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PRODI : MAGISTER  
DEPARTEMEN : TEKNIK MESIN

FAKULTAS  
INSTITUT TEKNOLOGI SEPULUH NOPEMBER  
2023



# **DOKUMEN**

## **Penyusunan Kurikulum Pendidikan Tinggi**

### **Program Studi Magister Teknik Mesin**

Surabaya, 21 Februari 2023

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**INSTITUT TEKNOLOGI SEPULUH NOPEMBER, Tahun 2023**



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	<b>DOKUMEN KURIKULUM</b>	Revisi: 1 Halaman : ...

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## KATA PENGANTAR

Departemen Teknik Mesin Institut Teknologi Sepuluh Nopember (ITS) didirikan pada tahun 1957. Sebagai departemen tertua di ITS, Departemen Teknik Mesin merupakan salah satu departemen teknik mesin terbaik di Indonesia dan Departemen Teknik Mesin telah berhasil mengelola tiga program studi di tingkat sarjana dan pascasarjana. Semua program telah diakreditasi oleh Badan Akreditasi Nasional Perguruan Tinggi dengan status akreditasi terbaik. Sebagai bagian dari upaya perbaikan terus-menerus untuk menjadi salah satu yang terbaik dan menjadi institusi kelas dunia, Departemen Teknik Mesin selalu bersedia untuk memperbaiki diri dengan mengikuti akreditasi dan standar internasional.

Program Magister Teknik Mesin dikembangkan untuk memenuhi kebutuhan pendidikan teknik tingkat pascasarjana yang sesuai dengan permintaan industri dan bidang penelitian dan pengembangan; oleh karena itu, kurikulum dan proses kami mencerminkan kebutuhan pemangku kepentingan, termasuk industri serta lembaga penelitian. Program Magister Teknik Mesin didirikan pada tahun 1993 dan mengikuti peraturan kementerian pendidikan serta standar kualitas (Baku Mutu) yang diterapkan di ITS.

Dokumen Kurikulum Program Studi Magister Teknik Mesin ITS ini dibuat dalam rangka pembaharuan Kurikulum 2018-2023 menjadi Kurikulum 2023-2028 yang dilakukan sesuai dengan aturan dan pedoman yang berlaku. Dokumen kurikulum ini tidak mungkin terwujud tanpa kerja keras dari seluruh dosen dan tenaga kependidikan di Departemen Teknik Mesin, khususnya anggota Tim Kurikulum. Oleh karena itu kami sangat berterima kasih atas kerjasama semua pihak yang telah membantu proses penyusunan dokumen kurikulum ini. Kami juga berterima kasih kepada mahasiswa, alumni, staf, dan semua pemangku kepentingan program Magister Teknik Mesin atas dukungan mereka dalam proses evaluasi kurikulum. Semoga buku ini dapat memberikan manfaat.

Wassalamu'alaikum wr. wb.

Kepala Program Studi Pascasarjana Departemen Teknik Mesin

Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng

NIP. 197505111999031001



## PREFACE

The Department of Mechanical Engineering, Sepuluh Nopember Institute of Technology (ITS) was established in 1957. As the oldest department at ITS, the Department of Mechanical Engineering is one of the best mechanical engineering departments in Indonesia, managing three study programs in undergraduate and postgraduate levels. All programs have been accredited by the National Accreditation Board for Higher Education with the highest accreditation status. As part of the continuous improvement efforts to become one of the best and a world-class institution, the Department of Mechanical Engineering is always willing to improve itself by adhering to international accreditations and standards.

The Master's Program in Mechanical Engineering was developed to meet the needs of postgraduate engineering education in line with industry demands and fields of research and development; therefore, our curriculum and processes reflect the needs of stakeholders, including industries and research institutions. The Master's Program in Mechanical Engineering was established in 1993 and follows the regulations of the Ministry of Education as well as the quality standards applied at ITS.

The Document of Curriculum for the Master's Program in Mechanical Engineering ITS was created in the context of the renewal from the 2018-2023 Curriculum to the 2023-2028 Curriculum, conducted in accordance with the rules and guidelines. This curriculum document would not have been possible without the hard work of all lecturers and staff in the Department of Mechanical Engineering, especially the Curriculum Team members. Therefore, we are very grateful for the cooperation of all parties who have assisted in the preparation of this curriculum document. We also thank the students, alumni, staff, and all stakeholders of the Master's Program in Mechanical Engineering for their support in the curriculum evaluation process. Hopefully, this book can be beneficial.

Wassalamu'alaikum wr. wb.

Head of Postgraduate Program Department of Mechanical Engineering

Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng

NIP. 197505111999031001



**IDENTITAS PROGRAM STUDI**  
***PROGRAM IDENTITY***

No	Nama Perguruan Tinggi (PT) <i>University Name</i>	INSTITUT TEKNOLOGI SEPULUH NOPEMBER
1	Fakultas <i>Faculty</i>	Teknologi Industri dan Rekayasa Sistem <i>Industrial Technology and Systems Engineering</i>
2	Departemen <i>Department</i>	Teknik Mesin <i>Mechanical Engineering</i>
3	Program Studi <i>Program</i>	S2 – Magister <i>Master</i>
4	Status Akreditasi <i>Accreditation Status</i>	
5	Jumlah Mahasiswa <i>Number of Students</i>	160
6	Jumlah Dosen <i>Number of Lecturers</i>	31
7	Alamat Prodi <i>Program Address</i>	Gedung C Lantai II - Kampus ITS Sukolilo, Surabaya 60111
8	Telepon <i>Telephone</i>	(031) 5946230
9	Website Prodi/ Departemen <i>Department Website</i>	<a href="https://www.its.ac.id/tmesin/">https://www.its.ac.id/tmesin/</a>



# *Landasan Pengembangan Kurikulum* — •

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

## **BAB 1**







## 1. Landasan Pengembangan Kurikulum

### *Foundation of Curriculum Development*

#### 1.1 Universitas Value

##### *University Value*

ITS memiliki tata nilai seperti yang tercantum dalam Peraturan Pemerintah Republik Indonesia Nomor 54 Tahun 2015 tentang Statuta Institut Teknologi Sepuluh Nopember Pasal 5, yaitu:

*ITS has a set of values as stipulated in Peraturan Pemerintah Republik Indonesia Number 54 of 2015 concerning the Statute of Institut Teknologi Sepuluh Nopember Article 5, namely:*

- a. etika dan integritas adalah perilaku dalam kehidupan bermasyarakat, bernegara, maupun menjalankan profesinya selalu berpegang teguh pada norma dan peraturan yang berlaku di masyarakat, negara dan agama  
*ethics and integrity are behaviors in social, state, and professional life that always adhere firmly to the norms and regulations applicable in society, state, and religion*
- b. kreativitas dan inovasi adalah perilaku yang selalu mencari ide baru untuk menghasilkan inovasi dalam menjalankan tugas/perannya dengan lebih baik  
*creativity and innovation are behaviors that always seek new ideas to produce innovations in carrying out tasks/roles more effectively*
- c. eksekusi adalah perilaku berusaha secara maksimal untuk mencapai hasil yang sempurna  
*excellence is behavior that strives maximally to achieve perfect results*
- d. kepemimpinan yang kuat adalah perilaku yang visioner, kreatif, inovatif, pekerja keras, berani melakukan perubahan-perubahan ke arah yang lebih baik, dan bertanggung jawab  
*strong leadership is behavior that is visionary, creative, innovative, hardworking, daring to make changes for the better, and responsible*
- e. sinergi adalah bekerja sama untuk dapat memanfaatkan semaksimal mungkin potensi yang dimiliki  
*synergy is working together to maximize the potential possessed*



- f. kebersamaan sosial dan tanggung jawab sosial adalah menjaga kerukunan dan peduli terhadap masyarakat sekitar  
*social togetherness and social responsibility are maintaining harmony and caring for the surrounding community*

## 1.2 Landasan Filosofi

### ***Philosophical Foundation***

Visi ITS adalah menjadi perguruan tinggi dengan reputasi internasional dalam ilmu pengetahuan dan teknologi terutama yang menunjang industri dan kelautan yang berwawasan lingkungan.

Berdasarkan hal tersebut maka lulusan Teknik Mesin harus dapat bekerja di bidang apapun, terutama yang terkait dengan teknik mesin untuk memenuhi kebutuhan masyarakat nasional dan internasional termasuk penelitian, industri, layanan pendidikan, dan layanan kewirausahaan. Selain itu, mereka juga harus dapat mengikuti perkembangan ilmu pengetahuan dan teknologi untuk peradaban manusia.

*The vision of ITS is to become a world-class university that contributes to the independence of the nation and becomes a reference in education, research and community service also the development of innovation, especially those that support industry and marine.*

*Based on that, graduates of Mechanical Engineering should be able to work in any field, especially those related to mechanical engineering, to meet the needs of national and international communities including research, industry, educational services, and entrepreneurial services. Additionally, they should also be able to keep up with the developments in science and technology for human civilization.*

## 1.3 Landasan Historis

### ***Historical Foundation***

Program Magister Teknik Mesin didirikan pada tahun 1993 di bawah Departemen Teknik Mesin berdasarkan Keputusan Direktorat Jenderal Pendidikan Tinggi Indonesia No 109/DIKTI/Kep/1993. Selanjutnya terdapat keputusan mengenai pengaturan dan penentuan ulang izin untuk pelaksanaan program studi Magister Teknik Mesin oleh Direktorat Jenderal Pendidikan Tinggi Indonesia No



76/DIKTI/Kep/2007. Program ini menyediakan infrastruktur yang lebih maju dan metode pengajaran yang lebih mendalam untuk memenuhi kebutuhan kualifikasi yang lebih tinggi dari program sarjana guna mendukung era globalisasi dan teknologi canggih.

Riset-riset mahasiswa program Master dilakukan di 7 Laboratorium yang nyaman dengan peralatan yang memadai. Kurikulum selalu di perbaharui secara periodik untuk dapat menyesuaikan dengan dinamika perkembangan ilmu pengetahuan dan pengembangan riset di Industri. Bidang peminatan dalam melakukan penelitian di Prodi Magister Teknik Mesin sangatlah bervariasi yang bisa berafiliasi dengan Laboratorium yang diminati. Bidang peminatan baru yang dibuka adalah Rekayasa Energi Terbarukan & Berkelanjutan (RETB), dimana bidang peminatan ini akan mengantisipasi akan kebutuhan tenaga profesional yang banyak di bidang energy terbarukan terkait dengan program dunia, yaitu NET ZERO EMISSION.

Prodi Magister Teknik Mesin ITS telah mendapatkan pengakuan Unggul dari Badan Akreditasi Nasional (BAN PT) sejak pertama kali terakreditasi sampai sekarang. Dan sekarang sedang dalam proses penyiapan akreditasi Internasional oleh lembaga akreditasi ASIIN.

Prodi Master Teknik Mesin telah melakukan kerjasama dalam pengembangan Sumber Daya Manusia untuk mencetak profesional lulusan Master dengan berbagai institusi dan industry, antara lain PT. PLN, PT. Pembangkitan Jawa Bali, PT. Indonesia Power dan industri lainnya. Untuk mengakomodasi minat yang semakin besar dari masyarakat industri akan peningkatan ilmu pengetahuan di bidang Teknik Mesin dan berkembangnya metode pembelajaran digital maka telah dikembangkan beberapa program, yaitu Master dengan riset dan Master dengan Pembelajaran Jarak Jauh (PJJ) selain program Master secara reguler yang ditempuh dengan perkuliahan di kelas dan penyusunan Thesis.

Kurikulum yang dikembangkan diharapkan mampu memfasilitasi mahasiswa belajar sesuai dengan zamannya; kurikulum yang mampu mewariskan nilai budaya dan sejarah keemasan masa lalu, dan mampu mempersiapkan mahasiswa agar dapat hidup lebih baik di abad 21, memiliki peran aktif di era industri 4.0 atau bahkan saat ini menuju era industry 5.0, serta mampu membaca tanda-tanda perkembangannya. Beberapa ketrampilan yang dituntut di abad 21 dan terdapat 3 aspek utama yaitu:



*The Master of Mechanical Engineering program was established in 1993 under the Department of Mechanical Engineering based on Keputusan Direktorat Jenderal Pendidikan Tinggi Indonesia No. 109/DIKTI/Kep/1993. Subsequently, a decision was made regarding the regulation and re-determination of permits for the implementation of the Master of Mechanical Engineering program, as outlined in Direktorat Jenderal Pendidikan Tinggi Indonesia No. 76/DIKTI/Kep/2007. This program provides more advanced infrastructure and employs comprehensive teaching methods to meet the demands of higher qualifications, supporting the globalization and advancements in technology.*

*Research by Master's program students are conducted in 7 comfortable laboratories with adequate equipment. The curriculum is periodically updated to adapt to the dynamic development of science and research in the industry. The research specializations in the Master of Mechanical Engineering program are highly varied and can be affiliated with the preferred laboratories. A newly opened specialization field, Renewable & Sustainable Energy Engineering (RETB), anticipates the growing demand for professionals in the field of renewable energy, in relation to the global program, Net Zero Emission.*

*The Master of Mechanical Engineering program at ITS has been recognized as Excellent by the National Accreditation Board (BAN PT) since its first accreditation until now. Currently, it is in the process of preparing for international accreditation by ASIIN accreditation agency.*

*The Master of Mechanical Engineering program has collaborated with various institutions and industries, including PT. PLN, PT. Pembangkitan Jawa Bali, PT. Indonesia Power, and others in developing human resources to produce professionals with Master's degrees. To accommodate the growing interest in mechanical engineering among industry professionals and to adapt to the development of digital learning methods, several programs have been developed. These programs include Master's degree through research and Master's degree with Distance Learning programs (PJJ), alongside the regular Master's program conducted through in-class lectures and thesis writing.*

*The developed curriculum is expected to facilitate learning in accordance with the times. The curriculum is expected to inherit cultural values and historical legacies. It is also expected to prepare students to live better in the 21st century, play an active role in the*



era of industry 4.0 or even towards the era of industry 5.0, and be able to read the signs of its development. Several skills demanded in the 21st century include 3 main aspects:

### **1. Cognitive skills**

#### *a. Processing and cognitive strategies*

- ✓ *Critical thinking*
- ✓ *Problem solving*
- ✓ *Analysis*
- ✓ *Logical Reasoning*
- ✓ *Interpretation*
- ✓ *Decision Making*
- ✓ *Executive Functioning*

#### *b. Knowledge*

- ✓ *Literation and communication skills*
- ✓ *Active listening skills*
- ✓ *Knowledge of the disciplines*
- ✓ *Ability to use evidence and assess based on information*
- ✓ *Digital literacy*

#### *c. Creativity*

- ✓ *Creativity*
- ✓ *Innovation*

### **2. Interpersonal skills**

#### *a. Collaboration group skills*

- ✓ *Communication*
- ✓ *Collaboration*
- ✓ *Team work*
- ✓ *Cooperation*
- ✓ *Coordination*
- ✓ *Empathy, Perspective taking*
- ✓ *Trust*
- ✓ *Service orientation*
- ✓ *Conflict resolution*
- ✓ *Negotiation*

#### *b. Leadership*

- ✓ *Leadership*
- ✓ *Responsibility*
- ✓ *Assetive communication*
- ✓ *Self persentation*
- ✓ *Social influence*

### **3. Intrapersonal skills**

#### *a. Intelectual opennes*

- ✓ *Flexibility*
- ✓ *Adaptability*
- ✓ *Artistic and cultural appreciation*



- ✓ *Personal and social responsibility*
- ✓ *Intercultural competency*
- ✓ *Appreciation for diversity*
- ✓ *Capacity for lifelong learning*
- ✓ *Intellectual interest and curiosity*
- b. *Work ethics, Responsibility*
  - ✓ *Iniciative*
  - ✓ *Self direction*
  - ✓ *Responsibility*
  - ✓ *Perseverance*
  - ✓ *Productivity*
  - ✓ *Persistence*
  - ✓ *Self regulation*
  - ✓ *Meta-cognitive skills, anticipate future, reflective skills*
  - ✓ *Profesionalism*
  - ✓ *Ethics*
  - ✓ *Integrity*
  - ✓ *Citizenships*
  - ✓ *Work orientation*
- c. *Self efficacy*
  - ✓ *Self-regulation (self monitoring and self a sssessment)*
  - ✓ *Physical and mental health*

## 1.4 Landasan Hukum

### ***Legal Foundation***

Landasan hukum di dalam penyusunan kurikulum adalah sebagai berikut:

*The legal foundation for curriculum development is as follows:*

1. Undang-Undang Republik Indonesia Nomor 14 Tahun 2005 tentang Guru dan Dosen (Lembaran Negara Republik Indonesia Tahun 2005 Nomor 157, Tambahan Lembaran Negara Republik Indonesia Nomor 4586).
2. Undang-Undang Republik Indonesia Nomor 12 Tahun 2012 tentang Pendidikan Tinggi (Lembaran Negara Republik Indonesia Tahun 2012 Nomor 158, Tambahan Lembaran Negara Republik Indonesia Nomor 5336).
3. Peraturan Presiden Republik Indonesia Nomor 8 Tahun 2012 tentang Kerangka Kualifikasi Nasional Indonesia (KKNI).
4. Peraturan Pemerintah Nomor 4 Tahun 2014 tentang Penyelenggaraan Pendidikan Tinggi dan Pengelolaan Perguruan Tinggi.





5. Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 73 Tahun 2013 tentang Penerapan KKNi Bidang Perguruan Tinggi.
6. Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi Republik Indonesia Nomor 62 Tahun 2016 tentang Sistem Penjaminan Mutu Pendidikan Tinggi.
7. Peraturan Menteri Pendayagunaan Aparatur Negara dan Reformasi Birokrasi Nomor 17 Tahun 2012 tentang Jabatan Fungsional Dosen dan Angka Kreditnya.
8. Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi Nomor 59 tahun 2018 tentang Ijazah, Sertifikat Kompetensi, Sertifikat Profesi, Gelar dan Tata Cara Penulisan Gelar di Perguruan Tinggi.
9. Keputusan Menteri Riset, Teknologi, dan Pendidikan Tinggi Nomor 123 Tahun 2019 tentang Magang dan Pengakuan Satuan Kredit Semester Magang Industri untuk Program Sarjana dan Sarjana Terapan.
10. Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 3 Tahun 2020 tentang Standar Nasional Pendidikan Tinggi.
11. Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 7 Tahun 2020 tentang Pendirian, Perubahan, Pembubaran PTN, dan Pendirian, Perubahan, Pencabutan Izin PTS
12. Peraturan Menteri Pendidikan dan Kebudayaan Nomor 22 Tahun 2020 tentang Rencana Strategis Kementerian Pendidikan dan Kebudayaan.
13. Peraturan Badan Akreditasi Nasional Perguruan Tinggi Nomor 12 Tahun 2021 tentang Instrumen Akreditasi Program Studi pada Pendidikan Akademik dan Vokasi Lingkup Teknik (IAPS-PAV Teknik)
14. Keputusan Majelis Wali Amanat Institut Teknologi Sepuluh Nopember Nomor 02 Tahun 2017 tentang Pengesahan Rencana Induk Pengembangan Institut Teknologi Sepuluh Nopember Tahun 2015 – 2040.
15. Keputusan Majelis Wali Amanat Institut Teknologi Sepuluh Nopember Nomor 04 Tahun 2021 tentang Pengesahan Rencana Strategis Institut Teknologi Sepuluh Nopember Tahun 2021 – 2025.
16. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 32 Tahun 2019 tentang Peraturan Akademik Institut Teknologi Sepuluh Nopember.
17. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 26 Tahun 2020 tentang Peraturan Akademik Program Vokasi Institut Teknologi Sepuluh Nopember.



18. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 25 Tahun 2020 tentang Pedoman Evaluasi Kurikulum Untuk Program Pendidikan Vokasi di Lingkungan Institut Teknologi Sepuluh Nopember.
19. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 27 Tahun 2020 tentang Pedoman Evaluasi Kurikulum Untuk Program Pendidikan Akademik Dan Profesi di Lingkungan Institut Teknologi Sepuluh Nopember.
20. Peraturan Rektor Institut Teknologi Sepuluh Nopember Nomor 22 Tahun 2021 tentang Penyelenggaraan Kegiatan Merdeka Belajar - Kampus Merdeka Institut Teknologi Sepuluh Nopember.

# *Visi, Misi, dan Tujuan Pendidikan* —●

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

## **BAB 2**



INSTITUT TEKNOLOGI SEPULUH NOPEMBER  
SURABAYA



## 2. Visi, Misi, dan Tujuan Pendidikan

### *Vision, Mission, and Objectives*

#### 2.1 Visi, Misi dan Tujuan Fakultas

##### *Vision, Mission, and Objectives of the Faculty*

###### a. VISI Fakultas Teknologi Industri dan Rekayasa Sistem – ITS

###### *VISION of Faculty of Industrial Technology and Systems Engineering-ITS*

Fakultas Teknologi Industri dan Rekayasa Sistem ITS sebagai fakultas dengan reputasi internasional dalam pengembangan ilmu pengetahuan dan teknologi industri.

*Our vision is to become the lead in development of industrial technology and systems engineering with international reputation.*

###### b. MISI Fakultas Teknologi Industri dan Rekayasa Sistem – ITS

###### *MISION of Faculty of Industrial Technology and Systems Engineering-ITS*

Mengkoordinasi, membina dan mendorong elemen-elemen fakultas dalam penyelenggaraan pendidikan, penelitian dan pemberdayaan masyarakat dengan kualitas internasional yang berkesinambungan, untuk meningkatkan daya saing bangsa dengan menjunjung tinggi etika dan moral akademik.

*Coordinating and supporting all elements within the faculty in continuously carrying out education, research and community service with international quality, to enhance the nation's competitiveness by upholding academic ethics and morals.*

###### c. Tujuan Fakultas Teknologi Industri dan Rekayasa Sistem – ITS

###### *Objectives of Faculty of Industrial Technology and Systems Engineering-ITS*

a. Menjadikan sistem pendidikan dan pengajaran pada semua elemen fakultas agar setara dengan standard internasional.

*Being able to bring the education and teaching system in all elements of the faculty up to international standards.*

b. Menyediakan lulusan yang memiliki skill, knowledge, kemampuan praktis sehingga mempunyai kompetensi dan kepercayaan diri untuk bersaing dalam pasar global serta memiliki moral dan etika yang baik.

*Providing graduates who have skills, knowledge and practical abilities so that they have the competence and confidence to compete in the global market and have good morals and ethics.*



- c. Memiliki hasil riset, melalui elemen fakultas, yang bisa dipatenkan dan diaplikasikan secara riil dalam dunia industri.  
*Having research results, which can be patented and applied in the real industries.*
- d. Menghasilkan publikasi nasional dan internasional.  
*Producing national and international publications.*
- e. Memberikan konsultasi dan pelatihan teknik di industri dan masyarakat, agar mampu memecahkan persoalan teknik.  
*Providing technical consultation and training both for industries and society, in order to be able to solve technical problems.*
- f. Memiliki jaringan kerjasama ditingkat nasional dan internasional.  
*Having both national and international networking.*

## 2.2 Visi, Misi dan Tujuan Departemen

### ***Vision, Mission, and Objectives of the Department***

#### **a. VISI Departemen Teknik Mesin**

##### ***VISION of Mechanical Engineering Department***

Menjadi jurusan yang bereputasi internasional dan menjadi panutan bagi jurusan Teknik Mesin lainnya dari institusi lain di Indonesia.

*Becoming an internationally reputable department and serving as a model for other Mechanical Engineering department from other institutions in Indonesia.*

#### **b. MISI Departemen Teknik Mesin**

##### ***MISION of Mechanical Engineering Department***

Memfasilitasi program pendidikan tinggi di bidang teknik mesin dan melahirkan alumni berkualitas yang siap bersaing di dunia internasional, melalui kegiatan pendidikan, penelitian, dan pengabdian kepada masyarakat.

