



# Satuan Acara Pengajaran

ENMT803114 - Metalurgi Las

Pengajar

*Prof. Dr. Ir. Winarto M.Sc*

## Tujuan Perkuliahan

Mahasiswa mampu menjelaskan kemampu-lasan (weldability) pada beberapa jenis material (ferrous dan non ferrous) untuk aplikasi rekayasa serta mampu menjelaskan dan menganalisis pengaruh unsur paduan, pengaruh siklus termal dan kecepatan pendinginan serta beberapa parameter lasan terhadap karakteristik hasil lasan untuk mengontrol kualitas hasil lasan dalam konstruksi rekayasa.

## Minggu 1

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<b>Materi</b>	INTRODUKSI: <ul style="list-style-type: none"><li>- Penjelasan SAP &amp; Tujuan MK</li><li>- Definisi Pengelasan</li><li>- Klasifikasi Penyambungan Material</li><li>- Aplikasi Pengelasan di Bidang Teknik</li></ul>
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<b>Media</b>	LCD
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<b>Referensi</b>	<ol style="list-style-type: none"><li>1. M. Anis &amp; Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)</li><li>2. Kou, S., Welding Metallurgy, Wiley &amp; Sons, ISBN 0-471-43491-4</li><li>3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7</li><li>4. Easterling, K., Introduction to the Physical Metallurgy of Welding, Butterworth-Heneimann Ltd. ISBN 0-7506-0394-1</li><li>5. AWS Welding Handbook, Metals and Their Weldability, AWS, ISBN 0-87171-218-0</li><li>6. Norrish, J., Advanced Welding Processes, IOP Publishing Ltd., ISBN 0-85274-326-2</li><li>7. AWS - Welding Jurnal - published by The American Welding Society (AWS)</li></ol>
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## Aktivitas

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### Minggu 2

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**Materi**            PENGELASAN BUSUR LISTRIK  
- Uraian SMAW, FCAW, SAW, ESW  
- Uraian GMAW (TIG & MIG)  
- Uraian Plasma Arc Welding (PAW)  
- Kawat Las : Coated & Wire electrodes

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**Media**            LCD

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**Referensi**        1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)  
2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4  
3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7  
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6. Norrish, J., Advanced Welding Processes, IOP Publishing Ltd., ISBN 0-85274-326-2  
7. AWS - Welding Jurnal - published by The American Welding Society (AWS)

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## Aktivitas

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### Minggu 3

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**Materi**            PENGELASAN BUSUR LISTRIK  
- Karakteristik Busur Listrik  
- Peralatan / Mesin Las Busur Listrik  
- Masukan Panas  
- Parameter Las

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**Media**            LCD

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- Referensi**
1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
  2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4
  3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7
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  6. Norrish, J., Advanced Welding Processes, IOP Publishing Ltd., ISBN 0-85274-326-2
  7. AWS - Welding Jurnal - published by The American Welding Society (AWS)
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**Aktivitas**

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Minggu 4

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- Materi**
- The Principles of Welding Metallurgy
  - Physical Welding Metallurgy
  - Effect of Heating & Cooling Rate
  - Geometrical of Weldments
  - Factors Influencing of Weld Properties
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**Media** LCD

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- Referensi**
1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
  2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4
  3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7
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  6. Norrish, J., Advanced Welding Processes, IOP Publishing Ltd., ISBN 0-85274-326-2
  7. AWS - Welding Jurnal - published by The American Welding Society (AWS)
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**Aktivitas**

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Minggu 5

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<b>Materi</b>	Weldability of Carbon Steel (Metalurgi Las Baja Karbon) <ul style="list-style-type: none"><li>- What is Weldability</li><li>- Factors influencing Weldability</li><li>- Carbon Steel Classification &amp; Their Weldability</li><li>- How to Measure the Weldability of CS</li><li>- What kind of defects on Welding of CS</li><li>- How to Weld CS</li></ul>
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<b>Media</b>	LCD
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<b>Referensi</b>	<ol style="list-style-type: none"><li>1. M. Anis &amp; Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)</li><li>2. Kou, S., Welding Metallurgy, Wiley &amp; Sons, ISBN 0-471-43491-4</li><li>3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7</li><li>4. Easterling, K., Introduction to the Physical Metallurgy of Welding, Butterworth-Heneimann Ltd. ISBN 0-7506-0394-1</li><li>5. AWS Welding Handbook, Metals and Their Weldability, AWS, ISBN 0-87171-218-0</li><li>6. Norrish, J., Advanced Welding Processes, IOP Publishing Ltd., ISBN 0-85274-326-2</li><li>7. AWS - Welding Jurnal - published by The American Welding Society (AWS)</li></ol>
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## Minggu 6

