurgy and Technologies, Taylor & Francis, Boca Raton, 2006. |
| **Aktivitas** | |

## Minggu 13

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| **Materi** | Principles of heat treating of nonferrous alloys:<br>- Heat treatment for aluminum,<br>- Heat treatment for copper,<br>- Heat treatment for nickel base alloys,<br>- Precipitation hardening,<br>- Solution treatment, quenching, aging, overaging. |

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| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. Karl-Erik Thelning: Steel and its heat treatment, Butterworths, 1984.<br>2. ASM Handbook: Vol 4, Heat Treating, ASM International, Ohio, USA, 1991.<br>3. ASM Handbook Vol 5: Surface Engineering, ASM International, Ohio, USA, 1994.<br>4. G.E. Totten: Steel Heat Treatment, Metallurgy and Technologies, Taylor & Francis, Boca Raton, 2006. |
| **Aktivitas** | |

## Minggu 14

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| **Materi** | Heat Treatment Equipment:<br>- Heat-treating furnaces;<br>- Salt bath heat-treating equipment;<br>- Fluidized-bed heat-treating equipment;<br>- Heat treating in vacuum furnaces and auxiliary equipment. |
| **Media** | LCD Projector<br>E-learning |
| **Referensi** | 1. Karl-Erik Thelning: Steel and its heat treatment, Butterworths, 1984.<br>2. ASM Handbook: Vol 4, Heat Treating, ASM International, Ohio, USA, 1991.<br>3. ASM Handbook Vol 5: Surface Engineering, ASM International, Ohio, USA, 1994.<br>4. G.E. Totten: Steel Heat Treatment, Metallurgy and Technologies, Taylor & Francis, Boca Raton, 2006. |
| **Aktivitas** | |

## Minggu 15

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| **Materi** | Defects and Distortion during Heat-Treatment:<br>- Overheating and Burning of Low-Alloy Steels<br>- Residual Stresses<br>- Quench Cracking<br>- Distortion in Heat Treatment/dimensional change during heat treatment |
| **Media** | LCD Projector<br>E-learning |

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|---|---|
| **Referensi** | 1. Karl-Erik Thelning: Steel and its heat treatment, Butterworths, 1984.<br>2. ASM Handbook: Vol 4, Heat Treating, ASM International, Ohio, USA, 1991.<br>3. ASM Handbook Vol 5: Surface Engineering, ASM International, Ohio, USA, 1994.<br>4. G.E. Totten: Steel Heat Treatment, Metallurgy and Technologies, Taylor & Francis, Boca Raton, 2006. |
| **Aktivitas** | |

## Minggu 16

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| **Materi** | Final examination |
| **Media** | |
| **Referensi** | |
| **Aktivitas** | |