*Facilitating the higher education program in the field of mechanical engineering and delivering alumni of excellent quality who are ready to compete worldwide, through educational activities, research, and community services.*

#### **c. Tujuan Departemen Teknik Mesin**

##### ***Objectives of Mechanical Engineering Department***

Sasaran yang ingin dicapai oleh Departemen Teknik Mesin, Institut Teknologi Sepuluh Nopember adalah:



*The goals to be achieved by the Department of Mechanical Engineering Institut Teknologi Sepuluh Nopember are:*

1. Bidang Pengajaran/Akademik

*Field of Teaching / Academic*

- Menghasilkan lulusan yang berdaya saing  
*Producing graduates who are ready to compete worldwide*
- Menyelenggarakan program yang mampu mendorong ke arah reputasi internasional  
*Organizing programs that are able to drive Mechanical Engineering Departments towards an international reputation*

2. Bidang Penelitian

*Field of Research*

- Menghasilkan penelitian yang berdampak pada revenue generation dan mendorong penelitian yang produknya layak jual  
*Producing research that has an impact on revenue generation and encouraging research whose products are worth selling*
- Menghasilkan paper yang dapat meningkatkan h-index  
*Producing a paper that can increase h-index*

3. Bidang Pengabdian

*Field of Community Service*

- Menerapkan IPTEK untuk meningkatkan perekonomian  
*Applying science and technology to improve the economy*

4. Bidang Sarana dan Prasarana

*Field of Facilities and Infrastructure*

- Tersedianya sarana dan prasarana  
*Availability of facilities and infrastructure*

5. Bidang Sumber Daya Manusia

*Field of Human Resources*

- Tersedia SDM yang berkompeten untuk tri dharma  
*Availability of competent human resources for Tri Dharma*

6. Bidang Organisasi dan Manajemen

*Field of Organization and Management*

- Tersedianya OTK dan SOP yang komprehensif





*Availability of comprehensive organization and work procedures (OTK) and standard operating procedures (SOP)*

- Terlaksananya sistem manajemen mutu di level Jurusan  
*Implementation of a quality management system on the Department of Mechanical Engineering*

## 2.3 Visi, Misi dan Tujuan Pendidikan Program Studi

### *Vision, Mission, and Objectives of the Program*

#### a. Visi Prodi

##### ***Vision of the Program***

Sebagai lembaga pendidikan dan penelitian yang bereputasi internasional dan menjadi pusat pengembangan Ilmu Pengetahuan dan Teknologi Teknik Mesin di Indonesia

*Becoming an educational and research institution with an international reputation and becoming a center for the development of science and technology in the field of Mechanical Engineering in Indonesia*

#### b. Misi Prodi

##### ***Mission of the Program***

Berkontribusi dalam pengembangan ilmu pengetahuan dan teknologi di bidang Teknik Mesin untuk kesejahteraan masyarakat melalui pendidikan, penelitian, pengabdian masyarakat

*Contributing to the development of science and technology in the field of Mechanical Engineering for societal welfare through education, research, and community service*

#### c. Tujuan Prodi

##### ***Program Educational Objective - PEO***

**Tabel 2.1. Tujuan Pendidikan Prodi (TPP)**

**Table 2.1 Program Educational Objectives (PEO)**

No	Kode Tujuan Pend. Prodi	Deskripsi Tujuan Pendidikan Prodi <i>PEO Description</i>
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1	TPP-1 PEO-1	Menghasilkan lulusan Magister (S2) dengan dasar pengetahuan akademik yang kuat dan kemampuan analisis yang tajam <i>(Having academic knowledge, sharp analytical skills in metallurgy and manufacturing, energy conversion engineering, and mechanical system design)</i>
2	TPP-2 PEO-2	Mampu mengembangkan dan menerapkan ilmu Teknik Mesin di lembaga pendidikan, industri, instansi pemerintah, dan/atau sektor lainnya. <i>(Being able to develop and apply mechanical engineering knowledge in educational institutions, industry, government agencies, and/or other sectors)</i>
3	TPP-3 PEO-3	Memiliki pemahaman yang utuh/menyeluruh atas ilmu dasar dan lanjut yang ada pada program studi. <i>(Having a comprehensive understanding of basic and advanced courses containing in the programme)</i>

# *Evaluasi Kurikulum & Tracer Study* — •

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

## **BAB 3**

PERPUSTAKAAN



### 3. Evaluasi Kurikulum dan *Tracer Study*

#### *Curriculum Evaluation and Tracer Study*

##### 3.1 Evaluasi Kurikulum

###### *Curriculum Evaluation*

Kurikulum dari program studi ditinjau kembali setiap lima tahun sekali. Namun, di setiap awal semester, akan dilakukan evaluasi kurikulum. Tujuan utama dari review kurikulum ini adalah untuk mengeksplorasi mata kuliah pilihan dan memberikan fleksibilitas dalam mengikuti kemajuan teknologi. Sebagai hasilnya, mahasiswa tetap dapat mengikuti perkembangan dan terobosan terbaru dalam bidang teknik mesin.

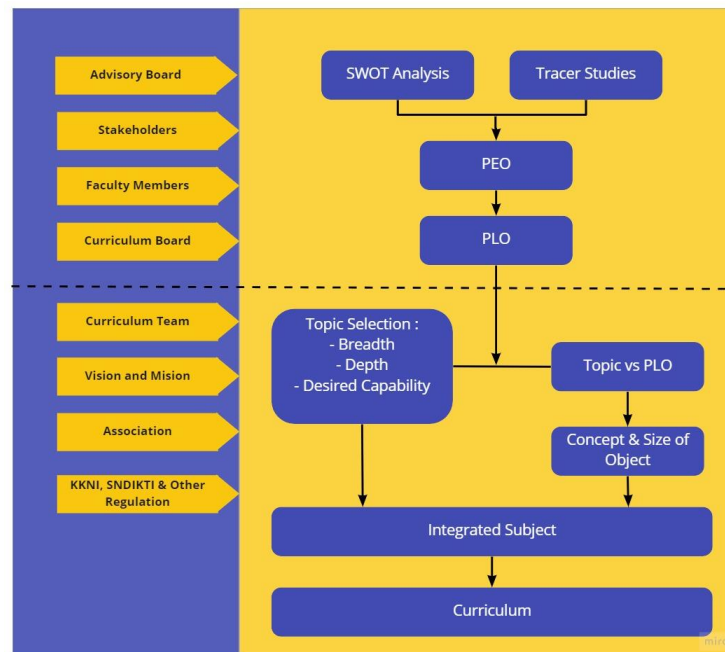
*The curriculum of the program is reviewed every five years. However, at the beginning of each semester, curriculum evaluations are conducted. The main goal of this curriculum review is to explore elective courses and provide flexibility to keep up with technological advancements. As a result, students can still follow the latest developments and breakthroughs in the field of mechanical engineering.*

Tahapan pengembangan profil lulusan sebagai bagian dari diagram pengembangan kurikulum ditunjukkan pada Gambar 1. Evaluasi dan pengembangan kurikulum melibatkan seluruh civitas akademika Magister Teknik Mesin dan pemangku kepentingan termasuk alumni dan industri. Kurikulum dievaluasi berdasarkan analisis kekuatan dan kelemahan dari hasil studi tracer. Masukan dan saran dari alumni dan pemangku kepentingan digunakan untuk meningkatkan dan memperbarui Tujuan Pendidikan Prodi (TPP) dan Capaian Pembelajaran Lulusan (CPL). Pengembangan TPP dan CPL dilakukan dalam bentuk perubahan atau variasi dari mata kuliah. Dengan demikian, kurikulum baru dapat diterapkan.

*The stages of developing the graduate profile as part of the curriculum development diagram are shown in Figure 1. Curriculum evaluation and development involve the entire academic community of the Master of Mechanical Engineering program and stakeholders, including alumni and industry. The curriculum is evaluated based on an analysis of the strengths and weaknesses of tracer study results. Input and suggestions from alumni and stakeholders are used to improve and update the Program Educational Objectives (PEO) and Program Learning Outcomes (PLO). The*



*development of PEO and PLO is done in the form of changes or variations of courses. Thus, the new curriculum can be implemented.*



**Gambar 3.1. Proses evaluasi dan pengembangan kurikulum melibatkan banyak pihak.**

***Figure 3.1. The process of curriculum evaluation and development involves many parties.***

Kurikulum 2023 tidak mengalami perubahan yang signifikan dari kurikulum 2018. Terdapat 4 mata kuliah wajib yang harus ditempuh oleh mahasiswa Magister Teknik Mesin dengan total kredit sebesar 11 SKS. Jumlah ini sama dengan kredit Mata Kuliah Wajib di Kurikulum 2018. Pada Kurikulum 2018, seluruh Mata Kuliah Wajib ada pada semester 1, sedangkan pada Kurikulum 2023 Mata Kuliah wajib ada pada dua semester pertama yaitu 5 SKS pada semester 1 dan 6 SKS pada semester 2. Mata Kuliah Proposal Tesis dihapuskan pada Kurikulum 2023. Sehingga jumlah kredit untuk Mata Kuliah Tesis menjadi 10 SKS.

*The 2023 curriculum has not undergone significant changes from the 2018 curriculum. There are 4 compulsory courses that must be taken by Master of Mechanical Engineering students with a total of 11 credit hours. This total is the same as the Compulsory Course credits in the 2018 curriculum. In the 2018*



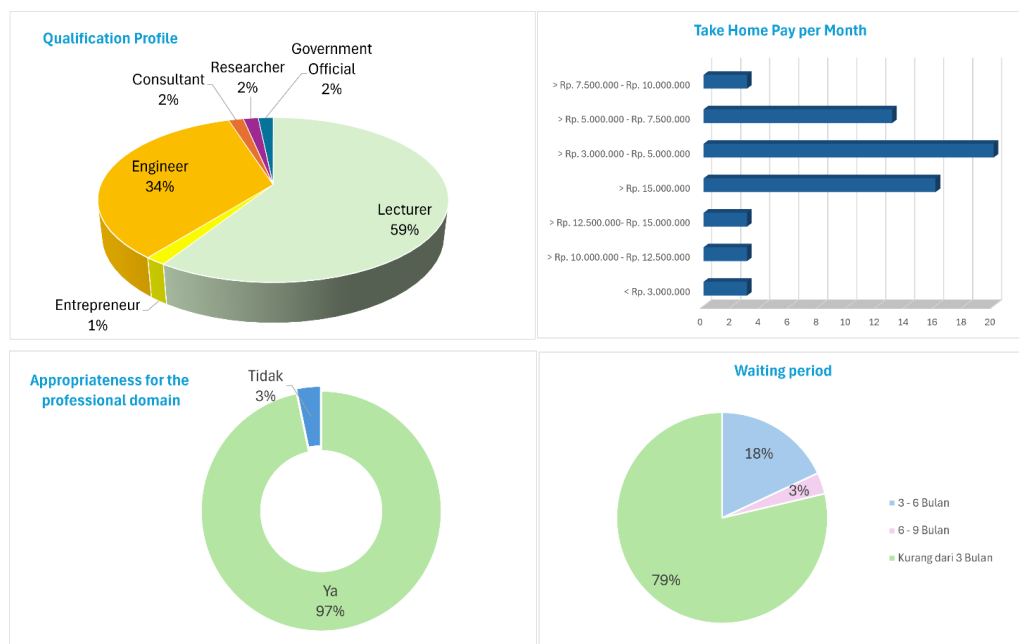
curriculum, all Compulsory Courses were in the first semester, while in the 2023 curriculum, Compulsory Courses are spread across the first two semesters, with 5 credit hours in the first semester and 6 credit hours in the second semester. The Thesis Proposal course has been removed in the 2023 curriculum. As a result, the credit hours for the Thesis Course become 10.

### 3.2 Tracer Study

#### Tracer Study

Hasil *Tracer Study* untuk alumni menunjukkan bahwa 79% alumni mendapatkan pekerjaan pertama mereka dalam waktu kurang dari tiga bulan. Variasi pekerjaan dapat dikategorikan sebagai dosen (59%), insinyur (34%), pegawai pemerintah (2%), konsultan (2%), peneliti (2%) dan wiraswasta (1%).

*The Tracer Study for alumni show that 79% of alumni obtained their first job within less than three months. The job variations can be categorized as follows: lecturer (59%), engineer (34%), government employee (2%), consultant (2%), researcher (2%), and entrepreneur (1%).*



**Gambar 3.2. Hasil tracer study**

**Figure 3.2. Tracer study results**



# *Profil Lulusan & Rumusan Capaian Pembelajaran Lulusan (CPL)* — •

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

## **BAB 4**





## 4. Profil Lulusan, Tujuan Pendidikan Prodi, dan Rumusan Capaian Pembelajaran Lulusan (CPL)

### *Graduate Profile, Program Educational Objectives, and Formulation of Program Learning Outcomes (PLO)*

#### 4.1 Profil Lulusan dan Tujuan Pendidikan Prodi

##### *Graduate Profile and Program Educational Objectives*

4.1 Lulusan Magister Teknik Mesin diharapkan dapat memenuhi profil lulusan sebagai berikut:

*Master of Mechanical Engineering graduates are expected to meet the following graduate profile:*

**Tabel 4.1. Profil lulusan dan deskripsinya**

**Table 4.1. Graduate profile and its description**

No	Profil Lulusan (PL) <i>Graduate Profile</i>	Deskripsi Profil Lulusan <i>Graduate Profile Description</i>
1	PL-1	Insinyur, yang menangani masalah proses industri dalam teknik mesin. <i>Engineer, who deals with industrial process issues in mechanical engineering.</i>
2	PL-2	Peneliti, yang bergabung dengan tim peneliti ilmiah di sebuah institusi penelitian atau perusahaan. <i>Researcher, who joins a scientific research team at a research institution or company.</i>
3	PL-3	Dosen, yang bergabung dengan universitas untuk mengajar mahasiswa, melakukan penelitian dan pengabdian kepada masyarakat, serta mengejar gelar pendidikan yang lebih tinggi. <i>Lecturer, who joins a university to teach students, conduct research and community service, and pursue higher education degrees.</i>
4	PL-4	Wiraswasta, yang mendirikan perusahaan mereka sendiri.



		<i>Entrepreneur, who establishes their own company.</i>
5	PL-5	Pejabat Pemerintah, yang bergabung dan bekerja di kantor pemerintahan. <i>Government Official, who joins and works in government offices.</i>
6	PL-6	Konsultan, yang bergabung dengan sebuah firma konsultan dalam bidang teknik mesin. <i>Consultant, who joins a consulting firm in the field of mechanical engineering.</i>

4.2 Korelasi antara Profil Lulusan (Tabel 4.1) dengan Tujuan Pendidikan Prodi (Tabel 2.1) yang dinyatakan dalam bentuk Tabel 4.2 di bawah ini

*Correlation between Graduate Profiles (Table 4.1) and Program Educational Objectives (Table 2.1) expressed in Table 4.2 below*

**Tabel 4.2. Tabel korelasi Profil Lulusan dan Tujuan Pendidikan Prodi**

**Table 4.2. Correlation table of Graduate Profiles and Program Educational Objectives**

No	Profil Lulusan (PL) <i>Graduate Profile</i>	Tujuan Pendidikan Prodi (TPP) <i>Program Educational Objectives (PEO)</i>		
		TPP-1 <i>PEO-1</i>	TPP-2 <i>PEO-2</i>	TPP-3 <i>PEO-3</i>
1	PL-1	√	√	√
2	PL-2	√	√	√
3	PL-3	√	√	√
4	PL-4		√	
5	PL-5	√	√	√
6	PL-6	√	√	√



## 4.2 Perumusan CPL

### Formulation of PLO

Tabel 4.3. Perumusan CPL

Table 4.3. Formulation of PLO

Unsur CPL Elements of PLO	CPL PLO	Magister Master's
SIKAP ATTITUDE	1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekselensi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>(Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, having noble character, being sensitive and caring about social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve maximum results.)</i>
KETERAMPILAN UMUM GENERAL SKILL	2	Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi <i>(Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars.)</i>
	3	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan. <i>(Able to manage self learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability.)</i>



Unsur CPL <i>Elements of PLO</i>	CPL <i>PLO</i>	Magister <i>Master's</i>
PENGETAHUAN <i>KNOWLEDGE</i>	4	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>(Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.)</i>
	5	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>(Able to understand and utilize the theory of engineering sciences in mechanical engineering.)</i>
KETERAMPILAN KHUSUS <i>SPECIALIZED SKILL</i>	6	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin. <i>(Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields.)</i>
	7	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin. <i>(Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach.)</i>
	8	Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>(Able to formulate new ideas from the previous research for the development of technology and mechanical systems.)</i>
	9	Mampu mengkritik dan mengembangkan rencana dari sudut pandang teknik mesin untuk memecahkan permasalahan lingkungan dalam bentuk karya ilmiah. <i>(Able to criticize and to develop plans from a Mechanical Engineering point of view to solve environmental problems in the form of scientific works.)</i>



**Tabel 4.4. Capaian Pembelajaran Lulusan Program Studi**

**Table 4.4. Program Learning Outcomes**

<b>Kode Code</b>	<b>Deskripsi Capaian Pembelajaran Lulusan (CPL) Program Learning Outcomes (PLO) Description</b>
<b>CPL-1 PLO-1</b>	<p>Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekseklesi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal.</p> <p><i>(Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, having noble character, being sensitive and caring about social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve maximum results.)</i></p>
<b>CPL-2 PLO-2</b>	<p>Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi</p> <p><i>(Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars.)</i></p>
<b>CPL-3 PLO-3</b>	<p>Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan.</p> <p><i>(Able to manage self learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability.)</i></p>
<b>CPL-4 PLO-4</b>	<p>Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam</p> <p><i>(Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.)</i></p>
<b>CPL-5 PLO-5</b>	<p>Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin.</p> <p><i>(Able to understand and utilize the theory of engineering sciences in mechanical engineering.)</i></p>
<b>CPL-6 PLO-6</b>	<p>Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.</p>





Kode Code	Deskripsi Capaian Pembelajaran Lulusan (CPL) Program Learning Outcomes (PLO) Description
	<i>(Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields.)</i>
<b>CPL-7 PLO-7</b>	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin. <i>(Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach.)</i>
<b>CPL-8 PLO-8</b>	Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>(Able to formulate new ideas from the previous research for the development of technology and mechanical systems.)</i>
<b>CPL-9 PLO-9</b>	Mampu mengkritik dan mengembangkan rencana dari sudut pandang teknik mesin untuk memecahkan permasalahan lingkungan dalam bentuk karya ilmiah. <i>(Able to criticize and to develop plans from a Mechanical Engineering point of view to solve environmental problems in the form of scientific works.)</i>

## 4.2 Matrik hubungan CPL dengan Profil Lulusan

### *Matrix of the relationship between PLO and Graduate Profile*

**Tabel 4.5. Matrik hubungan Profil & CPL Prodi**

*Table 4.5. Matrix of the relationship between Graduate Profile and PLO*

Kode Code	Deskripsi CPL Prodi PLO Description	PL1	PL2	PL3	PL4	PL5	PL6
<b>CPL-1 PLO-1</b>	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, eksekusi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>(Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, having noble character, being sensitive and caring about social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve maximum results.)</i>	√	√	√	√	√	√





<b>CPL-2</b> <b>PLO-2</b>	<p>Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi  <i>(Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars.)</i></p>	√	√	√	√	√	√
<b>CPL-3</b> <b>PLO-3</b>	<p>Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan.  <i>(Able to manage self learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability.)</i></p>	√	√	√		√	√
<b>CPL-4</b> <b>PLO-4</b>	<p>Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam  <i>(Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.)</i></p>		√				
<b>CPL-5</b> <b>PLO-5</b>	<p>Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin.  <i>(Able to understand and utilize the theory of engineering sciences in mechanical engineering.)</i></p>	√	√	√		√	
<b>CPL-6</b> <b>PLO-6</b>	<p>Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.  <i>(Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields.)</i></p>	√	√	√		√	√
<b>CPL-7</b> <b>PLO-7</b>	<p>Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin.  <i>(Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach.)</i></p>		√		√	√	



<b>CPL-8</b> <b>PLO-8</b>	Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>(Able to formulate new ideas from the previous research for the development of technology and mechanical systems.)</i>	√		√			
<b>CPL-9</b> <b>PLO-9</b>	Mampu mengkritik dan mengembangkan rencana dari sudut pandang teknik mesin untuk memecahkan permasalahan lingkungan dalam bentuk karya ilmiah. <i>(Able to criticize and to develop plans from a Mechanical Engineering point of view to solve environmental problems in the form of scientific works.)</i>	√		√	√	√	√

### 4.3 Matrik hubungan CPL Prodi dengan Tujuan Pendidikan Program Studi

#### *Matrix of the relationship between PLO and PEO*

Tabel 4.6. Matrik hubungan CPL Prodi & Tujuan Pendidikan Program Studi

*Table 4.6. Matrix of the relationship between PLO and PEO*

<b>Kode Code</b>	<b>Deskripsi CPL Prodi PLO Description</b>	<b>TPP-1 PEO-1</b>	<b>TPP-2 PEO-2</b>	<b>TPP-3 PEO-3</b>
<b>CPL-1</b> <b>PLO-1</b>	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, eksekusi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal. <i>(Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, having noble character, being sensitive and caring about social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve maximum results.)</i>	√	√	√
<b>CPL-2</b> <b>PLO-2</b>	Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi <i>(Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through</i>	√	√	



	<i>research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars.)</i>			
<b>CPL-3 PLO-3</b>	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan. <i>(Able to manage self learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability.)</i>	√		√
<b>CPL-4 PLO-4</b>	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>(Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.)</i>	√		√
<b>CPL-5 PLO-5</b>	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>(Able to understand and utilize the theory of engineering sciences in mechanical engineering.)</i>	√		
<b>CPL-6 PLO-6</b>	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin. <i>(Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields.)</i>		√	
<b>CPL-7 PLO-7</b>	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin. <i>(Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach.)</i>		√	
<b>CPL-8 PLO-8</b>	Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>(Able to formulate new ideas from the previous research for the development of technology and mechanical systems.)</i>		√	√



<b>CPL-9</b> <b>PLO-9</b>	Mampu mengkritik dan mengembangkan rencana dari sudut pandang teknik mesin untuk memecahkan permasalahan lingkungan dalam bentuk karya ilmiah. <i>(Able to criticize and to develop plans from a Mechanical Engineering point of view to solve environmental problems in the form of scientific works.)</i>		√	
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# Penentuan — . Bahan Kajian

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

## BAB 5





## 5. Penentuan Bahan Kajian

### *Determination of Study Materials*

#### 5.1 *Body of Knowledge (BoK)*

Bidang ilmu dan keahlian program studi S2 Teknik Mesin dibangun di atas fondasi pengetahuan dan pengembangan yang mencakup subjek dalam rekayasa mekanik, mechanical system design, energy conversion engineering, manufacture, dan metallurgy. Keempat fondasi tersebut mencerminkan hubungan energy, desain, manufaktur, dan metallurgy, yang merupakan landasan-landasan dalam pengembangan dan penelitian di bidang Teknik Mesin, dan saling terkait erat satu sama lain. Dimana saling keterkaitannya dapat dipandang sebagai sebuah sistem "mechanical engineering system".