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<b>Materi</b>	Weldability of Low Alloy Steel (Metalurgi Las Baja Paduan rendah) <ul style="list-style-type: none"><li>- Low Alloy Steel Classification &amp; Their Weldability</li><li>- How to Measure the Weldability of Low Alloy Steel</li><li>- What kind of defects occurring on Welding of Low Alloy Steels</li><li>- How to Weld the Low Alloy Steel</li></ul>
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<b>Media</b>	LCD
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<b>Referensi</b>	<ol style="list-style-type: none"><li>1. M. Anis &amp; Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)</li><li>2. Kou, S., Welding Metallurgy, Wiley &amp; Sons, ISBN 0-471-43491-4</li><li>3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7</li><li>4. Easterling, K., Introduction to the Physical Metallurgy of Welding, Butterworth-Heneimann Ltd. ISBN 0-7506-0394-1</li><li>5. AWS Welding Handbook, Metals and Their Weldability, AWS, ISBN 0-87171-218-0</li><li>6. Norrish, J., Advanced Welding Processes, IOP Publishing Ltd., ISBN 0-85274-326-2</li><li>7. AWS - Welding Jurnal - published by The American Welding Society (AWS)</li></ol>
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## Aktivitas

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### Minggu 7

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**Materi** Weldability of High Alloy Steel (Metalurgi Las Baja Paduan Tinggi)  
- High Alloy Steel Classification & Their Weldability  
- How to Measure the Weldability of High Alloy Steel  
- What kind of defects occurring on Welding of High Alloy Steels  
- How to Weld the High Alloy Steel

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**Media** LCD

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**Referensi**

1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4
3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7
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## Aktivitas

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### Minggu 8

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**Materi** MID TEST

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**Media** Paper

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**Referensi**

1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4
3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7
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6. Norrish, J., Advanced Welding Processes, IOP Publishing Ltd., ISBN 0-85274-326-2
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**Aktivitas** UTS

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## Minggu 9

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- Materi** Weldability of Cast Irons (Metalurgi Las Besi Tuang)
- Cast iron Classification & Their Weldability
  - How to Measure the Weldability of Cast Irons
  - What kind of defects occurring on Welding of Cast Irons
  - How to Weld the Cast Irons & Their Alloys
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**Media** LCD

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- Referensi**
1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
  2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4
  3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7
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  6. Norrish, J., Advanced Welding Processes, IOP Publishing Ltd., ISBN 0-85274-326-2
  7. AWS - Welding Jurnal - published by The American Welding Society (AWS)
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## Aktivitas

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## Minggu 10

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- Materi** Weldability of Aluminium Aloys (Metalurgi Las Aluminum & Paduannya)
- Aluminum Alloys Classification & Their Weldability
  - How to Measure the Weldability of Aluminum Alloys
  - What kind of defects occurring on Welding of Aluminum Alloys
  - How to Weld the Aluminum Alloys
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**Media** LCD

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- Referensi**
1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
  2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4
  3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7
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## Aktivitas

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### Minggu 11

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**Materi** Weldability of Copper, Nickel & Magnesium (Metalurgi Las Cu, Ni, Mg)  
- Cu, Ni, Mg Clasification & Their Weldability  
- How to Measure the Weldability of Cu, Ni & Mg  
- What kind of defects occuring on Welding of Cu, Ni & Mg  
- How to Weld Cu, Ni & Mg

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**Media** LCD

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**Referensi**

1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4
3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7
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## Aktivitas

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### Minggu 12

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**Materi** Weldability of Titanium Alloys (Metalurgi Las Titanium & Paduannya)  
- Ti Alloys Clasification & Their Weldability  
- How to Measure the Weldability of Ti Alloys  
- What kind of defects occuring on Welding of Ti Alloys  
- How to Weld the Ti Alloys

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**Media** LCD

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- Referensi**
1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
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**Aktivitas**

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Minggu 13

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**Materi** Group 1 - Presentation

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**Media** LCD

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- Referensi**
1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
  2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4
  3. Granjon, H., Fundamentals of Welding Metallurgy, Abington Publishing, ISBN 1-85573-019-7
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**Aktivitas** Presentasi Kelompok & Diskusi

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Minggu 14

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**Materi** Group 2 - Presentation

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**Media** LCD

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- Referensi**
1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
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**Aktivitas** Presentasi Kelompok & Diskusi

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## Minggu 15

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**Materi** Final Test

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**Media** LCD

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- Referensi**
1. M. Anis & Winarto, Pengelasan, Diktat Kuliah (Lecture Notes)
  2. Kou, S., Welding Metallurgy, Wiley & Sons, ISBN 0-471-43491-4
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  7. AWS - Welding Jurnal - published by The American Welding Society (AWS)
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**Aktivitas** UAS & Kumpulkan Paper

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