Berikut adalah beberapa cabang atau bidang ilmu yang dikembangkan sebagai dasar penentuan bahan kajian dalam program Studi S2 Teknik Mesin:

- Metallurgy: Fokus pada sifat mekanik material, termasuk analisis tegangan dan regangan, kekuatan material, dan perancangan komponen mesin yang kuat dan tahan lama.
- Pemodelan dan Simulasi: Penggunaan perangkat lunak dan teknik simulasi untuk memodelkan perilaku mesin dan sistem mekanis, termasuk analisis elemen hingga, dinamika fluida numerik, dan simulasi proses manufaktur.
- Mechanical System Design: Pengembangan konsep, perancangan, dan optimasi komponen dan sistem mekanis, termasuk metode desain terkini seperti CAD (Computer-Aided Design) dan CAE (Computer-Aided Engineering).
- Manufaktur dan Proses Produksi: Studi tentang teknologi manufaktur termasuk proses pembentukan, pemrosesan material, pemotongan logam, dan teknologi produksi terkini seperti manufaktur aditif.
- Energy Conversion Engineering: Konversi energi dari satu bentuk menjadi bentuk energi lainnya, serta aplikasi teknik untuk memaksimalkan efisiensi dan kinerja sistem energi.

Bahan kajian dalam setiap bidang ini mencakup teori dasar, metodologi penelitian, aplikasi praktis, dan perkembangan terkini dalam rekayasa mesin. Pemilihan bahan kajian harus mempertimbangkan tren industri, kebutuhan pasar tenaga kerja, dan tujuan akademik program studi S2 Teknik Mesin tersebut.





## Bahan Kajian

- Metallurgy
- Manufacturing
- Energy Conversion Engineering
- Mechanical System Desain

*The field of expertise of the Master of Mechanical Engineering program is built on a foundation of knowledge and development that includes subjects in mechanical engineering, mechanical system design, energy conversion engineering, manufacturing, and metallurgy. These foundations reflect the relationships between energy, design, manufacturing, and metallurgy, which are the foundations in the development and research in the field of Mechanical Engineering, and are closely interconnected with each other. Their interrelatedness can be viewed as a "mechanical engineering system".*

*Below are several branches or fields of study developed as the basis for determining course materials in the Master of Mechanical Engineering program.*

- *Metallurgy: Focuses on the mechanical properties of materials, including stress and strain analysis, material strength, and the design of strong and durable machine components.*
- *Modeling and Simulation: The use of software and simulation techniques to model the behavior of machines and mechanical systems, including finite element analysis, numerical fluid dynamics, and manufacturing process simulation.*
- *Mechanical System Design: Development of concepts, design, and optimization of mechanical components and systems, including state-of-the-art design methods such as CAD (Computer-Aided Design) and CAE (Computer-Aided Engineering).*
- *Manufacturing and Production Processes: Study of manufacturing technologies including forming processes, material processing, metal cutting, and advanced production technologies such as additive manufacturing.*
- *Energy Conversion Engineering: Conversion of energy from one form to another, as well as the application of techniques to maximize the efficiency and performance of energy systems.*

*The study materials in each of these fields include basic theory, research methodology, practical applications, and the latest developments in mechanical engineering. The*





*selection of course materials should consider industry trends, workforce market needs, and the academic objectives of the Master of Mechanical Engineering program.*

*Course Materials:*

- *Metallurgy*
- *Manufacturing*
- *Energy Conversion Engineering*
- *Mechanical System Design*

**Tabel 5.1. Bahan kajian berdasarkan CPL Prodi**

**Table 5.1. Study materials based on PLO**

<b>CPL PLO</b>	<b>Deskripsi CPL Prodi PLO Description</b>	<b>Bahan Kajian Course Materials</b>
<b>CPL-1 PLO-1</b>	<p>Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, eksekusi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal.</p> <p><i>(Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, having noble character, being sensitive and caring about social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve maximum results.)</i></p>	<p>Menghasilkan pengembangan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.</p> <p><i>Producing developments of innovative mechanical design system and its components by utilizing interdisciplinary or multidisciplinary knowledge.</i></p> <p>BK-1 BK-2 BK-3 BK-4</p>
<b>CPL-2 PLO-2</b>	<p>Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi</p>	<p>Menghasilkan pengembangan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.</p> <p><i>Producing developments of innovative mechanical design system and its components by utilizing interdisciplinary or multidisciplinary knowledge.</i></p> <p>BK-1</p>



<b>CPL PLO</b>	<b>Deskripsi CPL Prodi PLO Description</b>	<b>Bahan Kajian Course Materials</b>
	<i>(Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars.)</i>	BK-2 BK-3 BK-4
<b>CPL-3 PLO-3</b>	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan. <i>(Able to manage self learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability.)</i>	Menghasilkan pengembangan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin. <i>Producing developments of innovative mechanical design system and its components by utilizing interdisciplinary or multidisciplinary knowledge.</i> BK-1 BK-2 BK-3 BK-4
<b>CPL-4 PLO-4</b>	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>(Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.)</i>	Menghasilkan pengembangan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin. <i>Producing developments of innovative mechanical design system and its components by utilizing interdisciplinary or multidisciplinary knowledge.</i> BK-1 BK-2 BK-3 BK-4
<b>CPL-5 PLO-5</b>	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>(Able to understand and utilize the theory of engineering sciences in mechanical engineering.)</i>	Menghasilkan pengembangan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin. <i>Producing developments of innovative mechanical design system and its components by utilizing interdisciplinary or multidisciplinary knowledge.</i> BK-1 BK-2 BK-3



<b>CPL PLO</b>	<b>Deskripsi CPL Prodi PLO Description</b>	<b>Bahan Kajian Course Materials</b>
		BK-4
<b>CPL-6 PLO-6</b>	<p>Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.</p> <p><i>(Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields.)</i></p>	<p>Menghasilkan pengembangan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.</p> <p><i>Producing developments of innovative mechanical design system and its components by utilizing interdisciplinary or multidisciplinary knowledge.</i></p> <p>BK-1 BK-2 BK-3 BK-4</p>
<b>CPL-7 PLO-7</b>	<p>Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin.</p> <p><i>(Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach.)</i></p>	<p>Menghasilkan pengembangan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.</p> <p><i>Producing developments of innovative mechanical design system and its components by utilizing interdisciplinary or multidisciplinary knowledge.</i></p> <p>BK-1 BK-2 BK-3 BK-4</p>
<b>CPL-8 PLO-8</b>	<p>Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik.</p> <p><i>(Able to formulate new ideas from the previous research for the development of technology and mechanical systems.)</i></p>	<p>Menghasilkan pengembangan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.</p> <p><i>Producing developments of innovative mechanical design system and its components by utilizing interdisciplinary or multidisciplinary knowledge.</i></p> <p>BK-1 BK-2 BK-3 BK-4</p>
<b>CPL-9 PLO-9</b>	<p>Mampu mengkritik dan mengembangkan rencana dari sudut pandang teknik mesin untuk memecahkan permasalahan lingkungan dalam bentuk karya ilmiah.</p> <p><i>(Able to criticize and to develop plans from a Mechanical Engineering point of view to solve environmental problems in the form of scientific works.)</i></p>	<p>Menghasilkan pengembangan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.</p> <p><i>Producing developments of innovative mechanical design system and its components by utilizing interdisciplinary or multidisciplinary knowledge.</i></p> <p>BK-1 BK-2 BK-3</p>



CPL PLO	Deskripsi CPL Prodi PLO Description	Bahan Kajian Course Materials
		BK-4

## 5.2 Deskripsi Bahan Kajian

### *Course Materials Description*

**Tabel 5.2. Bahan Kajian (BK)**

**Table 5.2. Course Materials**

Kode Code	Bahan Kajian (BK) Course Materials	Deskripsi Bahan Kajian Course Materials Description
BK-1	Metallurgy	Pemahaman dan pendalaman struktur dan sifat material logam serta keterampilan dalam menerapkan pengetahuan tersebut dalam desain, pemrosesan, dan pengembangan produk yang inovatif. <i>Understanding and mastering the structure and properties of metal materials as well as the skills in applying this knowledge in innovative product design, processing, and development.</i>
BK-2	Manufacturing	Pemahaman dan pendalaman dalam pengelolaan proses produksi secara efektif dan efisien dalam berbagai industri manufaktur. <i>Understanding and mastering effective and efficient production process management in various manufacturing industries.</i>
BK-3	Energy Conversion Engineering	Pemahaman dan pendalaman dalam merancang, menganalisis, dan mengoptimalkan sistem konversi energi yang efisien, berkelanjutan, dan ramah lingkungan dalam berbagai konteks industri dan aplikasi. <i>Understanding and mastering the design, analysis, and optimization of efficient, sustainable, and environmentally friendly energy conversion systems in various industrial contexts and applications.</i>
BK-4	Mechanical System Desain	Pemahaman dan pendalaman dalam merancang, mengembangkan, dan memproduksi sistem mekanis yang inovatif, efisien, dan dapat diandalkan dalam berbagai aplikasi industri. <i>Understanding and mastering the design, development, and production of innovative, efficient, and reliable mechanical systems in various industrial applications.</i>



# *Pembentukan Mata Kuliah dan Penentuan Bobot SKS* ——— •

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## **BAB 6**





## 6. Pembentukan Mata Kuliah dan Penentuan Bobot SKS

### *Formation of Courses and Determination of Credits*

**Tabel 6.1. Matriks kesesuaian CPL dengan Bahan Kajian**  
**Table 6.1. Matrix of conformity between PLO and Course Materials**

<b>CPL PLO</b>	<b>Bahan kajian Course materials</b>
<p><b>CPL-1</b> Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, ekselensi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal.</p> <p><i>(Able to demonstrate attitudes and character that reflect: devotion to God Almighty, ethics and integrity, having noble character, being sensitive and caring about social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve maximum results.)</i></p>	BK-1 BK-2 BK-3 BK-4
<p><b>CPL-2</b> Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi</p> <p><i>(Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars.)</i></p>	BK-1 BK-2 BK-3 BK-4
<p><b>CPL-3</b> Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan.</p> <p><i>(Able to manage self learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability.)</i></p>	BK-1 BK-2 BK-3 BK-4
<p><b>CPL-4</b> Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam</p> <p><i>(Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.)</i></p>	BK-1 BK-2 BK-3 BK-4



<p><b>CPL-5</b> Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>(Able to understand and utilize the theory of engineering sciences in mechanical engineering.)</i></p>	<p>BK-1 BK-2 BK-3 BK-4</p>
<p><b>CPL-6</b> Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin. <i>(Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields.)</i></p>	<p>BK-1 BK-2 BK-3 BK-4</p>
<p><b>CPL-7</b> Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin. <i>(Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach.)</i></p>	<p>BK-1 BK-2 BK-3 BK-4</p>
<p><b>CPL-8</b> Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>(Able to formulate new ideas from the previous research for the development of technology and mechanical systems.)</i></p>	<p>BK-1 BK-2 BK-3 BK-4</p>
<p><b>CPL-9</b> Mampu mengkritik dan mengembangkan rencana dari sudut pandang teknik mesin untuk memecahkan permasalahan lingkungan dalam bentuk karya ilmiah. <i>(Able to criticize and to develop plans from a Mechanical Engineering point of view to solve environmental problems in the form of scientific works.)</i></p>	<p>BK-1 BK-2 BK-3 BK-4</p>

Penentuan MK dapat diperoleh dengan cara melakukan *break down* dalam bentuk tabel di bawah ini.

*The formation of courses can be done by breaking them down into the table below.*

**Tabel 6.2 Pembentukan MK**

**Table 6.2. Courses formation**

<b>Bahan Kajian Course Materials</b>	<b>Unsur dalam BK Element in Course Materials</b>	<b>Pembentukan MK Course Formation</b>	<b>Nama MK Course Name</b>
BK-1 Metalurgy	1.1.1 Identifikasi <i>Identification</i> 1.1.2 Analisis <i>Analysis</i> 1.1.3 Sintesis <i>Synthesis</i> 1.1.4. Simulasi <i>Simmulation</i>	1.1.1 Tujuan <i>Goals</i> 1.2.1 Metode <i>Methods</i> 1.3.1 Material <i>Materials</i> 1.4.1 Asesmen <i>Assesments</i>	<ul style="list-style-type: none"> <li>• Mekanika Komposit <i>Mechanics of Composite</i></li> <li>• Metalurgi Manufaktur <i>Manufacturing Metallurgy</i></li> <li>• Metode Penelitian dan Komunikasi Ilmiah <i>Research Methods and Scientific Communication</i></li> <li>• Analisa Kegagalan Material <i>Material Failure Analysis</i></li> </ul>
BK-2	2.1.1 Identifikasi <i>Identification</i>	2.1.1 Tujuan <i>Goals</i>	<ul style="list-style-type: none"> <li>• Desain Eksperimen <i>Design of Experiments</i></li> </ul>





Manufacturing	2.1.2 Analisis <i>Analysis</i> 2.1.3 Sintesis <i>Synthesis</i> 2.1.4. Simulasi <i>Simulation</i>	2.2.1 Metode <i>Methods</i> 2.3.1 Material <i>Materials</i> 2.4.1 Asesmen <i>Assesments</i>	<ul style="list-style-type: none"> <li>• Proses Pemesinan <i>Machining Process</i></li> <li>• Optimasi Proses <i>Process Optimization</i></li> <li>• Rekayasa Kualitas <i>Quality Engineering</i></li> <li>• Dinamika Mesin Perkakas <i>Machine Tool Dynamics</i></li> <li>• Sistem Pengendalian Linier <i>Linear Control System</i></li> <li>• Riset Operasional <i>Operational Research</i></li> </ul>
BK-3 Energy Conversion Engineering	3.1.1 Identifikasi <i>Identification</i> 3.1.2 Analisis <i>Analysis</i> 3.1.3 Sintesis <i>Synthesis</i> 3.1.4. Simulasi <i>Simulation</i>	3.1.1 Tujuan <i>Goals</i> 3.2.1 Metode <i>Methods</i> 3.3.1 Material <i>Materials</i> 3.4.1 Asesmen <i>Assesments</i>	<ul style="list-style-type: none"> <li>• Analisa Pencemaran Lingkungan <i>Environmental Pollution Analysis</i></li> <li>• Aliran Dua Fase <i>Two-Phase Flow</i></li> <li>• Mekanika Fluida <i>Fluid Mechanics</i></li> <li>• Metode Numerik untuk Rekayasa Mekanika <i>Numerical Method for Mechanical Engineering</i></li> <li>• Aliran Viscous <i>Viscous Flow</i></li> <li>• Aerodinamika Profil <i>Profile Aerodynamics</i></li> <li>• Matematika Rekayasa Lanjut <i>Advanced Engineering Mathematics</i></li> <li>• Audit Energi Terintegrasi <i>Integrated Energy Audit</i></li> <li>• Mesin-Mesin Konversi Energi <i>Energy Conversion Devices</i></li> <li>• Termodinamika Lanjut <i>Advanced Thermodynamics</i></li> <li>• Komputasi Fluida &amp; Perpan <i>Computational Fluid and Heat Transfer</i></li> <li>• Teknologi Pembangkit Daya <i>Power Generation Technology</i></li> <li>• Perpindahan Panas dan Masa <i>Heat and Mass Transfer</i></li> <li>• Teknik Pembakaran <i>Combustion Engineering</i></li> <li>• Ekonomi dan Manajemen Pembangkit Daya <i>Power Plant Economics and Management</i></li> <li>• Energi Surya <i>Solar Energy</i></li> </ul>
BK-4 Mechanical System Desain	4.1.1 Identifikasi <i>Identification</i> 4.1.2 Analisis <i>Analysis</i>	4.1.1 Tujuan <i>Goals</i> 4.2.1 Metode <i>Methods</i>	<ul style="list-style-type: none"> <li>• Prediksi Usia Lelah <i>Fatigue Life Prediction</i></li> <li>• Metode Elemen Hingga <i>Finite Element Methods</i></li> </ul>



	4.1.3 Sintesis <i>Synthesis</i> 4.1.4. Simulasi <i>Simulation</i>	4.3.1 Material <i>Materials</i> 4.4.1 Asesmen <i>Assesments</i>	<ul style="list-style-type: none"><li>• Optimasi Desain <i>Design Optimization</i></li><li>• Pemodelan Sistem Dinamis <i>Dynamic Systems Modeling</i></li><li>• Getaran Mekanis <i>Machanical Vibration</i></li><li>• Kinematika &amp; Dinamika Lanjut <i>Advanced Kinematics and Dynamics</i></li><li>• Dinamika Kendaraan <i>Vehicle Dynamics</i></li></ul>
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**Tabel 6.3 Perhitungan bobot SKS setiap MK**  
*Table 6.3. Calculation of credits for each courses*

No	Nama MK <i>Course Name</i>	CPL yang dibebankan pada MK <i>PLO charged to the course</i>	Indikator ketercapaian CPL <i>Indicator of CPL achievement</i>	Lama waktu ketercapaian CPL (dalam jam/SKS) <i>Duration of CPL achievement (in hour/credit)</i>	Total (dalam jam/SKS) <i>Total (in hour/credit)</i>	Konversi ke SKS <i>Conversion to credit</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Metode Penelitian dan Komunikasi Ilmiah <i>(Research Methods and Scientific Communication)</i>	CPL-1 <i>PLO-1</i>	<ul style="list-style-type: none"><li>• <b>CPMK-1</b> Mahasiswa memiliki kapasitas dalam mengumpulkan informasi dan menggali keterbaharuan terkait dengan ide penelitian tesis <i>(Students have the capacity to collect information and explore state of the art study related to thesis research ideas)</i></li></ul>	8.55	90	2 SKS = 90 / 45.3 jam  2 Credits = 90 / 45.3 hours
		CPL-2 <i>PLO-2</i>	<ul style="list-style-type: none"><li>• <b>CPMK-1</b> Mahasiswa memiliki kapasitas dalam mengumpulkan informasi dan menggali keterbaharuan terkait dengan ide penelitian tesis <i>(Students have the capacity to collect information and explore state of the art study related to thesis research ideas)</i></li><li>• <b>CPMK-4</b> Kemampuan dalam menganalisa hasil penelitian dan mempresentasikannya dalam bentuk tesis, disertasi dan artikel ilmiah <i>(Ability to analyze research results and present them in the form of theses, dissertations and scientific articles)</i></li></ul>	24.3		



			<ul style="list-style-type: none"><li>• <b>CPMK-5</b> Memahami tahapan-tahapan proses pembuatan manuskrip dan langkah-langkah dalam publikasi di konferensi atau jurnal <i>(Understand the stage of manuscript preparation for conference or journal publication)</i></li></ul>			
		CPL-3 PLO-3	<ul style="list-style-type: none"><li>• <b>CPMK-1</b> Mahasiswa memiliki kapasitas dalam mengumpulkan informasi dan menggali keterbaruan terkait dengan ide penelitian tesis <i>(Students have the capacity to collect information and explore state of the art study related to thesis research ideas)</i></li><li>• <b>CPMK-3</b> Kemampuan menyusun proposal tesis, proposal penelitian dan mempresentasikan proposal tersebut <i>(Ability to prepare a thesis proposal, research proposal and present the proposal in the seminar)</i></li></ul>	16.2		
		CPL-6 PLO-6	<ul style="list-style-type: none"><li>• <b>CPMK-2</b> Kemampuan memahami tahapan-tahapan dalam metodologi penelitian <i>(Ability to understand the different stages in research methodology)</i></li><li>• <b>CPMK-4</b> Kemampuan dalam menganalisa hasil penelitian dan mempresentasikannya dalam bentuk tesis, disertasi dan artikel ilmiah <i>(Ability to analyze research results and present them in the form of theses, dissertations and scientific articles)</i></li></ul>	16.2		



		CPL-8 PLO-8	<ul style="list-style-type: none"> <li>• <b>CPMK-3</b> Kemampuan menyusun proposal tesis, proposal penelitian dan mempresentasikan proposal tersebut <i>(Ability to prepare a thesis proposal, research proposal and present the proposal in the seminar)</i></li> </ul>	8.55		
		CPL-9 PLO-9	<ul style="list-style-type: none"> <li>• <b>CPMK-4</b> Kemampuan dalam menganalisa hasil penelitian dan mempresentasikannya dalam bentuk tesis, disertasi dan artikel ilmiah</li> <li>• <b>CPMK-5</b> Memahami tahapan-tahapan proses pembuatan manuskrip dan langkah-langkah dalam publikasi di konferensi atau jurnal <i>(Understand the stage of manuscript preparation for conference or journal publication)</i></li> </ul>	16.2		
2	Matematika Rekayasa Lanjut <i>(Advance Engineering Mathematics)</i>	CPL-4 PLO-4	<ul style="list-style-type: none"> <li>• <b>CPMK-1</b> Mengetahui teori matematika rekayasa yang digunakan pada bidang rekayasa mekanika <i>(Understanding the mathematical engineering theory utilized in the field of mechanical engineering.)</i></li> <li>• <b>CPMK-2</b> Mampu menggunakan teori matematika rekayasa untuk menyelesaikan permasalahan rekayasa pada bidang rekayasa mekanika <i>(Able to apply engineering mathematical theory to solve engineering problems in the field of mechanical engineering.)</i></li> </ul>	68	136	3 SKS = 136 / 45.3 jam  3 Credits = 136 / 45.3 hours
		CPL-5 PLO-5	<ul style="list-style-type: none"> <li>• <b>CPMK-1</b> Mengetahui teori matematika rekayasa yang digunakan pada bidang rekayasa mekanika</li> </ul>	68		



			<p>(Understanding the mathematical engineering theory utilized in the field of mechanical engineering.)</p> <ul style="list-style-type: none"> <li>• <b>CPMK-2</b> Mampu menggunakan teori matematika rekayasa untuk menyelesaikan permasalahan rekayasa pada bidang rekayasa mekanika (Able to apply engineering mathematical theory to solve engineering problems in the field of mechanical engineering.)</li> </ul>			
3	Metode Numerik untuk Rekayasa Mekanika (Numerical Method for Mechanical Engineering)	CPL-4 PLO-4	<ul style="list-style-type: none"> <li>• <b>CPMK-1</b> Mampu memahami konsep metode numerik, aproksimasi dan error. (Able to understand the concept of numerical, approximation and errors)</li> </ul>	23.12	136	3 SKS = 136 / 45.3 jam 3 Credits = 136 / 45.3 hours
		CPL-5 PLO-5	<ul style="list-style-type: none"> <li>• <b>CPMK-2</b> Mampu merumuskan masalah teknik dalam bentuk matematika yang sesuai dan memilih pendekatan numerik yang tepat. (Able to represent mechanical problems in suitable governing equations and choose the appropriate numerical approach)</li> <li>• <b>CPMK-3</b> Mampu mendiskritisasi persamaan differensial menjadi set persamaan linear aljabar dan menyelesaikannya dengan metode numerik. (Able to discretize differential equations into sets of linear algebra equations and solve them using numerical method)</li> <li>• <b>CPMK-4</b> Mampu menyusun algoritma penyelesaian numerik dan membuat program</li> </ul>	68		



			<p>numerik sederhana untuk kasus yang berkaitan dengan rekayasa mekanik. (<i>Able to construct numerical solution algorithm and to code a simple numerical program to solve engineering problem</i>)</p>			
		<p>CPL-7 PLO-7</p>	<ul style="list-style-type: none"> <li>• <b>CPMK-3</b> Mampu mendiskritisasi persamaan differensial menjadi set persamaan linear aljabar dan menyelesaikannya dengan metode numerik. (<i>Able to discretize differential equations into sets of linear algebra equations and solve them using numerical method</i>)</li> <li>• <b>CPMK-4</b> Mampu menyusun algoritma penyelesaian numerik dan membuat program numerik sederhana untuk kasus yang berkaitan dengan rekayasa mekanik. (<i>Able to construct numerical solution algorithm and to code a simple numerical program to solve engineering problem</i>)</li> </ul>	44.88		
4	<p>Desain Eksperimen (<i>Design of Experiments</i>)</p>	<p>CPL-2 PLO-2</p>	<ul style="list-style-type: none"> <li>• <b>CPMK-1</b> Mampu memahami dan memanfaatkan teori tentang full factorial untuk menentukan pengaruh faktor terhadap respon (<i>Able to understand and utilize full factorial theory to determine the influence of factors on responses</i>)</li> <li>• <b>CPMK-2</b> Mampu memahami dan memanfaatkan teori tentang fractional factorial untuk menentukan pengaruh faktor terhadap respon</li> </ul>	44.88	136	<p>3 SKS = 136 / 45.3 jam</p> <p>3 Credits = 136 / 45.3 hours</p>





			<p><i>(Able to understand and utilize the theory of fractional factorial to determine the influence of factors on the response)</i></p> <ul style="list-style-type: none"><li>• <b>CPMK-3</b> Mampu memahami dan memanfaatkan teori tentang regresi untuk mengestimasi hubungan antara faktor dan respon <i>(Able to understand and utilize the theory of regression to estimate the relationship between factors and responses)</i></li><li>• <b>CPMK-4</b> Mampu memahami dan memanfaatkan teori tentang respon surface untuk menentukan level dari faktor yang menghasilkan respon optimal <i>(Able to understand and utilize the theory of response surfaces to determine the level of factors that produce optimal responses)</i></li></ul>			
		CPL-3 PLO-3	<ul style="list-style-type: none"><li>• <b>CPMK-1</b> Mampu memahami dan memanfaatkan teori tentang full factorial untuk menentukan pengaruh faktor terhadap respon <i>(Able to understand and utilize full factorial theory to determine the influence of factors on responses)</i></li><li>• <b>CPMK-2</b> Mampu memahami dan memanfaatkan teori tentang fractional factorial untuk menentukan pengaruh faktor terhadap respon <i>(Able to understand and utilize the theory of fractional factorial to determine the influence of factors on the response)</i></li></ul>	44.88		



			<ul style="list-style-type: none"><li>• <b>CPMK-3</b> Mampu memahami dan memanfaatkan teori tentang regresi untuk mengestimasi hubungan antara faktor dan respon <i>(Able to understand and utilize the theory of regression to estimate the relationship between factors and responses)</i></li><li>• <b>CPMK-4</b> Mampu memahami dan memanfaatkan teori tentang respon surface untuk menentukan level dari faktor yang menghasilkan respon optimal <i>(Able to understand and utilize the theory of response surfaces to determine the level of factors that produce optimal responses)</i></li></ul>			
		CPL-5 PLO-5	<ul style="list-style-type: none"><li>• <b>CPMK-1</b> Mampu memahami dan memanfaatkan teori tentang full factorial untuk menentukan pengaruh faktor terhadap respon <i>(Able to understand and utilize full factorial theory to determine the influence of factors on responses)</i></li><li>• <b>CPMK-2</b> Mampu memahami dan memanfaatkan teori tentang fractional factorial untuk menentukan pengaruh faktor terhadap respon <i>(Able to understand and utilize the theory of fractional factorial to determine the influence of factors on the response)</i></li><li>• <b>CPMK-3</b> Mampu memahami dan memanfaatkan teori tentang regresi untuk</li></ul>	44.88		



			<p>mengestimasi hubungan antara faktor dan respon  <i>(Able to understand and utilize the theory of regression to estimate the relationship between factors and responses)</i></p> <ul style="list-style-type: none"> <li>• <b>CPMK-4</b> Mampu memahami dan memanfaatkan teori tentang respon surface untuk menentukan level dari faktor yang menghasilkan respon optimal  <i>(Able to understand and utilize the theory of response surfaces to determine the level of factors that produce optimal responses)</i></li> </ul>			
5	Mata Kuliah Pilihan <i>(Elective Course)</i>	Sesuai Mata Kuliah <i>According to the Course</i>				
6	Tesis <i>(Thesis)</i>	CPL-1 <i>PLO-1</i>	<ul style="list-style-type: none"> <li>• <b>CPMK-1</b> Mampu memberikan analisis terkait latar belakang penelitian dan membuat kajian literatur yang komprehensif serta merancang metodologi yang tepat untuk mendukung penyelesaian permasalahan dalam penelitian  <i>(Able to conduct an analysis concerning the research background, develop an extensive literature review, and formulate a suitable methodology to assist in resolving research issues)</i></li> </ul>	31.71	443.94	10 SKS = 443.94 / 45.3 jam  10 Credits = 443.94 / 45.3 hours
		CPL-2 <i>PLO-2</i>	<ul style="list-style-type: none"> <li>• <b>CPMK-2</b> Mampu menyusun proposal penelitian dan mengerjakan penelitian dengan metodologi yang tepat.</li> </ul>	63.42		



			<p><i>(Able to create a research proposal and conduct research using a suitable methodology.)</i></p> <ul style="list-style-type: none"><li>• <b>CPMK-4</b> Mampu menuliskan hasil penelitian dalam bentuk Buku Tesis dan mempresentasikan pada ujian Tesis. <i>(Able to compile the results of research into a Thesis Book and present it during the Thesis defense.)</i></li></ul>			
		CPL-3 PLO-3	<ul style="list-style-type: none"><li>• <b>CPMK-4</b> Mampu menuliskan hasil penelitian dalam bentuk Buku Tesis dan mempresentasikan pada ujian Tesis. <i>(Able to compile the results of research into a Thesis Book and present it during the Thesis defense.)</i></li></ul>	31.71		
		CPL-4 PLO-4	<ul style="list-style-type: none"><li>• <b>CPMK-3</b> Mampu menganalisis hasil penelitian dan merumuskan kesimpulan. <i>(Able to analyze the results of research and create conclusions)</i></li></ul>	31.71		
		CPL-5 PLO-5	<ul style="list-style-type: none"><li>• <b>CPMK-2</b> Mampu menyusun proposal penelitian dan mengerjakan penelitian dengan metodologi yang tepat. <i>(Able to create a research proposal and conduct research using a suitable methodology.)</i></li><li>• <b>CPMK-3</b> Mampu menganalisis hasil penelitian dan merumuskan kesimpulan. <i>(Able to analyze the results of research and create conclusions)</i></li></ul>	63.42		



		CPL-6 PLO-6	<ul style="list-style-type: none"><li>• <b>CPMK-2</b> Mampu menyusun proposal penelitian dan mengerjakan penelitian dengan metodologi yang tepat. <i>(Able to create a research proposal and conduct research using a suitable methodology.)</i></li><li>• <b>CPMK-3</b> Mampu menganalisis hasil penelitian dan merumuskan kesimpulan. <i>(Able to analyze the results of research and create conclusions)</i></li></ul>	63.42		
		CPL-7 PLO-7	<ul style="list-style-type: none"><li>• <b>CPMK-1</b> Mampu memberikan analisis terkait latar belakang penelitian dan membuat kajian literatur yang komprehensif serta merancang metodologi yang tepat untuk mendukung penyelesaian permasalahan dalam penelitian <i>(Able to conduct an analysis concerning the research background, develop an extensive literature review, and formulate a suitable methodology to assist in resolving research issues)</i></li><li>• <b>CPMK-3</b> Mampu menganalisis hasil penelitian dan merumuskan kesimpulan. <i>(Able to analyze the results of research and create conclusions)</i></li></ul>	63.42		
		CPL-8 PLO-8	<ul style="list-style-type: none"><li>• <b>CPMK-1</b> Mampu memberikan analisis terkait latar belakang penelitian dan membuat kajian literatur yang komprehensif serta merancang</li></ul>	63.42		



			<p>metodologi yang tepat untuk mendukung penyelesaian permasalahan dalam penelitian <i>(Able to conduct an analysis concerning the research background, develop an extensive literature review, and formulate a suitable methodology to assist in resolving research issues)</i></p> <ul style="list-style-type: none"><li>• <b>CPMK-4</b> Mampu menuliskan hasil penelitian dalam bentuk Buku Tesis dan mempresentasikan pada ujian Tesis. <i>(Able to compile the results of research into a Thesis Book and present it during the Thesis defense.)</i></li></ul>			
		CPL-9 PLO-9	<ul style="list-style-type: none"><li>• <b>CPMK-2</b> Mampu menyusun proposal penelitian dan mengerjakan penelitian dengan metodologi yang tepat. <i>(Able to create a research proposal and conduct research using a suitable methodology.)</i></li></ul>	31.71		





**Tabel 6.4 Matrik CPL dan Mata kuliah (Baru)**

**Table 6.4. Matrix of PLO and Courses**

No	MK Course	CPL PLO								
		1	2	3	4	5	6	7	8	9
<b>Semester-1</b>										
1	Metode Penelitian dan Komunikasi Ilmiah ( <i>Research Methods and Scientific Communication</i> )	√	√	√			√		√	√
2	Matematika Rekayasa Lanjut ( <i>Advance Engineering Mathematics</i> )				√	√				
3	Metode Numerik untuk Rekayasa Mekanika ( <i>Numerical Method for Mechanical Engineering</i> )				√	√		√		
4	Desain Eksperimen ( <i>Design of Experiments</i> )		√	√		√				
<b>Semester-2</b>										
5	Mata Kuliah Pilihan 1 ( <i>Elective Course 1</i> )	Sesuai Mata Kuliah <i>According to the Course</i>								
6	Mata Kuliah Pilihan 2 ( <i>Elective Course 2</i> )									
7	Mata Kuliah Pilihan 3 ( <i>Elective Course 3</i> )									
<b>Semester-3</b>										
8	Mata Kuliah Pilihan 4 ( <i>Elective Course 4</i> )	Sesuai Mata Kuliah <i>According to the Course</i>								
9	Mata Kuliah Pilihan 5 ( <i>Elective Course 5</i> )									
<b>Semester-4</b>										
10	Tesis ( <i>Thesis</i> )	√	√	√	√	√	√	√	√	√

# Organisasi Mata Kuliah Program Studi

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

## BAB 7





## 7. Organisasi Mata Kuliah Program Studi

### *Organization of Program Courses*

Sebaran Mata Kuliah dalam kategori sesuai yang dituliskan dalam "Kelompok MK" pada Tabel 7.1.

*Distribution of courses into appropriate categories listed as "Course Group" in Table 7.1.*

**Tabel 7.1. Sebaran mata kuliah dalam kelompok mata kuliah**

*Table 7.1. Distribution of courses in course groups*

NO	SKS <i>Credit</i>	Nama MK dan Kode <i>Course Name and Code</i>	Kelompok Mata Kuliah <i>Course Group</i>						
			MK Inti <i>Core Course</i>	MK Pilihan <i>Elective Course</i>	Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Science</i>	Ilmu dan Teknologi Rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan Komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan Eksperimen Berbasis Masalah <i>Engineering Design and Problem- based Experiment</i>	Pendidikan Umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio- cultural, environmental, and management) including MKWK</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<b>SEMESTER 1</b>									
1	2	Metode Penelitian dan Komunikasi Ilmiah <i>(Methods and Scientific Communication)</i>	√						



NO	SKS Credit	Nama MK dan Kode Course Name and Code	Kelompok Mata Kuliah Course Group						
			MK Inti Core Course	MK Pilihan Elective Course	Matematika dan Ilmu Pengetahuan Alam Mathematics and Natural Science	Ilmu dan Teknologi Rekayasa Engineering Science and Technology	Teknologi Informasi dan Komunikasi Information and Communication Technology	Desain Teknik dan Eksperimen Berkas Masalah Engineering Design and Problem- based Experiment	Pendidikan Umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK General Education (moral, ethics, socio- cultural, environmental, and management) including MKWK
2	3	Matematika Rekayasa Lanjut (Advance Engineering Mathematics)	√						
3	3	Metode Numerik untuk Rekayasa Mekanika (Numerical Method for Mechanical Engineering)	√						
4	3	Desain Eksperimen (Design of Experiments)	√						
<b>SEMESTER 2</b>									
1	3	Mata Kuliah Pilihan 1 (Elective Course 1)		√					
2	3	Mata Kuliah Pilihan 2 (Elective Course 2)		√					
3	3	Mata Kuliah Pilihan 3 (Elective Course 3)		√					
<b>SEMESTER 3</b>									



NO	SKS <i>Credit</i>	Nama MK dan Kode <i>Course Name and Code</i>	Kelompok Mata Kuliah <i>Course Group</i>						
			MK Inti <i>Core Course</i>	MK Pilihan <i>Elective Course</i>	Matematika dan Ilmu Pengetahuan Alam <i>Mathematics and Natural Science</i>	Ilmu dan Teknologi Rekayasa <i>Engineering Science and Technology</i>	Teknologi Informasi dan Komunikasi <i>Information and Communication Technology</i>	Desain Teknik dan Eksperimen Berbasis Masalah <i>Engineering Design and Problem- based Experiment</i>	Pendidikan Umum (moral, etika, sosial budaya, lingkungan, dan manajemen) termasuk MKWK <i>General Education (moral, ethics, socio- cultural, environmental, and management) including MKWK</i>
1	3	Mata Kuliah Pilihan 4 <i>(Elective Course 4)</i>		√					
2	3	Mata Kuliah Pilihan 5 <i>(Elective Course 5)</i>		√					
<b>SEMESTER 4</b>									
1	10	Tesis <i>(Thesis)</i>	√						
<b>Total</b>	<b>36</b>								

**Tabel 7.2. Matrik Organisasi Mata Kuliah Program Studi Magister**

**Table 7.2. Organization Matrix of Master Program Courses**

Semester	SKS <i>Credit</i>	JUMLAH MK <i>Number of Courses</i>	JUMLAH SKS MK Inti <i>Total Credits of Core Courses</i>	JUMLAH SKS MK Pilihan <i>Total Credits of Elective Courses</i>
(1)	(2)	(3)	(4)	(5)
IV	10	1	10	0
III	6	2	0	6



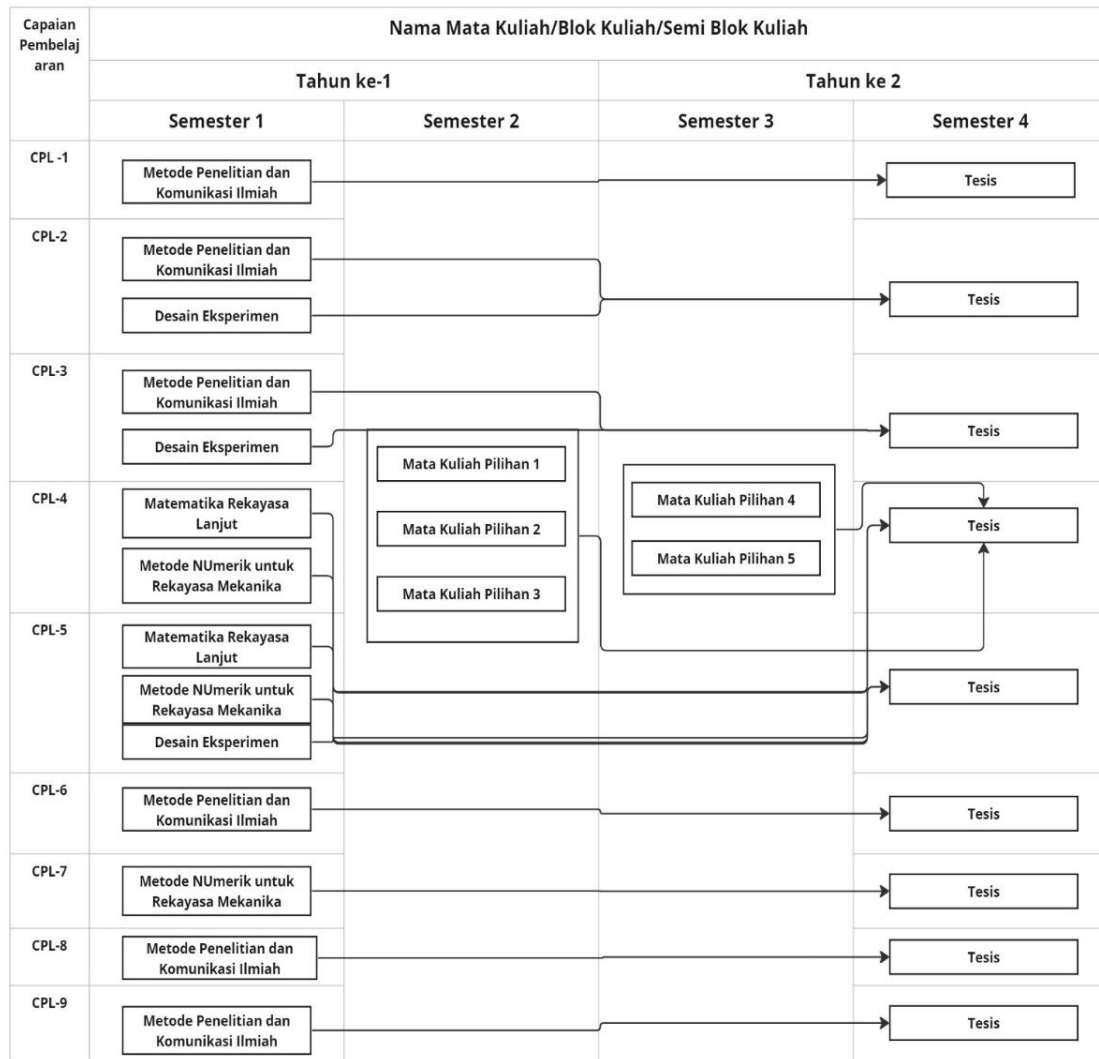
II	9	3	0	9
I	11	4	11	0
<b>Total</b>	36	10	21	15





## PETA CPL Program Studi Magister Teknik Mesin

### PLO Map for Master of Mechanical Engineering Program



# Daftar Sebaran Mata Kuliah Tiap Semester

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

## BAB 8

INSTITUT TEKNOLOGI SEPULUH NOPEMBER





## 8. Sebaran Mata Kuliah Tiap Semester dan Penjadwalan Pengukuran CPL

### *Distribution of Courses Each Semester and Scheduling of PLO Measurement*

NO	KODE MK <i>COURSE CODE</i>	NAMA MK <i>COURSE NAME</i>	CPL-1 <i>PLO-1</i>	CPL-2 <i>PLO-2</i>	CPL-3 <i>PLO-3</i>	CPL-4 <i>PLO-4</i>	CPL-5 <i>PLO-5</i>	CPL-6 <i>PLO-6</i>	CPL-7 <i>PLO-7</i>	CPL-8 <i>PLO-8</i>	CPL-9 <i>PLO-9</i>
(1)	(2)	(3)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	TM235100	Metode Penelitian dan Komunikasi Ilmiah <i>(Methods and Scientific Communication)</i>	1	1	1			1		1	1
2	TM235101	Matematika Rekayasa Lanjut <i>(Advance Engineering Mathematics)</i>				1	1				
3	TM235102	Metode Numerik untuk Rekayasa Mekanika <i>(Numerical Method for Mechanical Engineering)</i>				1	1		1		
4	TM235103	Desain Eksperimen <i>(Design of Experiments)</i>		1	1		1				
5	TM2352XX	Mata Kuliah Pilihan 1 <i>(Elective Course 1)</i>	Sesuai mata kuliah <i>According to the Course</i>								
6	TM2352XX	Mata Kuliah Pilihan 2 <i>(Elective Course 2)</i>	Sesuai mata kuliah <i>According to the Course</i>								
7	TM2352XX	Mata Kuliah Pilihan 3 <i>(Elective Course 3)</i>	Sesuai mata kuliah <i>According to the Course</i>								
8	TM2352XX	Mata Kuliah Pilihan 4	Sesuai mata kuliah								



NO	KODE MK <i>COURSE CODE</i>	NAMA MK <i>COURSE NAME</i>	CPL-1 <i>PLO-1</i>	CPL-2 <i>PLO-2</i>	CPL-3 <i>PLO-3</i>	CPL-4 <i>PLO-4</i>	CPL-5 <i>PLO-5</i>	CPL-6 <i>PLO-6</i>	CPL-7 <i>PLO-7</i>	CPL-8 <i>PLO-8</i>	CPL-9 <i>PLO-9</i>
(1)	(2)	(3)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
		<i>(Elective Course 4)</i>	<i>According to the Course</i>								
9	TM2352XX	Mata Kuliah Pilihan 5 <i>(Elective Course 5)</i>	<i>Sesuai mata kuliah According to the Course</i>								
10	TM235400	Tesis <i>(Thesis)</i>	4	4	4	4	4	4	4	4	4



# *Pembelajaran Melalui* **MB - KM** ——— .

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

## **BAB 9**





## **9. Pembelajaran melalui MB-KM**

### ***Learning through MB-KM***

Program MBKM tidak diterapkan untuk jenjang pendidikan magister dan doktoral.

*MBKM program is not implemented for master's and doctoral program.*



# *Rencana Pembelajaran Semester (RPS)* —●

INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA


## **BAB 10**





## 10. Rencana Pembelajaran Semester (RPS)

### *Semester Learning Plan*

		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b><i>SEMESTER LEARNING PLAN</i></b>						
MATA KULIAH <i>SUBJECTS</i>	KODE <i>CODE</i>	RUMPUN MK <i>COURSE CLUSTER</i>	BOBOT (SKS) <i>CREDITS</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>DATE</i>
Metode Penelitian & Komunikasi Ilmiah <i>Research Methods &amp; Scientific Communication</i>	TM235100	PASCASARJANA <i>POSTGRADUATE</i>	T= 2	P= 0	1	27 November 2023
OTORISASI <i>AUTHORIZATION</i>	Pengembang RPS <i>Developer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Postgraduate Program</i>	
	Fahmi Mubarok, ST, MSc, PhD		Dr. Eng. Sutikno		Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng	
Capaian Pembelajaran	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to The Course</i>					



<b>Learning Outcomes</b>	<b>CPL-1 PLO-1</b>	<p>Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, eksekusi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal.</p> <p><i>Able to represent attitudes and character that reflect: devotion to God Almighty, ethics and integrity, having noble character, being sensitive and caring about social and environmental problems, respecting cultural differences and pluralism, upholding law enforcement, prioritizing the interests of the nation and wider community, through creativity and innovation, excellence, strong leadership, synergy, and other potential to achieve maximum results.</i></p>
	<b>CPL-2 PLO-2</b>	<p>Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi.</p> <p><i>Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars.</i></p>
	<b>CPL-3 PLO-3</b>	<p>Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan.</p> <p><i>Able to manage self learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability.</i></p>
	<b>CPL-4 PLO-4</b>	<p>Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam.</p> <p><i>Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.</i></p>
	<b>CPL-5 PLO-5</b>	<p>Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin.</p> <p><i>Able to understand and utilize the theory of engineering sciences in mechanical engineering.</i></p>
	<b>CPL-6 PLO-6</b>	<p>Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.</p>



		<i>Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields.</i>
<b>CPL-7</b> <b>PLO-7</b>		Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin. <i>Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach.</i>
<b>CPL-8</b> <b>PLO-8</b>		Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>Able to formulate new ideas from the previous research for the development of technology and mechanical systems.</i>
<b>CPL-9</b> <b>PLO-9</b>		Mampus mengkritik dan mengembangkan rencana dari sudut pandang teknik mesin untuk memecahkan permasalahan lingkungan dalam bentuk karya ilmiah. <i>Able to criticize and to develop plans from a Mechanical Engineering point of view to solve environmental problems in the form of scientific works.</i>
<b>Capaian Pembelajaran Mata Kuliah (CPMK)</b> <b>Course Learning Outcome (CLO)</b>		
CP MK 1 CLO 1		Mahasiswa memiliki kapasitas dalam mengumpulkan informasi dan menggali keterbaharuan terkait dengan ide penelitian tesis <i>Students have the capacity to collect information and explore updates related to thesis research ideas</i>
CP MK 2 CLO 2		Mahasiswa mampu memahami tahapan-tahapan dalam metodologi penelitian <i>Students are able to understand the stages in research methodology</i>
CP MK 3 CLO 3		Mahasiswa mampu menyusun proposal tesis, proposal penelitian dan mempresentasikan proposal tersebut <i>Students are able to prepare a thesis proposal, research proposal and present the proposal</i>
CP MK 4 CLO 4		Mahasiswa memiliki kemampuan dalam menganalisa hasil penelitian yang disajikan dalam bentuk tesis, disertasi dan artikel ilmiah <i>Students have the ability to analyze research results presented in the form of theses, dissertations and scientific articles</i>
CP MK 5 CLO 5		Mahasiswa memiliki kemampuan dalam mempresentasikan tesis, disertasi dan karya ilmiah lainnya <i>Students have the ability to present theses, dissertations and other scientific works</i>
CP MK 6		Mahasiswa memahami tahapan proses pembuatan manuskrip konferensi atau jurnal dan langkah-langkah dalam publikasi di konferensi atau jurnal



	CLO 6	<i>Students understand the stages of the process of creating a conference or journal manuscript and the steps in publication in a conference or journal</i>									
		<b>Matrik CPL – CPMK</b> <i>PLO-CLO Matrix</i>									
		<b>CPMK</b> <b>CLO</b>	<b>CPL-1</b> <b>PLO-1</b>	<b>CPL-2</b> <b>PLO-2</b>	<b>CPL-3</b> <b>PLO-3</b>	<b>CPL-4</b> <b>PLO-4</b>	<b>CPL-5</b> <b>PLO-5</b>	<b>CPL-6</b> <b>PLO-6</b>	<b>CPL-7</b> <b>PLO-7</b>	<b>CPL-8</b> <b>PLO-8</b>	<b>CPL-9</b> <b>PLO-9</b>
		CPMK-1 CLO-1	V	V	V						
		CPMK-2 CLO-2						V			
		CPMK-3 CLO-3			V					V	
		CPMK-4 CLO-4		V				V			V
		CPMK-5 CLO-5									V
		CPMK-6 CLO-6		V							V
<b>Deskripsi Singkat MK</b> <i>(Short Description of Course)</i>	<p>Mata kuliah ini memberikan pembelajaran tentang bagaimana menyusun sebuah proposal penelitian dalam tesis yang memenuhi kaidah penelitian ilmiah pada level pascasarjana. Dalam kaidah penelitian akan dikenalkan tentang kebaruan, plagiarisme, metode penelitian, jenis-jenis penelitian. Aspek analisa di dalam desain rencana penelitian dan kebermanfaatannya, serta teknik visualisasi data. Penyusunan proposal dan laporan penelitian setara tesis, penyusunan artikel jurnal ilmiah untuk publikasi hasil penelitian, etika penelitian, pencegahan plagiarisme.</p> <p><i>This course provides learning about how to prepare a research proposal in a thesis that meets the rules of scientific research at postgraduate level. In research principles, novelty, plagiarism, research methods and types of research will be introduced. Analytical aspects in research plan design and usability, as well as data visualization techniques. Preparation of proposals and research reports equivalent to theses, preparation of scientific journal articles for publication of research results, research ethics, prevention of plagiarism.</i></p>										



<p><b>Bahan Kajian: Materi Pembelajaran (Course Materials)</b></p>	<p>Dalam mata kuliah ini akan mempelajari materi pembelajaran sebagai berikut:</p> <ol style="list-style-type: none"> <li>1. Penjelasan tentang RPKPS, peraturan kuliah, sistem ujian dan penilaian, Prinsip-prinsip dasar teknik presentasi.</li> <li>2. Pengertian penelitian, Pendekatan Kebenaran, Kebenaran ilmiah, Metode ilmiah, Sarana penelitian, Jenis penelitian, Tahapan penelitian,</li> <li>3. Perumusan masalah, Perumusan tujuan penelitian.</li> <li>4. Teknik penyusunan Tinjauan pustaka, daftar pustaka dan penggunaan pustaka pada proposal penelitian.</li> <li>5. Teknik pengumpulan data.</li> <li>6. Teknik analisis data.</li> <li>7. Penyusunan proposal dan laporan penelitian setara skripsi, penyusunan artikel jurnal ilmiah untuk publikasi hasil penelitian, etika penelitian,</li> <li>8. pencegahan plagiarisme.</li> </ol> <p><i>This course will study the following learning materials:</i></p> <ol style="list-style-type: none"> <li>1. <i>Explanation of RPKPS, lecture regulations, examination and assessment systems, basic principles of presentation techniques.</i></li> <li>2. <i>Definition of research, Truth Approach, Scientific Truth, Scientific Method, Research Facilities, Types of Research, Stages of Research,</i></li> <li>3. <i>Formulation of the problem, formulation of research objectives.</i></li> <li>4. <i>Techniques for preparing literature reviews, bibliography lists and use of literature in research proposals.</i></li> <li>5. <i>Data collection techniques.</i></li> <li>6. <i>Data analysis techniques.</i></li> <li>7. <i>Preparation of proposals and research reports equivalent to theses, preparation of scientific journal articles for publication of research results, research ethics,</i></li> <li>8. <i>prevention of plagiarism.</i></li> </ol>	
<p><b>Pustaka (References)</b></p>	<p><b>Utama : (Main)</b></p>	
	<ol style="list-style-type: none"> <li>1. Kothari, C.R., 2004, Research Metthodology: Methods and Techniques, Second Revision Edition, New Age International Publiher</li> <li>2. Dawson, C. , 2007, A Practical Guide to Research Methids, Third Edition, How To Books, Oxford, United Kingdom.</li> <li>3. Bailey, S., 2015, Academic Writing, A Handbook for International students, Fourth Edition, Routledge, Taylor &amp; Francis Group, New York, USA.</li> </ol>	





		4. Wallwork, A, 2011, English for Writing Research Papers, Springer, New York					
		<b>Pendukung : (supporting)</b>					
		Slide handout					
		<b>Software:</b>					
		Mendeley, Zotaro, Grammarly, Quilboot, ChatGPT					
<b>Dosen Pengampu (Lecturers)</b>		Fahmi Mubarak, ST, MSc, PhD, Ika Dwi Wijayanti ST, MSC, PhD, Bambang Arif, PhD, Latifah Nurrahmi, PhD					
<b>Matakuliah syarat (Prerequisites)</b>							
Minggu / Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian Assesment		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [ Estimasi Waktu] <i>(Form of Learning; Learning Method; Student Assignment)</i>		Materi Pembelajaran [ Pustaka ] <i>Learning Material</i>	Bobot Penilaian (%) <i>Assesment Load (%)</i>
		Indikator / indicator	Kriteria & Bentuk <i>Criteria &amp; Model</i>	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	<ul style="list-style-type: none"> <li>Memahami tata tertib kuliah <i>Understand college rules</i></li> </ul>	<ul style="list-style-type: none"> <li>Menyetujui kontrak kuliah <i>Approve the tuition contract</i></li> </ul>	Penjelasan dalam bentuk verbal atau tulisan <i>Explanation in verbal or written form</i>	<b>TM [3x50']:</b> Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i>	myITS Classroom <i>myITS Classroom</i>	Research Methodology, Methods, and Techniques, C.R Kothari, 2004.	0





	<p><i>and regulations</i></p> <ul style="list-style-type: none"> <li>• Mengenal berbagai jenis dan ragam penelitian <i>Get to know the various types and varieties of research</i></li> </ul>	<ul style="list-style-type: none"> <li>• Kecakapan dalam memahami jenis dan ragam penelitian <i>Skills in understanding the types and varieties of research</i></li> </ul>		<p><b>PT</b> [3x60']: Home work (PR) <i>Home work (PR)</i></p> <p><b>PM</b> [3x60']: Review materi kuliah dan PR <i>Lecture material and homework review</i></p>		<p><i>Research Methodology, Methods, and Techniques, C.R Kothari, 2004.</i></p> <p>[1]: Bab 1, 2 dan 3 Kotari <i>[1]: Chapters 1, 2 and 3 Kotari</i></p> <p>[2]: Handout di myITS Calssroom <i>[2]: Handout di myITS Calssroom</i></p>	
2-3	<ul style="list-style-type: none"> <li>• Mahasiswa mampu menjelaskan berbagai metodologi penelitian <i>Students are able to explain various research methodologie s</i></li> <li>• Mahasiswa mampu</li> </ul>	<ul style="list-style-type: none"> <li>• Memahami metodologi penelitian dan metode penelitian <i>Understand research methodology and research methods</i></li> <li>• Memiliki pengetahuan berbagai metode penelitian yang tersedia</li> </ul>	<p>Penjelasan dalam bentuk verbal atau tulisan <i>Explanation in verbal or written form</i></p>	<p><b>TM</b> [3x50']: Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i></p> <p><b>PT</b> [3x60']: Home work (PR) <i>Home work (PR)</i></p> <p><b>PM</b> [3x60']: Review materi kuliah dan PR <i>Lecture material and homework review</i></p>	myITS Classroom <i>myITS Classroom</i>	<p><i>Research Methodology, Methods, and Techniques, C.R Kothari, 2004.</i></p> <p><i>Research Methodology, Methods, and Techniques, C.R Kothari, 2004.</i></p>	



	menjelaskan metode ilmiah dan tahapan di dalam metode ilmiah <i>Students are able to explain the scientific method and the stages in the scientific method</i>	<i>Have knowledge of the various research methods available</i>					
4	Mahasiswa mampu mengetahui karakteristik penulisan tesis <i>Students are able to know the characteristics of thesis writing</i>	Memahami karakteristik penulisan tesis <i>Understand the characteristics of thesis writing</i>	<b>Oral post test:</b> (acak): penulisan akademik <b>Oral post test:</b> (random): <i>academic writing</i>	<b>TM</b> [3x50']: Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i> <b>PT</b> [3x60']: Home work (PR) <i>Home work (PR)</i> <b>PM</b> [3x60']: Review materi kuliah dan PR <i>Lecture material and homework review</i>	myITS Classroom <i>myITS Classroom</i>	Research Methodology, Methods, and Techniques, C.R Kothari, 2004. <i>Research Methodology, Methods, and Techniques, C.R Kothari, 2004.</i>	



5	Mahasiswa mampu menjelaskan konsep kebaruan dalam penelitian <i>Students are able to explain the concept of novelty in research</i>	Mahasiswa mampu menemukan kebaruan dalam sebuah rencana riset <i>Students are able to find novelty in a research plan</i>	<b>Oral Post-Test</b> (acak): Pencarian kebaruan untuk topik tesis  <b>Oral Post-Test</b> (random): <i>Novelty search for thesis topics</i>  <b>Tugas Mandiri:</b> Mencari keterbaruan untuk topik tesis <b>Independent task:</b> <i>Looking for updates on the thesis topic</i>	<b>TM</b> [3x50']: Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i> <b>PT</b> [3x60']: Home work (PR) <i>Home work (PR)</i> <b>PM</b> [3x60']: Review materi kuliah dan PR <i>Lecture material and homework review</i>	myITS Classroom <i>myITS Classroom</i>	Research Methodology, Methods, and Techniques, C.R Kothari, 2004. <i>Research Methodology, Methods, and Techniques, C.R Kothari, 2004.</i>	
6	<b>Evaluasi 1</b> Mahasiswa mampu menyusun penulisan proposal tesis <b>Evaluation 1</b> <i>Students are able to write a thesis proposal</i>	Mahasiswa mampu menyusun Pengantar, Dasar Teori dan Metodologi dalam proposal tesis <i>Students are able to prepare an Introduction, Basic Theory and Methodology in a thesis proposal</i>	<b>Evaluasi 1</b> (120 menit): Pengumpulan proposal tesis di myITS classroom <i>Evaluation 1 (120 minutes): Submission of thesis proposals in myITS classroom</i>	Panduan tesis mahasiswa magister ITS <i>ITS master's student thesis guide</i>	myITS Classroom <i>myITS Classroom</i>	Buku Pedoman Penyusunan Tesis Program Studi Magister 2018, Direktorat Akademik ITS <i>Guide book Preparation of a Thesis Master Study Program</i>	



						2018, ITS Academic Directorate	
7-8	<b>Evaluasi 2</b> Mahasiswa mampu mempresentasi proposal tesis yang dibuat <i>Evaluation 2 Students are able to present their thesis proposals</i>	Mahasiswa menyiapkan presentasi proposal tesis <i>Students prepare a thesis proposal presentation</i>	<b>Evaluasi 2</b> (120 menit): Mahasiswa mempresentasikan proposal tesis selama 10 menit dilanjutkan diskusi <b>Evaluation 2</b> (120 minutes): <i>Students present their thesis proposals for 10 minutes followed by discussion</i>	<b>TM</b> [3x50']: Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i> <b>PT</b> [3x60']: Home work (PR) <i>Home work (PR)</i> <b>PM</b> [3x60']: Review materi kuliah dan PR <i>Lecture material and homework review</i>	myITS Classroom <i>myITS Classroom</i>		
9	Mahasiswa mampu memahami perbedaan artikel konferensi dan artikel jurnal <i>Students are able to understand the difference between</i>	Mahasiswa memahami artikel konferensi dan artikel jurnal <i>Students understand conference articles and journal articles</i>	<b>Oral Post-Test</b> (acak): Perbedaan artikel konferensi dan jurnal  <b>Oral Post-Test</b> (random): <i>Difference between conference and journal articles</i>  <b>Tugas Mandiri:</b> -	<b>TM</b> [3x50']: Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i> <b>PT</b> [3x60']: Home work (PR) <i>Home work (PR)</i> <b>PM</b> [3x60']: Review materi kuliah dan PR	myITS Classroom <i>myITS Classroom</i>		



	<i>conference articles and journal articles</i>		<b>Independent task:</b> -	<i>Lecture material and homework review</i>			
10-11	Mahasiswa mampu menyiapkan manuskrip konferensi atau jurnal <i>Students are able to prepare conference or journal manuscripts</i>	Mahasiswa membuat manuskrip artikel konferensi atau artikel jurnal <i>Students create conference article manuscripts or journal articles</i>	<b>Oral Post-Test:</b> Membuat artikel konferensi dan jurnal  <b>Oral Post-Test:</b> <i>Create conference and journal articles</i>  <b>Tugas Mandiri:</b> - <b>Independent task:</b> -	<b>TM [3x50']:</b> Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i> <b>PT [3x60']:</b> Home work (PR) <i>Home work (PR)</i> <b>PM [3x60']:</b> Review materi kuliah dan PR <i>Lecture material and homework review</i>	myITS Classroom <i>myITS Classroom</i>		
12	Mahasiswa mengetahui software untuk membantu penulisan manuskrip <i>Students know software to help write manuscripts</i>	Mahasiswa memakai dan menginstal software penulisan manuskrip <i>Students use and install manuscript writing software</i>	<b>Oral Post-Test:</b> Memakai software penulisan manuskrip  <b>Oral Post-Test:</b> <i>Using manuscript writing software</i>  <b>Tugas Mandiri:</b> Menginstal software untuk membantu penulisan manuskrip <b>Independent task:</b>	<b>TM [3x50']:</b> Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i> <b>PT [3x60']:</b> Home work (PR) <i>Home work (PR)</i> <b>PM [3x60']:</b> Review materi kuliah dan PR <i>Lecture material and homework review</i>	myITS Classroom <i>myITS Classroom</i>	Materi presentasi di myITS Classroom <i>Presentation materials in myITS Classroom</i>	




			<i>Install software to assist in writing manuscripts</i>				
13	<p><b>Evaluasi 3</b> Penulisan manuskrip konferensi atau jurnal</p> <p><b>Evaluation 3</b> <i>Writing conference or journal manuscripts</i></p>	<p>Mahasiswa membuat manuskrip artikel jurnal atau konferensi</p> <p><i>Students create journal or conference article manuscripts</i></p>	<p><b>Evaluasi 3:</b> Mahasiswa membuat manuskrip artikel jurnal atau konferensi</p> <p><b>Evaluation 3:</b> <i>Students create journal or conference article manuscripts</i></p>	<p><b>TM [3x50']:</b> Kuliah, diskusi kelompok, latihan soal</p> <p><i>Lectures, group discussions, practice questions</i></p> <p><b>PT [3x60']:</b> Home work (PR)</p> <p><i>Home work (PR)</i></p> <p><b>PM [3x60']:</b> Review materi kuliah dan PR</p> <p><i>Lecture material and homework review</i></p>	myITS Classroom <i>myITS Classroom</i>		
14	<p>Mahasiswa mampu memilih dan menelaah jurnal</p> <p><i>Students are able to select and review journals</i></p>	<p>Mahasiswa memilih jurnal untuk proses submisi</p> <p><i>Students choose a journal for the submission process</i></p>	<p><b>Oral Post-Test:</b> Memilih 3 jurnal untuk submisi</p> <p><b>Oral Post-Test:</b> <i>Select 3 journals for submission</i></p> <p><b>Tugas Mandiri:</b> Melakukan proses submisi ke jurnal yang dipilih</p> <p><b>Independent task:</b></p>	<p><b>TM [3x50']:</b> Kuliah, diskusi kelompok, latihan soal</p> <p><i>Lectures, group discussions, practice questions</i></p> <p><b>PT [3x60']:</b> Home work (PR)</p> <p><i>Home work (PR)</i></p> <p><b>PM [3x60']:</b> Review materi kuliah dan PR</p> <p><i>Lecture material and homework review</i></p>	myITS Classroom <i>myITS Classroom</i>		





			<i>Carry out the submission process to the selected journal</i>				
15	Kode Etik dalam penulisan ilmiah <i>Code of Ethics in scientific writing</i>	Mahasiswa memahami kode etik penulisan ilmiah <i>Students understand the code of ethics for scientific writing</i>	<b>Tugas Mandiri:</b> Melakukan proses submisi ke jurnal yang dipilih <b>Independent task:</b> <i>Carry out the submission process to the selected journal</i>	<b>TM</b> [3x50']: Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i> <b>PT</b> [3x60']: Home work (PR) <i>Home work (PR)</i> <b>PM</b> [3x60']: Review materi kuliah dan PR <i>Lecture material and homework review</i>	myITS Classroom <i>myITS Classroom</i>		
16	<b>Evaluasi Akhir Semester</b> <b>Final Exam</b>	Bukti submission manuscript ke jurnal <i>Proof of manuscript submission to a journal</i>	Memilih 3 jurnal internasional sebagai target <i>Choose 3 international journals as targets</i>	<b>TM</b> [3x50']: Kuliah, diskusi kelompok, latihan soal <i>Lectures, group discussions, practice questions</i> <b>PT</b> [3x60']: Home work (PR) <i>Home work (PR)</i> <b>PM</b> [3x60']: Review materi kuliah dan PR <i>Lecture material and homework review</i>	myITS Classroom <i>myITS Classroom</i>	Myclassroom, scopus.com dan sjr <i>Myclassroom, scopus.com and sjr</i>	



		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>			Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b>SEMESTER LEARNING PLAN</b>					
MATA KULIAH ( <i>SUBJECTS</i> )	KODE ( <i>CODE</i> )	Rumpun MK ( <i>Class of Course</i> )	BOBOT (sks) ( <i>credits</i> )	SEMESTER	Tgl Penyusunan
MATEMATIKA REKAYASA LANJUT ( <i>Advanced Engineering Mathematics</i> )	TM235101		T=3 sks ~ 4.8 ECTS	1	
OTORISASI ( <i>AUTHORIZATION</i> )	Pengembang RP ( <i>Learning Plan Developer</i> )	Koordinator RMK ( <i>Class of Course Coordinator</i> )	KaPRODI Pascasarjana ( <i>Head of Postgraduate Program</i> )		
	Bambang Arip Dwiyantoro		Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng		
Capaian Pembelajaran MK ( <i>Learning Achievement</i> )	<b>Program Studi (<i>Study Program</i>)</b>				
	CPL 1	Mampu menunjukkan sikap dan karakter yang mencerminkan: ketakwaan kepada Tuhan Yang Maha Esa, etika dan integritas, berbudi pekerti luhur, peka dan peduli terhadap masalah sosial dan lingkungan, menghargai perbedaan budaya dan kemajemukan, menjunjung tinggi penegakan hukum, mendahulukan kepentingan bangsa dan masyarakat luas, melalui kreatifitas dan inovasi, eksekusi, kepemimpinan yang kuat, sinergi, dan potensi lain yang dimiliki untuk mencapai hasil yang maksimal.			
CPL 2	Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan				



	<p>karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi</p> <p>CPL 4 Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam</p> <p>CPL 5 Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin.</p>
	<p><b>Mata Kuliah (Subjects)</b></p> <p>Mengetahui teori matematika rekayasa yang digunakan pada bidang rekayasa mekanika <i>Knowing the engineering mathematics theory used in the field of mechanical engineering</i></p> <p>Mampu menggunakan teori matematika rekayasa untuk menyelesaikan permasalahan rekayasa pada bidang rekayasa mekanika <i>Able to use engineering mathematics theory to solve engineering problems in the field of mechanical engineering</i></p>
<p><b>Diskripsi Bahan Kajian (Description of Study)</b></p>	<p><b>Bahan Kajian (Material)</b></p> <p><b>Pokok Bahasan (Core of Study)</b></p> <ul style="list-style-type: none"><li>- Ordinary Differential Equations</li><li>- Linear Algebra &amp; Vector Calculus</li><li>- Fourier Analysis &amp; Partial Differential Equations</li></ul>
<p><b>Pustaka (References)</b></p>	<p><b>Utama (Main) :</b></p> <ol style="list-style-type: none"><li>1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley &amp; Sons, 2011</li><li>2. Glyn James, Advanced Modern Engineering Mathematics, 4th Edition, Prentice Hall, Pearson Education Limited, 2011</li><li>3. G. Strang. Linear Algebra and its Applications, Brooks Cole, 4th edition, 2005.</li><li>4. D. P. Bertsekas and J. N. Tsitsiklis. Introduction to ProChility. Athena Scientific, 2002.</li></ol> <p><b>Pendukung (Supporter) :</b></p>



<b>Media Pembelajaran (Learning Media)</b>		<b>Software :</b>				
<b>Team Teaching</b>						
<b>Assessment</b>						
Mg Ke- (Weeks)	Sub-Capaian Pembelajaran MK (Sub- Learning Outcome)	Materi Pembelajaran (Material) [ Pustaka ] (Reference)	Metode / Strategi Pembelajaran (Learning methods/strategy) [ Estimasi Waktu ] (Estimated Time)	Assessment		
				Indikator (Indicator)	Bentuk (Model)	Bobot (Weight)
(1-2)	Mahasiswa mampu memahami dan menganalisa persamaan differensial ordinal. <i>Students are able to understand and analyze ordinal differential equations.</i>	Persamaan differensial ordinal tingkat pertama; Persamaan differensial ordinal tingkat kedua [Kreyszig: Ch 1-2] <i>First-order ordinal differential equations; Second order ordinal differential equation</i>	Kuliah dan studi kasus (Lecture and Case Study)	Mampu menyelesaikan persoalan persamaan differensial ordinal tingkat pertama dan kedua. <i>Able to solve first and second order ordinal differential equations.</i>	Latihan (Exercise)	
(3)	Mahasiswa mampu memahami dan menganalisa persamaan differensial ordinal tingkat tinggi <i>Students are able to understand and analyze</i>	Homogeneous linear persamaan differensial ordinal dan Nonhomogeneous linear persamaan differensial ordinal. [Kreyszig: Ch 3] <i>Homogeneous linear</i>	Kuliah dan studi kasus (Lecture and Case Study)	Mampu menyelesaikan persoalan persamaan differensial ordinal tingkat tinggi <i>Able to solve high level ordinal differential equation problems</i>	Tugas 1 (Assessment 1)	



	<i>high-level ordinal differential equations</i>	<i>ordinal differential equations and Nonhomogeneous linear ordinal differential equations.</i>				
<b>(4)</b>	Mahasiswa mampu menganalisa persamaan differensial ordinal dengan series solutions <i>Students are able to analyze ordinal differential equations with series solutions</i>	<i>Power Series Method dan Legendre's Equation.</i> [Kreyszig: Ch 5]	Kuliah dan studi kasus <i>(Lecture and Case Study)</i>	Mampu menyelesaikan persoalan persamaan differensial ordinal dengan series solutions <i>Able to solve ordinal differential equation problems with series solutions</i>	Quiz 1	
<b>(5)</b>	Mahasiswa mampu menganalisa persamaan differensial ordinal dengan Laplace Transforms. <i>Students are able to analyze ordinal differential equations with Laplace Transforms.</i>	<i>Laplace Transforms; Differentiation and Integration of Transforms.</i> [Kreyszig: Ch 6]	Kuliah dan studi kasus <i>(Lecture and Case Study)</i>	Mampu menyelesaikan persoalan persamaan differensial ordinal dengan Laplace Transforms. <i>Able to solve ordinal differential equation problems with Laplace Transforms.</i>	Latihan <i>(Exercise)</i>	
<b>(6)</b>	Mahasiswa mampu memahami dan menganalisa persamaan dengan Fourier Analysis <i>Students are able to understand and analyze</i>	<i>Fourier Series, Fourier Integral dan Fourier Transforms</i> [Kreyszig: Ch 11]	Kuliah dan studi kasus <i>(Lecture and Case Study)</i>	Mampu menyelesaikan persoalan persamaan differensial dengan Fourier Analysis <i>Able to solve problems</i>	Tugas 2 <i>(Assessment 2)</i>	



	<i>equations with Fourier Analysis</i>			<i>of differential equations with Fourier Analysis</i>		
<b>(7)</b>	Mahasiswa mampu menganalisa persamaan differensial parsial <i>Students are able to analyze partial differential equations</i>	Basic Concepts of PDEs; Modeling proses perpindahan panas. [Kreyszig: Ch 12] <i>Basic Concepts of PDEs; Modeling heat transfer process</i>	Kuliah dan studi kasus ( <i>Lecture and Case Study</i> )	Mampu menyelesaikan persoalan persamaan differensial parsial <i>Able to solve partial differential equation problems</i>	Latihan ( <i>Exercise</i> )	
<b>(8)</b>	<b>EVALUASI TENGAH SEMESTER (MID EXAM)</b>					
<b>(9-10)</b>	Mahasiswa mampu memahami dan menganalisa persamaan linear algebra <i>Students are able to understand and analyze linear algebra equations</i>	<i>Matrix Eigenvalue Problem, Vector Differential Calculus, Vector Integral Calculus.</i> [Kreyszig: Ch 8-10]	Kuliah dan studi kasus ( <i>Lecture and Case Study</i> )	Mampu menyelesaikan persoalan persamaan linear algebra <i>Able to solve linear algebraic equation problems</i>	Latihan ( <i>Exercise</i> )	
<b>(11-12)</b>	Mahasiswa mampu memahami dan menyelesaikan permasalahan dengan Complex Analysis <i>Students are able to understand and solve problems with Complex Analysis</i>	<i>Complex numbers and functions; Complex Differentiation; dan Complex Integration</i> [Kreyszig: Ch 13-14]	Kuliah dan studi kasus ( <i>Lecture and Case Study</i> )	Mampu menyelesaikan permasalahan dengan Complex Analysis <i>Able to solve problems with Complex Analysis</i>	Tugas 3 ( <i>Assessment 3</i> )	
<b>(13)</b>	Mahasiswa mampu memahami dan menyelesaikan	<i>Gauss Elimination; Matrix Inversion, Splution by Iteration</i> [Kreyszig: Ch 20]	Kuliah dan studi kasus ( <i>Lecture and Case Study</i> )	Mampu menyelesaikan permasalahan dengan Numeric linear algebra	Quiz 2	

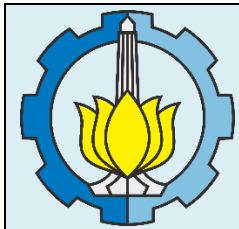




	permasalahan dengan Numeric Linear Algebra <i>Students are able to understand and solve problems with Numeric Linear Algebra</i>			<i>Able to solve problems with numeric linear algebra</i>		
<b>(14-15)</b>	Mahasiswa mampu memahami dan menyelesaikan dengan numeric permasalahan persamaan differensial ordinal dan persamaan differensial parsial. <i>Students are able to understand and solve numerical problems of ordinal differential equations and partial differential equations.</i>	Methods for First-Order ODEs; Methods for Systems and Higher Order ODEs; Methods for Elliptic PDEs; Methods for Parabolic PDEs. [Kreyszig: Ch 21]	Kuliah dan studi kasus ( <i>Lecture and Case Study</i> )	Mampu menyelesaikan dengan numeric permasalahan persamaan differensial ordinal dan persamaan differensial parsial. <i>Able to solve numerical ordinal differential equations and partial differential equations.</i>	Tugas 4 ( <i>Assessment 4</i> )	
<b>(16)</b>	<b>EVALUASI AKHIR SEMESTER (FINAL EXAM)</b>					
<b>Jenis evaluasi (Evaluation type)</b>	<b>Fail Less than 50%</b>	<b>Pass 50 – 59%</b>	<b>Credit 60-69%</b>	<b>Distinction 70 – 79%</b>	<b>High Distinction 80 – 100%</b>	
<b>Tugas tertulis (Written Assignment)</b>	Tidak mengikuti langkah-langkah pengerjaan. Persamaan/rumus	Tidak menuliskan asumsi dan tidak menggambarkan diagram sistem atau proses.	Tidak menuliskan asumsi dan tidak menggambarkan diagram sistem atau	Mengikuti langkah-langkah pengerjaan namun tidak terlalu lengkap (tidak ada diagram sistem/proses,	Mengikuti langkah-langkah pengerjaan (terdapat diagram sistem/proses, rumus, asumsi). Perhitungan	



	<p>yang digunakan salah, tidak ada satuan. Pekerjaan mencontoh tugas teman.</p> <p><i>Do not follow the work steps. The equation/formula used is wrong, there are no units. Work imitates a friend's assignment.</i></p>	<p>Persamaan/rumus yang digunakan kurang lengkap dan tidak ada satuan dari besaran.</p> <p><i>Do not write down assumptions and do not draw system or process diagrams. The equation/formula used is incomplete and there is no unit of quantity.</i></p>	<p>proses.</p> <p>Persamaan/rumus yang digunakan kurang lengkap.</p> <p><i>Do not write down assumptions and do not draw system or process diagrams. The equation/formula used is incomplete</i></p>	<p>rumus, asumsi).</p> <p>Perhitungan dan analisa 80% tepat disertai satuan dari besaran yang ada.</p> <p><i>Followed the steps but didn't do it too complete (no system/process diagrams, formulas, assumptions). Calculation and analysis 80% correct accompanied by units of existing quantities</i></p>	<p>dan analisa lebih dari 80% tepat disertai satuan dari besaran yang ada.</p> <p><i>Following the work steps (there are system/process diagrams, formulas, assumptions). Calculation and analysis is more than 80% correct with the units of the existing quantities.</i></p>
<p><b>Ujian tertulis (Written Exam)</b></p>	<p>Tidak mengikuti langkah-langkah pengerjaan. Rumus yang digunakan salah, tidak ada satuan.</p> <p><i>Do not follow the work steps. The formula used is wrong, there is no unit.</i></p>	<p>Tidak menuliskan asumsi dan tidak menggambarkan diagram sistem atau proses.</p> <p>Persamaan/rumus yang digunakan kurang lengkap dan tidak ada satuan dari besaran.</p> <p><i>Do not write down assumptions and do not draw system or process diagrams. The equation/formula used is incomplete and there is no unit of quantity.</i></p>	<p>Tidak menuliskan asumsi dan tidak menggambarkan diagram sistem atau proses.</p> <p>Persamaan/rumus yang digunakan kurang lengkap.</p> <p><i>Do not write down assumptions and do not draw system or process diagrams. The equation/formula used is incomplete</i></p>	<p>Mengikuti langkah-langkah pengerjaan namun tidak terlalu lengkap (tidak ada diagram sistem/proses, rumus, asumsi). Perhitungan dan analisa 80% tepat disertai satuan dari besaran yang ada.</p> <p><i>Followed the steps but didn't do it too complete (no system/process diagrams, formulas, assumptions). Calculation and analysis 80% correct accompanied by units of existing quantities</i></p>	<p>Mengikuti langkah-langkah pengerjaan (terdapat diagram sistem/proses, rumus, asumsi). Perhitungan dan analisa lebih dari 80% tepat disertai satuan dari besaran yang ada.</p> <p><i>Following the work steps (there are system/process diagrams, formulas, assumptions). Calculation and analysis is more than 80% correct with the units of the existing quantities.</i></p>



**INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)**  
**FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM**  
**DEPARTEMEN TEKNIK MESIN**  
**PROGRAM STUDI S2 TEKNIK MESIN**

Kode Dokumen

**RENCANA PEMBELAJARAN SEMESTER**  
*(Semester Learning Plan)*

MATA KULIAH <i>SUBJECTS</i>	KODE <i>CODE</i>	RUMPUN MK <i>COURSE CLUSTER</i>	BOBOT (SKS) <i>CREDITS</i>		SEMESTER <i>SEMESTER</i>	Tgl Penyusunan <i>DATE</i>
DESAIN EKSPERIMEN <i>(Design of Experiments)</i>	TM235103		T=3 sks ~ 4.8 ECTS	P=0	1	
OTORISASI <i>AUTHORIZATION</i>	Pengembang RPS <i>Developer of Semester Learning Plan</i>	Koordinator RMK <i>Course Cluster Coordinator</i>			Ketua PRODI <i>Head of Postgraduate Program</i>	
	Arif Wahjudi				Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng	
Capaian Pembelajaran <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>PLO Program Charged to The Course</i>					
	CPL-2 PLO-2	Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi <i>Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars.</i>				



	<b>CPL-3</b> <b>PLO-3</b>	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan. <i>Able to manage self learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability.</i>								
	<b>CPL-5</b> <b>PLO-5</b>	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>Able to understand and utilize the theory of engineering sciences in mechanical engineering.</i>								
	<b>Capaian Pembelajaran Mata Kuliah (CPMK)</b> <b>Course Learning Outcome (CLO)</b>									
	CP MK 1 CLO 1	Mampu memahami dan memanfaatkan teori tentang full factorial untuk menentukan pengaruh faktor terhadap respon <i>Able to understand and utilize full factorial theory to determine the influence of factors on responses</i>								
	CP MK 2 CLO 2	Mampu memahami dan memanfaatkan teori tentang fractional factorial untuk menentukan pengaruh faktor terhadap respon <i>Able to understand and utilize the theory of fractional factorial to determine the influence of factors on the response</i>								
	CP MK 3 CLO 3	Mampu memahami dan memanfaatkan teori tentang regresi untuk mengestimasi hubungan antara faktor dan respon <i>Able to understand and utilize the theory of regression to estimate the relationship between factors and responses</i>								
	CP MK 4 CLO 4	Mampu memahami dan memanfaatkan teori tentang respon surface untuk menentukan level dari faktor yang menghasilkan respon optimal <i>Able to understand and utilize the theory of response surfaces to determine the level of factors that produce optimal responses</i>								
	<b>Matrik CPL – CPMK</b> <i>PLO-CLO Matrix</i>									
	<b>CPMK</b> <b>CLO</b>	<b>CPL-1</b> <b>PLO-1</b>	<b>CPL-2</b> <b>PLO-2</b>	<b>CPL-3</b> <b>PLO-3</b>	<b>CPL-4</b> <b>PLO-4</b>	<b>CPL-5</b> <b>PLO-5</b>	<b>CPL-6</b> <b>PLO-6</b>	<b>CPL-7</b> <b>PLO-7</b>	<b>CPL-8</b> <b>PLO-8</b>	<b>CPL-9</b> <b>PLO-9</b>
	CP MK 1 CLO 1		V	V		V				



		CP MK 2 CLO 2		V	V		V					
		CP MK 3 CLO 3		V	V		V					
		CP MK 4 CLO 4		V	V		V					
<b>Deskripsi Singkat MK</b> <i>(Short Description of Course)</i>	<p><i>Mata kuliah ini merupakan mata kuliah yang memberi pengetahuan tentang konsep perancangan dan analisa suatu eksperimen untuk memperoleh hubungan antar variable eksperimen tersebut. Selain konsep perancangan dan analisa, mata kuliah ini juga memberikan pengetahuan tentang penerapannya dalam riset dan penelitian.</i></p> <p><i>This course provides knowledge about the concept of designing and analyzing an experiment to obtain the relationship between the experimental variables. This course also provides knowledge about its application in research and investigation.</i></p>											
<b>Bahan Kajian: Materi Pembelajaran (Course Materials)</b>	<p><b>Bahan Kajian :</b> Statistika (Statistics) Perancangan Eksperimen (Experimental Design)</p> <p>Dalam mata kuliah ini akan mempelajari materi pembelajaran sebagai berikut:</p> <ul style="list-style-type: none"> <li>- Uji hipotesis (Hypothesis testing)</li> <li>- Analisa Varian (ANOVA) (Analysis of Variance)</li> <li>- Regresi (Regression)</li> </ul>											
<b>Pustaka (References)</b>	<b>Utama : (Main)</b>											
		<ol style="list-style-type: none"> <li>1. Blank, L., "Statistical Procedures for Engineering, Management, and Science", McGraw-Hill, 1980</li> <li>2. Bhattacharya, G.K., Johnson, R.A., "Statistical Concepts and Methods", John Wiley, 1977</li> <li>3. Montgomery, D.C., "Design and Analysis of Experiments", John Wiley, 1991</li> </ol>										
	<b>Pendukung : (supporting)</b>											



		Kuehl, R. O., "Design of experiments : statistical principles of research design and analysis", Pacific Grove: Duxbury, 2000					
		<b>Software:</b>					
		Minitab					
<b>Dosen Pengampu (Lecturers)</b>		Prof. Abdullah Shahab, Bobby Oedy P. S., PhD, Arif Wahjudi, PhD					
<b>Matakuliah syarat (Prerequisites)</b>							
Minggu / Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian Assesment		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [ Estimasi Waktu] <i>(Form of Learning; Learning Method; Student Assignment)</i>		Materi Pembelajaran [ Pustaka ] <i>Learning Material</i>	Bobot Penilaian (%) <i>Assesment Load (%)</i>
		Indikator / indicator	Kriteria & Bentuk Criteria & Model	Luring (offline)	Daring (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Mahasiswa mampu merefresh kembali materi statistik <i>Students are able to refresh the statistical material</i>	Mampu menerapkan tool statistik untuk menyelesaikan kasus engineering <i>Able to apply statistical tools to solve</i>		- Kuliah pengantar & Brainstorming - Latihan soal  - Introductory Course - Exercise <b>[TM: 1x(3x50")]</b>		- kontrak kuliah ( <i>Learning Agreement</i> ) - Refresh statistik ( <i>Statistics Review</i> ) <b>[1:Blank, 2:Bhattacharya]</b>	




		<i>engineering cases</i>					
<b>(2-4)</b>	Mahasiswa mampu menganalisa dan mempraktekkan uji hipotesa <i>Students are able to analyze and apply hypothesis testing</i>	Mampu menganalisa kasus-kasus perbandingan 1 dan 2 sample <i>Able to analyze cases of comparison of 1 and 2 samples</i>		- Presentasi materi ( <i>Presentation</i> ) - Eksperimen ( <i>Experiment</i> ) - Presentasi hasil Eksperimen ( <i>Presentation of Experiment Result</i> ) <b>[TM: 3x(3x50")]</b>		- Uji Hipotesa ( <i>Hypothesis Testing</i> ): <input type="checkbox"/> Test on means (1 dan 2 sample) <input type="checkbox"/> Test on variances (1 dan 2 sample) <b>[1:Blank, 2:Bhattacharya, 3:Montgomery]</b>	25%
<b>(5-8)</b>	Mahasiswa mampu menganalisa dan mempraktekkan ANOVA dan regresi single factor <i>Students are able to analyze and apply ANOVA and single factor regression</i>	Mampu menganalisa kasus-kasus perbandingan 1 factor dan regresinya <i>Able to analyze cases of 1 factor comparison and its regression</i>		- Presentasi materi ( <i>Presentation</i> ) - Eksperimen ( <i>Experiment</i> ) - Presentasi hasil Eksperimen ( <i>Presentation of Experiment Result</i> ) <b>[TM: 4x(3x50")]</b>		- ANOVA: • Single factor • Regresi ( <i>Regression</i> ) <b>[1:Blank, 2:Bhattacharya, 3:Montgomery]</b>	25%
<b>(9-11)</b>	Mahasiswa mampu menganalisa dan mempraktekkan ANOVA multi factor <i>Students are able to analyze and apply multi-factor ANOVA</i>	Mampu menganalisa kasus-kasus perbandingan multi factor <i>Able to analyze multi-factor comparison cases</i>		- Presentasi materi ( <i>Presentation</i> ) - Eksperimen ( <i>Experiment</i> ) - Presentasi hasil Eksperimen ( <i>Presentation of Experiment Result</i> ) <b>[TM: 3x(3x50")]</b>		- ANOVA: <input type="checkbox"/> Multi factor <b>[1:Blank, 2:Bhattacharya, 3:Montgomery]</b>	25%





<b>(12-16)</b>	Mahasiswa mampu mengaplikasikan metode perancangan eksperimen pada riset <i>Students are able to apply experimental design methods to research</i>	Mampu memahami dan memanfaatkan metode eksperimen untuk kasus-kasus riset <i>Able to understand and utilize experimental methods for research cases</i>		- Review paper ( <i>Paper review</i> ) <b>[TM: 5x(3x50")]</b>		- ANOVA single maupun multi faktor ( <i>Single or Multi-factor ANOVA</i> ) - Regresi ( <i>Regression</i> ) <b>[1:Blank, 2:Bhattacharya]</b>	25%
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		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				<b>Kode Dokumen</b>
<b>RENCANA PEMBELAJARAN SEMESTER</b> <i>(Semester Learning Plan)</i>						
MATA KULIAH (SUBJECTS)		KODE (CODE)	Rumpun MK (Course cluster)	BOBOT (sks) (credits)		SEMESTER SEMESTER
METODE NUMERIK UNTUK REKAYASA MEKANIKA <i>Numerical Method for Mechanical Engineering</i>		TM235102		T= 3	P= 0	1 8 Desember 2023
OTORISASI (AUTHORIZATION)		Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)		Ketua PRODI (Head of Postgraduate Program)	
		Vivien Suphandani	Prof. Sutardi		Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng	
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-4 PLO-4	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.</i>				
	CPL-5 PLO-5	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>Able to understand and utilize the theory of engineering sciences in mechanical engineering.</i>				
	CPL-7 PLO-7	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin.				



		<i>Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach.</i>			
<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>					
CPMK-1 CLO-1	Mampu memahami konsep metode numerik, aproksimasi dan error <i>Able to understand the concept of numerical, approximation and errors</i>				
CPMK-2 CLO-2	Mampu merumuskan masalah teknik dalam bentuk matematika yang sesuai dan memilih pendekatan numerik yang tepat. <i>Able to represent mechanical problems in suitable governing equations and choose the appropriate numerical approach</i>				
CPMK-3 CLO-3	Mampu mendiskritisasi persamaan differensial menjadi set persamaan linear aljabar dan menyelesaikannya dengan metode numerik. <i>Able to discretize differential equations into sets of linear algebra equations and solve them using numerical method</i>				
CPMK-4 CLO-4	Mampu menyusun algoritma penyelesaian numerik dan membuat program numerik sederhana untuk kasus yang berkaitan dengan rekayasa mekanik. <i>Able to construct numerical solution algorithm and to code a simple numerical program to solve engineering problem</i>				
		<b>Matrik CPL – CPMK PLO – CLO Matrix</b>			
	CPMK CLO	CPL-4 PLO-4	CPL-5 PLO-5	CPL-7 PLO-7	
	CPMK-1 CLO-1	V			
	CPMK-2 CLO-2		V		



		CPMK-3 CLO-3		V	V	
		CPMK-4 CLO-4		V	V	
<b>Deskripsi Singkat MK</b> <i>(Short Description of Course)</i>	<p>Mata kuliah ini membahas tentang metode numerik yang dapat diaplikasikan untuk menyelesaikan berbagai permasalahan kompleks dalam bidang teknik mesin yang sulit diselesaikan secara analitis. Metode numerik yang dipelajari dapat digunakan sebagai dasar untuk lebih lanjut digunakan dalam analisis data maupun pemodelan.</p> <p><i>This course discusses numerical methods that can be applied to solve various complex problems in the field of mechanical engineering that are difficult to solve analytically. The numerical methods studied can be used as a basis for further use in data analysis and modeling.</i></p>					
<b>Bahan Kajian: Materi Pembelajaran</b> <i>(Course Materials)</i>	<ul style="list-style-type: none"> <li>- Introduction to numerical methods</li> <li>- Truncation errors, Taylor series and numerical differentiation</li> <li>- Systems of Linear Algebraic Equations</li> <li>- Polynomial approaches and interpolations</li> <li>- Numerical integration and differentiation</li> <li>- Ordinary Differential Equations</li> <li>- Matrix Eigenvalue Problems</li> <li>- Partial Differential Equations (elliptic, parabolic, hyperbolic equations)</li> <li>- Introduction to finite element method and finite volume method</li> <li>- <i>Introduction to numerical methods</i></li> <li>- <i>Truncation errors, Taylor series and numerical differentiation</i></li> <li>- <i>Systems of Linear Algebraic Equations</i></li> <li>- <i>Polynomial approaches and interpolations</i></li> <li>- <i>Numerical integration and differentiation</i></li> <li>- <i>Ordinary Differential Equations</i></li> <li>- <i>Matrix Eigenvalue Problems</i></li> </ul>					



	- <i>Partial Differential Equations (elliptic, parabolic, hyperbolic equations)</i> <i>Introduction to finite element method and finite volume method</i>						
<b>Pustaka (References)</b>	<b>Utama : (Main)</b>	Steven C. Chapra dan Raymond P. Canale, 'Numerical Methods for Engineers', 7th Ed., McGraw-Hill, Singapore, 2010					
	<b>Pendukung : (supporting)</b>	<ol style="list-style-type: none"> <li>1. Masayuki Yano, James Douglass Penn, George Konidaris, and Anthony T. Patera. Math, Numerics, and Programming (for Mechanical Engineers). V1.2, September 2012.</li> <li>2. Barret et al. Templates for the Solution of Linear Systems: Building Blocks for Iterative Methods. 2nd edition. SIAM Books.</li> </ol>					
	<b>Dosen Pengampu (Lecturers)</b> Vivien Suphandani, Agus Sigit Pramono						
<b>Matakuliah syarat (Prerequisites)</b>		-					
Mg Ke- / Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assesment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [ <b>Estimasi Waktu</b> ] <i>(Form of Learning; Learning Method; Student Assignment)</i>		Materi Pembelajaran [ <b>Pustaka</b> ] <i>Learning Material</i>	Bobot Penilaian (%) <i>Assesment Load (%)</i>
		Indikator / <i>indicator</i>	Kriteria & Bentuk <i>Criteria &amp; Model</i>	Luring ( <i>offline</i> )	Daring ( <i>online</i> )		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami dengan baik konsep dasar numerik, algoritma.	- Mampu menjelaskan konsep dasar	Diskusi <i>Discussion</i>	- Kontrak perkuliahan <i>Tuition contract</i> - Video: Contoh simulasi numerik		- Kontrak kuliah - Konsep dasar numerik (pemodelan)	



	<i>Students are able to understand well basic numerical concepts and algorithms.</i>	numerik dan algoritma. <i>Able to explain basic numerical concepts and algorithms.</i>		<i>Video: Example of numerical simulation</i> - Kuliah pengantar <i>Introductory lecture</i> [TM: 1 x (3x50'')]		matematik dan algoritma) <i>Introduction, concept of numerical method</i> [1: Chapra Bab 1-2] [1: Chapra Chapter 1-2]	
2	Mahasiswa mampu memahami dengan baik konsep error dan deret Taylor. <i>Students are able to understand well the concepts of error and Taylor series.</i>	Mampu menjelaskan mengenai error dan ekspansi deret Taylor dalam komputasi numerik <i>Able to explain errors and Taylor series expansions in numerical computing</i>	Diskusi <i>Discussion</i>	- Kuliah <i>Course</i> - Studi kasus <i>Case study</i>  [TM: 1x(3x50'')]		- Klasifikasi error (significant figure, accuracy, precision, round-off error dan truncation error). - Deret Taylor <i>Error classification (significant figure, accuracy, precision, round-off error dan truncation error). Taylor series.</i> [1: Chapra Bab 3 dan 4] [1: Chapra Chapter 3-4]	
3-4	Mahasiswa mampu menganalisa persamaan aljabar linear sesuai metode yang tepat <i>Students are able to analyze linear</i>	Mampu menyelesaikan persoalan persamaan aljabar linear dengan metode	Diskusi <i>Discussion</i> Tugas <i>Assignment</i>	- Kuliah <i>Course</i> - Demo via Matlab <i>Matlab demo</i> - Studi kasus <i>Case study</i> [TM: 2x(3x50'')]		- Sistem persamaan aljabar linear (Eliminasi naiff gauss, Gauss Jordan, Gauss-Seidal, dekomposisi matriks LU)	3



	<i>algebra equations using appropriate methods</i>	numerik yang tepat <i>Able to solve linear algebra equation problems using appropriate numerical methods</i>				<i>Solution of the set of linear algebra equations (Gaussian elimination, Gauss Jordan)</i> <b>[1: Chapra Bab 9, 10 dan 11]</b> <b>[1: Chapra Chapter 9,10,11]</b>	
<b>5</b>	Mahasiswa mampu menyelesaikan persoalan interpolasi dengan metode numerik yang tepat <i>Students are able to solve interpolation problems using appropriate numerical methods</i>	Mampu menyelesaikan persoalan interpolasi dengan metode numerik yang tepat <i>Able to solve interpolation problems with appropriate numerical methods</i>	Diskusi <i>Discussion</i> Tugas <i>Assignment</i>	- Kuliah <i>Course</i> - Studi kasus <i>Case study</i> <b>[TM: 1x(3x50'')]</b>		Interpolasi polinomial (Newton's dan Lagrange) <i>Polynomial interpolation (Newton's and Lagrange)</i> <b>[1: Chapra Bab 18, 20]</b> <b>[1: Chapra Chapter 18, 20]</b>	2
<b>6</b>	Mahasiswa mampu menganalisa persamaan integrasi dan diferensiasi dengan metode yang tepat	Mampu menganalisa persamaan integrasi dan diferensiasi	Diskusi <i>Discussion</i> Tugas <i>Assignment</i>	- Kuliah <i>Course</i> - Studi kasus <i>Case study</i> <b>[TM: 1x(3x50'')]</b>		- Integrasi numerik (Trapezoidal rule, Simpson's rule, dan Romberg integration) - Differensiasi numerik (forward, backward,	3





	<i>Students are able to analyze integration and differentiation equations using appropriate methods</i>	dengan metode yang tepat <i>Able to analyze integration and differentiation equations with appropriate methods</i>				central, order of accuracy) <i>Numerical integration and differentiation</i> <b>[1: Chapra Bab 21 - 24]</b> <b>[1: Chapra Chapter 21-24]</b>	
7	Mahasiswa mampu menganalisa persamaan differential ordinal (initial value problem) <i>Students are able to analyze ordinal differential equations (initial value problem)</i>	Mampu menganalisa persamaan differential ordinal (initial value problem) <i>Able to analyze ordinal differential equations (initial value problem)</i>	Diskusi <i>Discussion</i> Tugas <i>Assignment</i>	- Kuliah <i>Course</i> - Studi kasus <i>Case study</i> <b>[TM: 1x(3x50'')]</b>		- Persamaan Diferensial Ordinal dengan metode One-Step methods (Euler, Modification Euler dan Runge-Kutta) <i>Ordinary Differential Equations (Euler, Modification Euler dan Runge-Kutta)</i> <b>[1: Chapra Bab 25]</b> <b>[1: Chapra Chapter 25]</b>	2
8	<b>Evaluasi Tengah Semester / Ujian Tengan Semester</b> <b>MIDTERM EXAM</b>						30
9	Mahasiswa mampu menganalisa persamaan differential ordinal	Mampu menganalisa persamaan differential ordinal	Diskusi <i>Discussion</i>	- Kuliah <i>Course</i> - Studi kasus <i>Case study</i> <b>[TM: 1x(3x50'')]</b>		- Persamaan Diferensial Ordinal (Boundary-value problem)	



	(boundary value problem) <i>Students are able to analyze ordinal differential equations (boundary value problems)</i>	(boundary value problem) <i>Able to analyze ordinal differential equations (boundary value problems)</i>				<i>Ordinary Differential Equations (boundary value problem)</i> <b>[1: Chapra Bab 27]</b> <b>[1: Chapra Chapter 27]</b>	
<b>10</b>	Mahasiswa mampu menganalisa persamaan differential ordinal (eigenvalue problem) <i>Students are able to analyze ordinal differential equations (eigenvalue problems)</i>	Mampu menganalisa persamaan differential ordinal (eigenvalue problem) <i>Able to analyze ordinal differential equations (eigenvalue problems)</i>	Diskusi <i>Discussion</i>	- Kuliah <i>Course</i> - Studi kasus <i>Case study</i> <b>[TM: 1x(3x50")]</b>		- Persamaan Diferensial Ordinal (Eigenvalue problem) <i>Eigenvalue problems</i> <b>[1: Chapra Bab 27-28]</b> <b>[1: Chapra Chapter 27-28]</b>	
<b>11</b>	Mahasiswa mampu menganalisa persamaan differential parsial eliptik <i>Students are able to analyze elliptic</i>	Mampu menganalisa persamaan differential parsial eliptik <i>Able to analyze elliptic partial</i>	Diskusi <i>Discussion</i>	- Kuliah <i>Course</i> - Studi kasus <i>Case study</i> <b>[TM: 1x(3x50")]</b>		- Persamaan Diferensial Parsial: elliptic <i>Partial differential equations: elliptic</i> <b>[1: Chapra Bab 29]</b> <b>[1: Chapra Chapter 29]</b>	




	<i>partial differential equations</i>	<i>differential equations</i>					
<b>12-13</b>	Mahasiswa mampu menganalisa persamaan differential parsial parabolik <i>Students are able to analyze parabolic partial differential equations</i>	Mampu menganalisa persamaan differential parsial parabolik <i>Able to analyze parabolic partial differential equations</i>	Diskusi <i>Discussion</i>	- Kuliah <i>Course</i> - Studi kasus <i>Case study</i> [TM: 1x(3x50")]		- Persamaan Diferensial Parsial: parabolic <i>Partial Differential Equations: parabolic</i> - Pengenalan metode elemen hingga dan volume hingga <i>Introduction to finite element and finite volume methods</i>  [1: Chapra Bab 30-31] [1: Chapra Chapter 30-31]	
<b>14-15</b>	Mahasiswa mampu menganalisis persamaan differensial dan membuat program numerik sederhana. <i>Students are able to analyze differential equations and create simple numerical programs.</i>	Mampu menganalisis persamaan differensial dan membuat program numerik sederhana. <i>Able to analyze differential equations and create simple</i>	Presentasi proyek <i>Project presentation</i>	- Proyek MATLAB <i>MATLAB Project</i> - Presentasi <i>Presentation</i> [TM: 1x(3x50")]		- Contoh kode Matlab <i>Matlab code example</i> - PDE Case studies <i>PDE Case studies</i> [1: Chapra Bab 32] [1: Chapra Chapter 32]	30



		<i>numerical programs.</i>					
16	<b>Evaluasi Akhir Semester / Ujian Akhir Semester</b> <b>FINAL EXAM</b>						30



		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b>SEMESTER LEARNING PLAN</b>						
MATA KULIAH COURSE	KODE CODE	RUMPUN MK COURSE CLUSTER	BOBOT (SKS) CREDITS		SEMESTER SEMESTER	TGL PENYUSUNAN DATE
GETARAN MEKANIS MECHANICAL VIBRATION	TM235207	REKAYASA VIBRASI DAN SISTEM OTOMOTIF VIBRATION AND AUTOMOTIVE SYSTEM ENGINEERING	T= 3	P= 0	PILIHAN ELECTIVE	20 NOVEMBER 2023
OTORISASI AUTHORIZATION	Pengembang RPS Developer of Semester Learning Plan	Koordinator RMK Course Cluster Coordinator			Ketua PRODI Head of Postgraduate Program	
	Wiwiek Hendrowati.	Wiwiek Hendrowati			Prof. Dr.Eng. Harus Laksana Guntur, S.T., M.Eng.	
Capaian Pembelajaran Learning Outcomes	CPL-PRODI yang dibebankan pada MK PLO Charged to the Course					
	CPL-4 PLO-4	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth				
	CPL-5 PLO-5	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin Able to understand and utilize the theory of engineering sciences in mechanical engineering				



	CPL-7 PLO-7	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin <i>Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach</i>																		
	CPL-8 PLO-8	Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik <i>Able to formulate new ideas from the previous research for the development of technology and mechanical systems</i>																		
	<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>																			
	CPMK-1 CLO-1	Mahasiswa mampu menganalisis konsep getaran sistem dan karakteristiknya sistem getaran 2DOF beserta responnya <i>Students are able to analyze the concept of vibration systems and their characteristics, including the response of a 2DOF vibration system</i>																		
	CPMK-2 CLO-2	Mahasiswa mampu menganalisis getaran multi DOF beserta responnya dengan analisis Ortogonalitas dan Modal <i>Students are able to analyze multi-DOF vibrations and their responses using Orthogonality and Modal analysis</i>																		
	CPMK-3 CLO-3	Mahasiswa mampu menganalisis getaran sistem kontinyu dan sistem getaran diskrit (MDOF) <i>Students are able to analyze continuous vibration system and discrete vibration system (MDOF)</i>																		
	CPMK-4 CLO-4	Mahasiswa mampu menganalisis pengendalian getaran <i>Students are able to analyze vibration control</i>																		
	CPMK-5 CLO-5	Mahasiswa mampu menganalisis getaran kondisi mesin <i>Students are able to analyze machine vibration conditions</i>																		
	<b>Matrik CPL – CPMK PLO – CLO Matrix</b> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>CPMK CLO</th> <th>CPL-4 PLO-4</th> <th>CPL-5 PLO-5</th> <th>CPL-7 PLO-7</th> <th>CPL-8 PLO-8</th> <th>Total Total</th> </tr> </thead> <tbody> <tr> <td>CPMK-1 CLO-1</td> <td>v</td> <td>v</td> <td></td> <td>v</td> <td>20%</td> </tr> <tr> <td>CPMK-2</td> <td>v</td> <td>v</td> <td>v</td> <td>v</td> <td>20%</td> </tr> </tbody> </table>		CPMK CLO	CPL-4 PLO-4	CPL-5 PLO-5	CPL-7 PLO-7	CPL-8 PLO-8	Total Total	CPMK-1 CLO-1	v	v		v	20%	CPMK-2	v	v	v	v	20%
CPMK CLO	CPL-4 PLO-4	CPL-5 PLO-5	CPL-7 PLO-7	CPL-8 PLO-8	Total Total															
CPMK-1 CLO-1	v	v		v	20%															
CPMK-2	v	v	v	v	20%															



		CLO-2						
		CPMK-3	v	v	v	v	20%	
		CLO-3						
		CPMK-4	v	v	v	v	20%	
		CLO-4						
		CPMK-5	v	v	v	v	20%	
		CLO-5						
		Total	26%	26%	21%	26%	100%	
		Total						
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	<p>Mata kuliah ditujukan untuk memberi pengetahuan dan memberi kemampuan untuk me-analisis getaran yang terjadi pada sistem mekanikal. Disamping itu, mata kuliah memberi pengetahuan tentang aspek praktis dari persoalan pengendalian getaran dan kondisi getaran mesin</p> <p><i>The course is intended to provide knowledge and provide the ability to analyze vibrations that occur in mechanical systems. Apart from that, the course provides knowledge about practical aspects of vibration control issues and machine vibration conditions</i></p>							
<b>Bahan Kajian Materi Pembelajaran</b> <i>Course Materials</i>	<ul style="list-style-type: none"> <li>- Fenomena, konsep dasar, pemodelan sistem. <i>Phenomena, basic concepts, system modeling.</i></li> <li>- Review tentang respon sistem 1 d.o.f. dan problem eigen-value, matrik massa, redaman, kekakuan. <i>Review of 1-degree-of-freedom system response and eigenvalue problems, mass, damping, and stiffness matrices.</i></li> <li>- Analisis sistem 2 d.o.f. Analisis fundamental sistem m.d.o.f., termasuk sistem yang memuat rigid body motion. <i>Analysis of 2-degree-of-freedom systems. Fundamental analysis of multi-degree-of-freedom systems, including systems involving rigid body motion.</i></li> <li>- Ortogonalitas vektor mode getaran. <i>Orthogonality of vibration mode vectors.</i></li> <li>- Analisis sistem kontinyu: penjabaran model matematikl dan penyelesaian analitis. <i>Analysis of continuous systems: mathematical model elaboration and analytical solutions</i></li> <li>- Analisis respon sistem diskrit dengan metode normal-mode (modal analysis) dan dengan metode numerik.</li> </ul>							





	<p><i>Analysis of discrete system responses using normal-mode method (modal analysis) and numerical methods.</i></p> <ul style="list-style-type: none"> <li>- Analisis pengendalian getaran <i>Vibration control analysis.</i></li> <li>- Analisis kondisi mesin : deskriptor getaran, variabel ukur dan alat ukur, waveform &amp; frequency domain, FFT, diagnosis sinyal getaran. <i>Machine condition analysis: vibration descriptors, measurement variables and instruments, waveform &amp; frequency domain, FFT, vibration signal diagnosis.</i></li> </ul>				
<b>Pustaka References</b>	<b>Utama Main</b>				
		1. Rao, Singiresu S., "Mechanical Vibrations", 5 <sup>th</sup> Edition, Prentice Hall, 2013.			
	<b>Pendukung Supporting</b>				
		2. Kelly, S. Graham, "Mechanical Vibrations: Theory and Applications", SI Edition, Cengage Learning, 2011.			
		3. Inman, D. J. "Engineering Vibration", 3 <sup>rd</sup> Edition, Pearson Prentice Hall, 2008.			
<b>Dosen Pengampu Lecturers</b>	Wiwiek Hendrowati				
<b>Mata Kuliah Syarat Prerequisites</b>	-				
<b>Mg Ke- Week</b>	<b>Kemampuan akhir tiap tahapan belajar (Sub-CPMK) Final ability of each learning stage (LLO)</b>	<b>Penilaian Assessment</b>	<b>Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu] Form of Learning, Learning Method, Student Assignment [Time Estimation]</b>	<b>Materi Pembelajaran [Pustaka] Learning Material [Reference]</b>	<b>Bobot Penilaian (%) Assessment Load (%)</b>



		<b>Indikator Indicator</b>	<b>Kriteria &amp; Bentuk Criteria &amp; Model</b>	<b>Luring Offline</b>	<b>Daring Online</b>		
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>	<b>(7)</b>	<b>(8)</b>
<b>1</b>	Mahasiswa mampu menganalisis konsep getaran sistem dan karakteristiknya. <i>Students are able to analyze the concept of vibration systems and their characteristics</i>	Mampu dan terampil menyelesaikan permasalahan getaran sistem dan karakteristiknya <i>Capable and skilled in solving problems of the vibration system and their characteristics</i>	Kriteria: <i>Criteria</i> - <b>Rubrik</b> <i>Rubric</i> - <b>Marking Scheme</b> <i>Marking Scheme</i> Bentuk: non-tes (tugas) <i>Model: non-test (assignment)</i>	<ul style="list-style-type: none"> <li>- Kuliah &amp; Brainstorming <i>Lecture &amp; Brainstorming</i></li> <li>- Latihan soal <i>Practice problems</i></li> <li>- Video Jembatan Tacoma Runtuh karena getaran angin <i>Video of the Tacoma Narrows Bridge Collapse due to wind-induced vibrations</i></li> </ul> <p>[TM: 3x50"] [PT: 3x60"] [BM: 3x60"]</p>	<ul style="list-style-type: none"> <li>- Dokumen RPS di MyITS Classroom <i>Semester Learning Plan in MyITS Classroom</i></li> <li>- Review &amp; Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i></li> <li>- Video Jembatan Tacoma Runtuh karena getaran angin <i>Video of the Tacoma Narrows</i></li> </ul>	Pengenalan kontrak kuliah <i>Introduction to course contract</i> <ul style="list-style-type: none"> <li>- Pengenalan getaran sistem mekanikal <i>Introduction to vibration of mechanical system</i></li> <li>- Review getaran mekanik : SDOF, frekuensi natural dan pembebanan eksitasi <i>Mechanical vibration review: SDOF, natural frequency, and excitation loading</i></li> </ul>	



					<i>Bridge Collapse due to wind-induced vibrations</i> - Kuliah Pengantar & Brainstorming <i>Introductory Lecture &amp; Brainstorming</i>	Prosedur analisis getaran <i>Vibration analysis procedure</i>  <b>[1: Rao Bab 5]</b>	
<b>2 &amp; 3</b>	Mahasiswa mampu menganalisis getaran sistem 2DOF beserta responnya <i>Students are able to analyze the 2DOF vibration system along with its response</i>	Mampu dan terampil menyelesaikan permasalahan getaran sistem 2DOF beserta responnya <i>Capable and skilled in solving problems of the 2DOF vibration system along with its response</i>	Kriteria: <i>Criteria</i> - <b>Rubrik</b> <i>Rubric</i> - <b>Marking Scheme</b> <i>Marking Scheme</i> Bentuk: non-tes (tugas) <i>Model: non-test (assignment)</i>	- Kuliah & Brainstorming <i>Lecture &amp; Brainstorming</i> - Latihan soal <i>Practice problems</i>  <b>[TM: 3x50"]</b> <b>[PT: 3x60"]</b> <b>[BM: 3x60"]</b>	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i>	Analisis sistem diskrit <i>Discrete system analysis</i> - Sistem dengan 2DOF <i>2DOF system</i> - Analisis fundamental respon getaran <i>Fundamental analysis of vibration response</i> - Analisis dynamic vibration absorber	



						<i>Dynamic vibration absorber analysis</i>	
						<b>[1: Rao Bab 5]</b>	
<b>4&amp;5</b>	Mahasiswa mampu menganalisis getaran sistem multi DOF beserta responnya <i>Students are able to analyze the multi-DOF vibration systems along with their response</i>	Mampu dan terampil menyelesaikan permasalahan getaran sistem multi DOF beserta responnya <i>Capable and skilled in solving problems of the multi-DOF vibration systems along with their response</i>	Kriteria: <i>Criteria</i> - <b>Rubrik</b> <b>Rubric</b> - <b>Marking Scheme</b> <b>Marking Scheme</b> Bentuk: tes (dokumen tes, Quiz 1) <i>Model: non-test (test document, Quiz 1)</i>	- Kuliah & Brainstorming <i>Lecture &amp; Brainstorming</i> - Latihan soal <i>Practice problems</i>  <b>[TM: 3x50"]</b> <b>[PT: 3x60"]</b> <b>[BM: 3x60"]</b>	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i>	Sistem dengan multi-DOF <i>Multi-DOF system</i> - Analisis fundamental respon getaran <i>Fundamental analysis of vibration response</i>  <b>[1: Rao Bab 6]</b>	25%
<b>6&amp;7</b>	Mahasiswa mampu menganalisis getaran sistem multi DOF dengan analisis Ortogonalitas dan Modal	Mampu dan terampil menyelesaikan permasalahan getaran sistem multi DOF dengan analisis	Kriteria: <i>Criteria</i> - <b>Rubrik</b> <b>Rubric</b> - <b>Marking Scheme</b> <b>Marking Scheme</b>	- Kuliah & Brainstorming <i>Lecture &amp; Brainstorming</i> - Latihan soal <i>Practice problems</i>	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i>	Analisis dan penyelesaian <i>Analysis and solution</i> - Ortogonalitas <i>Orthogonality</i> - Analisis modal <i>Modal analysis</i>	



	<i>Students are able to analyze the multi-DOF vibration systems using Orthogonality and Modal analysis</i>	Ortogonalitas dan Modal <i>Capable and skilled in solving problems of the multi-DOF vibration systems using Orthogonality and Modal analysis</i>	Bentuk: non-tes (tugas) <i>Model: non-test (assignment)</i>	[TM: 3x50"] [PT: 3x60"] [BM: 3x60"]		[1: Rao Bab 6]	
<b>8</b>	<b>Evaluasi Tengah Semester / Ujian Tengah Semester Midterm Exam</b>						<b>25%</b>
<b>9</b>	Mahasiswa mampu menganalisis sistem kontinyu <i>Students are able to analyze continuous systems</i>	Mampu dan terampil menyelesaikan permasalahan getaran sistem kontinyu <i>Capable and skilled in solving problems of the continuous systems</i>	Kriteria: <i>Criteria</i> - <b>Rubrik</b> <i>Rubric</i> - <b>Marking Scheme</b> <i>Marking Scheme</i> Bentuk: non-tes (tugas) <i>Model: non-test (assignment)</i>	- Kuliah & Brainstorming <i>Lecture &amp; Brainstorming</i> - Latihan soal <i>Practice problems</i> [TM: 3x50"] [PT: 3x60"] [BM: 3x60"]	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i>	Analisi sistem kontinyu <i>Continuous system analysis</i> - Getaran transversal pada tali dan kabel <i>Transversal vibration in strings and cables</i> - Getaran lateral pada batang <i>Lateral vibration in rods</i>	



						<ul style="list-style-type: none"> <li>- Getaran longitudinal pada batang <i>Longitudinal vibration in rods</i></li> </ul> <p>[1: Rao Bab 8]</p>	
10	<p>Mahasiswa mampu menganalisis getaran aksial pada batang <i>tudents are able to analyze axial vibrations in beams</i></p>	<p>Mampu dan terampil menyelesaikan permasalahan getaran aksial pada batang <i>Capable and skilled in solving problems of axial vibrations in beams</i></p>	<p>Kriteria: <i>Criteria</i></p> <ul style="list-style-type: none"> <li>- <b>Rubrik</b> <i>Rubric</i></li> <li>- <b>Marking Scheme</b> <i>Marking Scheme</i></li> </ul> <p>Bentuk: non-tes (tugas) <i>Model: non-test (assignment)</i></p>	<ul style="list-style-type: none"> <li>- Kuliah &amp; Brainstorming <i>Lecture &amp; Brainstorming</i></li> <li>- Latihan soal <i>Practice problems</i></li> </ul> <p>[TM: 3x50"] [PT: 3x60"] [BM: 3x60"]</p>	<p>Review &amp; Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i></p>	<p>Sistem kontinu didiskritisasi <i>Discretization of continuous system</i></p> <ul style="list-style-type: none"> <li>- Getaran aksial pada batang <i>Axial vibration in beam</i></li> </ul> <p>[1: Rao Bab 8]</p>	
11	<p>Mahasiswa mampu menganalisis getaran pada struktur <i>Students are able to analyze vibrations in structures</i></p>	<p>Mampu dan terampil menyelesaikan permasalahan getaran pada struktur truss <i>Capable and skilled in solving problems</i></p>	<p>Kriteria: <i>Criteria</i></p> <ul style="list-style-type: none"> <li>- <b>Rubrik</b> <i>Rubric</i></li> <li>- <b>Marking Scheme</b> <i>Marking Scheme</i></li> </ul>	<ul style="list-style-type: none"> <li>- Kuliah &amp; Brainstorming <i>Lecture &amp; Brainstorming</i></li> <li>- Latihan soal <i>Practice problems</i></li> </ul> <p>[TM: 3x50"]</p>	<p>Review &amp; Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i></p>	<p>Getaran struktur <i>Vibration in structures</i></p> <ul style="list-style-type: none"> <li>- Analisis getaran pada truss <i>Vibration analysis of truss</i></li> </ul> <p>[1: Rao Bab 12]</p>	




		<i>of vibrations on truss structures</i>	Bentuk: non-tes (tugas) <i>Model: non-test (assignment)</i>	[PT: 3x60"] [BM: 3x60"]			
12	Mahasiswa mampu menganalisis getaran pada struktur <i>Students are able to analyze vibrations in structures</i>	Mampu dan terampil menyelesaikan permasalahan getaran pada struktur beam <i>Capable and skilled in solving problems of vibrations on beam structures</i>	Kriteria: <i>Criteria</i> - <b>Rubrik</b> <b>Rubric</b> - <b>Marking Scheme</b> <b>Marking Scheme</b> Bentuk: tes (dokumen tes, Quiz 2) <i>Model: non-test (test document, Quiz 2)</i>	- Kuliah & Brainstorming <i>Lecture &amp; Brainstorming</i> - Latihan soal <i>Practice problems</i>  [TM: 3x50"] [PT: 3x60"] [BM: 3x60"]	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i>	Getaran struktur <i>Vibration in structures</i> - Analisis getaran pada beam <i>Vibration analysis of beam</i>  [1: Rao Bab 12]	25%
13	Mahasiswa mampu menganalisis pengendalian getaran <i>Students are able to analyze vibration control</i>	Mampu dan terampil menyelesaikan permasalahan pengendalian getaran <i>Capable and skilled in solving problems of vibration control</i>	Kriteria: <i>Criteria</i> - <b>Rubrik</b> <b>Rubric</b> - <b>Marking Scheme</b> <b>Marking Scheme</b>	- Kuliah & Brainstorming <i>Lecture &amp; Brainstorming</i> - Latihan soal <i>Practice problems</i>  [TM: 3x50"]	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i>	Pengendalian getaran <i>Vibration control</i> - Analisis pengendalian getaran <i>Vibration control analysis</i>  [1: Rao Bab 9]	





			Bentuk: non-tes (tugas) <i>Model: non-test (assignment)</i>	[PT: 3x60"] [BM: 3x60"]			
14 & 15	Mahasiswa mampu menganalisis getaran kondisi mesin <i>Students are able to analyze machine vibration conditions</i>	Mampu dan terampil menyelesaikan permasalahan getaran kondisi mesin <i>Capable and skilled in solving problems of machine vibration conditions</i>	Kriteria: <i>Criteria</i> - <b>Rubrik</b> <i>Rubric</i> - <b>Marking Scheme</b> <i>Marking Scheme</i> Bentuk: non-tes (tugas) <i>Model: non-test (assignment)</i>	- Kuliah & Brainstorming <i>Lecture &amp; Brainstorming</i> - Latihan soal <i>Practice problems</i> [TM: 3x50"] [PT: 3x60"] [BM: 3x60"]	Review & Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of the lecture in MyITS Classroom</i>	Getaran kondisi mesin <i>Machine vibration conditions</i> - Analisis kondisi mesin <i>Machine condition analysis</i>  [1: Rao Bab 10]	
16	<b>Evaluasi Akhir Semester / Ujian Akhir Semester</b> <i>Final Exam</i>						25%



		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b>SEMESTER LEARNING PLAN</b>						
<b>MATA KULIAH</b> <b>COURSE</b>	<b>KODE</b> <b>CODE</b>	<b>RUMPUN MK</b> <b>COURSE CLUSTER</b>	<b>BOBOT (SKS)</b> <b>CREDITS</b>		<b>SEMESTER</b> <b>SEMESTER</b>	<b>TGL PENYUSUNAN</b> <b>DATE</b>
DINAMIKA KENDARAAN <i>VEHICLE DYNAMICS</i>	TM235212	REKAYASA VIBRASI DAN SISTEM OTOMOTIF <i>VIBRATION AND AUTOMOTIVE SYSTEM ENGINEERING</i>	T= 3	P= ?	PILIHAN <i>ELECTIVE</i>	27 NOVEMBER 2023
<b>OTORISASI</b> <b>AUTHORIZATION</b>	<b>Pengembang RPS</b> <i>Developer of Semester Learning Plan</i>	<b>Koordinator RMK</b> <i>Course Cluster Coordinator</i>		<b>Ketua PRODI</b> <i>Head of Postgraduate Program</i>		
	I Nyoman Sutantra	Wiwiek Hendrowati		Prof. Dr.Eng. Harus Laksana Guntur, S.T., M.Eng.		
<b>Capaian</b> <b>Pembelajaran</b> <b>Learning</b> <b>Outcomes</b>	<b>CPL-PRODI yang dibebankan pada MK</b> <b>PLO Charged to the Course</b>					
	CPL-2 PLO-2	Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi				



		<i>Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars</i>
CPL-4 PLO-4		Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth</i>
CPL-5 PLO-5		Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin <i>Able to understand and utilize the theory of engineering sciences in mechanical engineering</i>
CPL-6 PLO-6		Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin <i>Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields</i>
<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>		
CPMK-1 CLO-1		Mahasiswa mampu menganalisa dan mendisain sistem penggerak <i>Students are able to analyze and design propulsion systems</i>
CPMK-2 CLO-2		Mahasiswa mampu menganalisa dan mendisain sistem suspensi <i>Students are able to analyze and design suspension systems</i>
CPMK-3 CLO-3		Mahasiswa mampu menganalisa dan mendisain sistem kemudi dan sistem pengereman <i>Students are able to analyze and design steering and braking systems</i>
CPMK-4 CLO-4		Mahasiswa mampu menganalisa kestabilan suatu kendaraan <i>Students are able to analyze the stability of a vehicle</i>
		<b>Matrik CPL – CPMK PLO – CLO Matrix</b>



		CPMK <i>CLO</i>	CPL-2 <i>PLO-2</i>	CPL-4 <i>PLO-4</i>	CPL-5 <i>PLO-5</i>	CPL-6 <i>PLO-6</i>	Bobot (%) <i>Proportion (%)</i>
		CPMK-1 <i>CLO-1</i>	V	V	V	V	25%
		CPMK-2 <i>CLO-2</i>	V	V	V	V	25%
		CPMK-3 <i>CLO-3</i>	V	V	V	V	25%
		CPMK-4 <i>CLO-4</i>	V	V	V	V	25%
		Total <i>Total</i>	25%	25%	25%	25%	100%
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	Mata kuliah ini memberi pengetahuan dan kemampuan merancang konstruksi kendaraan dan menganalisa kestabilan kendaraan sesuai dengan Sub-CPMK <i>This course provides knowledge and skills in designing vehicle constructions and analyzing vehicle stability in accordance with the LLO</i>						
<b>Bahan Kajian Materi Pembelajaran</b> <i>Course Materials</i>	<ul style="list-style-type: none"> <li>- Konsep Desain, konstruksi kendaraan dan perkembangan teknologi kendaraan <i>Design concepts, vehicle construction and vehicle technology development</i></li> <li>- Stabilitas kendaraan <i>Vehicle stability</i></li> <li>- Pengaruh Karakteristik ban terhadap stabilitas Kendaraan <i>Effect of tire characteristics on vehicle stability</i></li> <li>- Desain sistem penggerak <i>Drive system design</i></li> <li>- Desain sistem suspensi, sistem kemudi, dan sistem pengereman <i>Suspension system, steering system, and braking system design</i></li> </ul>						



<b>Pustaka References</b>	<b>Utama Main</b>						
		1. Sutantra, "Teknologi Otomotif, Teori dan Aplikasinya, Guna Widya, Surabaya, 2001					
	<b>Pendukung Supporting</b>	2. Wong, "Theory of Ground Vehicles", John Wiley. 3. Kamal & Wolf, "Modern Automotive Structural Analysis", Von Nostrand Reinhold Company 4. Hucho, "Aerodynamics for Automotive", John Willey					
<b>Dosen Pengampu Lecturers</b>	I Nyoman Sutantra						
<b>Mata Kuliah Syarat Prerequisites</b>	-						
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assessment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>[Estimasi Waktu]</i> <i>Form of Learning, Learning Method, Student Assignment</i> <i>[Time Estimation]</i>		Materi Pembelajaran <i>[Pustaka]</i> <i>Learning Material</i> <i>[Reference]</i>	Bobot Penilaian (%) <i>Assessment Load (%)</i>
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria &amp; Model</i>	Luring <i>Offline</i>	Daring <i>Online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)



1	Mahasiswa mampu mendeskripsikan dinamika kendaraan <i>Students are able to describe vehicle dynamics</i>	Mampu mendeskripsikan dinamika kendaraan <i>Able to describe vehicle dynamics</i>	- Latihan soal <i>Practice problems</i>	- Kuliah pengantar <i>Introductory lecture</i>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	- Kontrak Kuliah <i>Course Contract</i> - Dasar dinamika kendaraan <i>Fundamentals of vehicle dynamics</i>  [1] : Chen et. al Bab 1	5%
2-3	Mahasiswa mampu memahami perilaku dasar kontak ban dengan jalan <i>Students are able to understand the basic behavior of tire-road contact</i>	memahami perilaku dasar kontak ban dengan jalan <i>Able to understand the basic behavior of tire-road contact</i>	- PR <i>Homework</i>	- Kuliah <i>Lecture</i>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	- Perilaku Ban <i>Behavior of Tire</i>  [1] : Chen et. al Bab 2	5%
4-5	Mahasiswa mampu memahami kinematika kemudi kendaraan dan stabilitas kendaraan, mampu memodelkan dan menganalisa dinamika kendaraan. <i>Students are able to understand vehicle steering kinematics and vehicle stability, capable of</i>	Mampu memahami kinematika kemudi kendaraan dan stabilitas kendaraan <i>Able to understand vehicle steering kinematics and vehicle stability</i>	- Proyek 1 <i>Project 1</i>	- Kuliah <i>Lecture</i> - Software Scilab <i>Scilab software</i>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	- Kinematika kemudi dan handling kendaraan <i>Vehicle steering kinematics and vehicle handling</i>  [1] : Pauwelussen Bab 4-5	10%



	<i>modeling and analyzing vehicle dynamics.</i>						
<b>6</b>	Mahasiswa mampu menganalisa, merembuk, melaporkan dan membentuk pendapat <i>Students are capable of analyzing, discussing, reporting, and forming opinions.</i>	Mampu menganalisa, merembuk, melaporkan dan membentuk pendapat <i>Capable of analyzing, discussing, reporting, and forming opinions.</i>	- Presentasi <i>Presentation</i>	- Kuliah <i>Lecture</i> - Presentasi <i>Presentation</i>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	- Presentasi Proyek 1 <i>Project 1 Presentation</i>	10%
<b>7-8</b>	Mahasiswa mampu menyusun persamaan gerak kendaraan arah longitudinal, mampu memahami cara kerja ABS, TCS dan VSC. <i>Students are able to formulate the equation of longitudinal motion of vehicle and understand the operation of ABS, TCS, and VSC</i>	Mampu menyusun persamaan gerak kendaraan arah longitudinal, mampu memahami cara kerja ABS dan TCS <i>Able to formulate the equations of longitudinal motion of vehicle and understand the operation of ABS, TCS, and VSC</i>	- PR <i>Homework</i>	- Kuliah <i>Lecture</i>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	- Dinamika dan pengendalian kendaraan arah longitudinal <i>Longitudinal vehicle dynamics and control</i>  [1] : <a href="#">Chen et. al Bab 3</a>	10%
<b>9-10</b>	Mahasiswa mampu menyusun persamaan gerak kendaraan arah vertical dan mensimulasikan dengan	Mampu menyusun persamaan gerak kendaraan arah vertical dan mensimulasikan	- PR <i>Homework</i>	- Kuliah <i>Lecture</i> - Software Scilab	Handout di myITS Classroom	- Dinamika dan pengendalian kendaraan arah vertikal (Pemodelan dinamika kendaraan	10%





	berbagai model ketidakrataan jalan <i>Students are able to formulate the equation of vertical motion of vehicles and simulate it with various road roughness models</i>	dengan berbagai model ketidakrataan jalan <i>Able to formulate the equation of vertical motion of vehicles and simulate it with various road roughness models</i>		<i>Scilab software</i>	<i>Handout in myITS Classroom</i>	arah vertical dan model ketidakrataan jalan) <i>Vertical vehicle dynamics and control (Modeling of vertical vehicle dynamics and road roughness models)</i>  [1] : Chen et. al Bab 4	
<b>11</b>	Mahasiswa mampu memahami teknologi dan memahami metode pengendalian pada sistem suspensi semi- aktif <i>Students are able to understand the technology and comprehend the control methods in semi-active suspension system</i>	mampu memahami teknologi dan memahami metode pengendalian pada sistem suspensi semi-aktif <i>Able to understand the technology and comprehend the control methods in semi-active suspension system</i>	- PR <i>Homework</i>	- Kuliah <i>Lecture</i> - Software <i>Scilab software</i>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	- Dinamika dan pengendalian kendaraan arah vertikal (Sistem suspensi semi-aktif) <i>Vertical vehicle dynamics and control (Semi-active suspension system)</i>  [1] : Chen et. al Bab 4	10%
<b>12</b>	Mahasiswa mampu memahami teknologi dan memahami metode pengendalian pada sistem suspensi aktif	mampu memahami teknologi dan memahami metode pengendalian pada sistem suspensi aktif	- Proyek 2 <i>Project 2</i>	- Kuliah <i>Lecture</i> - Software <i>Scilab</i>	Handout di myITS Classroom	- Dinamika dan pengendalian kendaraan arah vertikal (Sistem suspensi semi-aktif)	10%




	<i>Students are able to understand the technology and comprehend the control methods in active suspension system</i>	<i>Able to understand the technology and comprehend the control methods in active suspension system</i>		<i>Scilab software</i>	<i>Handout in myITS Classroom</i>	<i>Vertical vehicle dynamics and control (Active suspension system)</i>  <a href="#">[1] : Chen et. al Bab 4</a>	
<b>13</b>	Mahasiswa mampu menganalisa, merembuk, melaporkan dan membentuk pendapat <i>Students are able to analyze, discuss, report, and form opinions</i>	mampu menganalisa, merembuk, melaporkan dan membentuk pendapat <i>Able to analyze, discuss, report, and form opinions</i>	- Presentasi <i>Presentation</i>	- Kuliah <i>Lecture</i>  - Presentasi <i>Presentation</i>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	- Presentasi Project 2 <i>Project 2 Presentation</i>	10%
<b>14</b>	Mahasiswa mampu memahami cara kerja W4S, EPS dan Lane Keeping System <i>Students are able to understand how W4S, EPS, and Lane Keeping System work</i>	mampu memahami cara kerja W4S, EPS dan Lane Keeping System <i>Able to understand how W4S, EPS, and Lane Keeping System work</i>	- PR <i>Homework</i>	- Kuliah <i>Lecture</i>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	- Dinamika dan pengendalian kendaraan arah lateral <i>Lateral vehicle dynamics and control</i>  <a href="#">[1] : Chen et. al Bab 5</a>	10%
<b>15</b>	Mahasiswa mampu memahami dan menurunkan persamaan gerak sistem terkopel dari kendaraan	mampu memahami dan menurunkan persamaan gerak sistem terkopel dari kendaraan <i>Capable of understanding and</i>	- Proyek 3 <i>Project 3</i>	- Kuliah <i>Lecture</i>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	- Model dinamika kendaraan dan mekanisme sistem terkopel <i>Vehicle dynamics and coupled system</i>	10%



	<i>Students are capable of understanding and deriving the equation of motion of coupled system from vehicle</i>	<i>deriving the equation of motion of coupled system from vehicle</i>				<i>mechanism modeling</i>  [1] : Chen et. al Bab 6	
<b>16</b>	<b>Evaluasi Akhir Semester / Ujian Akhir Semester</b> <b>Final Exam</b>						



		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b>SEMESTER LEARNING PLAN</b>						
MATA KULIAH COURSE	KODE CODE	RUMPUN MK COURSE CLUSTER	BOBOT (SKS) CREDITS		SEMESTER SEMESTER	TGL PENYUSUNAN DATE
PEMODELAN SISTEM DINAMIS <i>DYNAMIC SYSTEM MODELING</i>	TM235213	REKAYASA VIBRASI DAN SISTEM OTOMOTIF <i>VIBRATION AND AUTOMOTIVE SYSTEM ENGINEERING</i>	T= 3	P= 0	PILIHAN <i>ELECTIVE</i>	25 NOVEMBER 2023
OTORISASI <i>AUTHORIZATION</i>	Pengembang RPS <i>Developer of Semester Learning Plan</i>	Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Postgraduate Program</i>		
	Harus Laksana Guntur	Wiwiek Hendrowati		Harus Laksana Guntur		
Capaian Pembelajaran <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>PLO Charged to The Course</i>					
	CPL-2 <i>PLO-2</i>	Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi				



		<i>Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars</i>
CPL-4 PLO-4		Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth</i>
CPL-5 PLO-5		Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin <i>Able to understand and utilize the theory of engineering sciences in mechanical engineering</i>
CPL-6 PLO-6		Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin <i>Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields</i>
CPL-7 PLO-7		Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin <i>Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach</i>
CPL-8 PLO-8		Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik <i>Able to formulate new ideas from the previous research for the development of technology and mechanical systems</i>
<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>		
CPMK-1 CLO-1		Mahasiswa mampu membangun model dan persamaan dari sistem dinamis mekanika translasional, rotasional, sistem non linier dan elektromekanikal. <i>Students are able to construct models and equations of translational and rotational mechanical dynamic systems, nonlinear and electromechanical systems.</i>
CPMK-2 CLO-2		Mahasiswa mampu membangun persamaan, bentuk variabel keadaan, dan diagram blok yang merepresentasikan problem dinamis. <i>Students are able to develop equations, state variable forms, and block diagrams that represent dynamic problems.</i>
CPMK-3 CLO-3		Mahasiswa mampu mengimplementasikan diagram blok dan menggunakan software simulasi untuk menyelesaikan problem dinamis.



		<i>Students are able to implement block diagrams and utilize simulation software to solve dynamic problems.</i>																																																
	CPMK-4 CLO-4	Mahasiswa mampu menganalisis dan menginterpretasikan hasil yang didapatkan dari simulasi. <i>Students are able to analyze and interpret results obtained from simulations.</i>																																																
		<p><b>Matrik CPL – CPMK</b> <b>PLO – CLO Matrix</b></p> <table border="1"> <thead> <tr> <th>CPMK CLO</th> <th>CPL-2 PLO-2</th> <th>CPL-4 PLO-4</th> <th>CPL-5 PLO-5</th> <th>CPL-6 PLO-6</th> <th>CPL-7 PLO-7</th> <th>CPL-8 PLO-8</th> <th>Bobot (%) Proportion (%)</th> </tr> </thead> <tbody> <tr> <td>CPMK-1 CLO-1</td> <td></td> <td>V</td> <td>V</td> <td></td> <td></td> <td></td> <td>25%</td> </tr> <tr> <td>CPMK-2 CLO-2</td> <td>V</td> <td></td> <td></td> <td>V</td> <td>V</td> <td></td> <td>25%</td> </tr> <tr> <td>CPMK-3 CLO-3</td> <td>V</td> <td>V</td> <td>V</td> <td></td> <td></td> <td></td> <td>25%</td> </tr> <tr> <td>CPMK-4 CLO-4</td> <td></td> <td></td> <td>V</td> <td></td> <td>V</td> <td>V</td> <td>25%</td> </tr> <tr> <td>Total Total</td> <td>18%</td> <td>18%</td> <td>27%</td> <td>9%</td> <td>10%</td> <td>9%</td> <td>100%</td> </tr> </tbody> </table>	CPMK CLO	CPL-2 PLO-2	CPL-4 PLO-4	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7	CPL-8 PLO-8	Bobot (%) Proportion (%)	CPMK-1 CLO-1		V	V				25%	CPMK-2 CLO-2	V			V	V		25%	CPMK-3 CLO-3	V	V	V				25%	CPMK-4 CLO-4			V		V	V	25%	Total Total	18%	18%	27%	9%	10%	9%	100%
CPMK CLO	CPL-2 PLO-2	CPL-4 PLO-4	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7	CPL-8 PLO-8	Bobot (%) Proportion (%)																																											
CPMK-1 CLO-1		V	V				25%																																											
CPMK-2 CLO-2	V			V	V		25%																																											
CPMK-3 CLO-3	V	V	V				25%																																											
CPMK-4 CLO-4			V		V	V	25%																																											
Total Total	18%	18%	27%	9%	10%	9%	100%																																											
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	Pengenalan sistem dinamis, pemodelan sistem dinamis, dan penggunaan software simulasi untuk penyelesaian problem dinamis. <i>Introduction to dynamic systems, dynamic system modeling, and the use of simulation software for solving dynamic problems.</i>																																																	
<b>Bahan Kajian Materi Pembelajaran</b> <i>Course Materials</i>	Pengenalan sistem dinamis, pemodelan sistem dinamis translasi mekanik, pemodelan sistem rotasi mekanik, pemodelan variable keadaan (state variabel), pembuatan diagram blok sistem dinamis, penggunaan software simulasi utk penyelesaian problem dinamis, pemodelan sistem non linier, pemodelan sistem elektromekanikal.																																																	



							<i>Introduction to dynamic systems, modeling of translational mechanical dynamic system, modeling of rotational mechanical systems, modeling of state variable, construction of dynamic system block diagrams, use of simulation software for solving dynamic problems, modeling of nonlinear systems, modeling of electromechanical systems.</i>					
<b>Pustaka References</b>							<b>Utama Main</b>					
							1. Modelling and Analysis of Dynamic System, Charles M. Close, Dean K. Frederic, Jonathan C. Newell					
							<b>Pendukung Supporting</b>					
							2. Modeling and Simulation of Dynamic Systems, Robert H Woods, Kent L. Lawrence, Robert L. Woods, Robert H. Woods 3. Dynamic Systems: Modeling, Simulation, and Control, Craig A. Kluever					
<b>Dosen Pengampu Lecturers</b>							Harus Laksana Guntur					
<b>Mata Kuliah Syarat Prerequisites</b>							-					
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assessment</i>		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>[Estimasi Waktu] Form of Learning, Learning Method, Student Assignment [Time Estimation]</i>		Materi Pembelajaran <i>[Pustaka] Learning Material [Reference]</i>	Bobot Penilaian (%) <i>Assessment Load (%)</i>					
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria &amp; Model</i>	Luring <i>Offline</i>	Daring <i>Online</i>							



(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami prinsip dasar sistem dinamis, pemodelan dan simulasi, serta mampu menganalisis dinamika sistem mekanis translasi. <i>Students are able to understand the basic principles of dynamic systems, modeling, and simulation, as well as analyze the dynamics of mechanical translational systems</i>	Mampu menganalisis dan terampil menyelesaikan permasalahan dinamika sistem mekanis translasi <i>Able to analyze and skillfully solve problems of dynamics of mechanical translational systems</i>	Latihan soal <i>Practice problems</i>	<ul style="list-style-type: none"> <li>- Ilustrasi gambar dan video <i>Illustration of image and video</i></li> <li>- Kuliah Pengantar <i>Introductory lecture</i></li> <li>- Kuliah Materi <i>Lecture</i></li> </ul>	Handout di myITS Classroom <i>Handout in myITS Classroom</i>	<p><b>Pengenalan dan review <i>Introduction and review</i></b></p> <ul style="list-style-type: none"> <li>- Pengenalan Prinsip Dasar Sistem Dinamis, Pemodelan dan Simulasi. <i>Introduction to the Basic Principles of Dynamic Systems, Modeling, and Simulation.</i></li> <li>- Review Dinamika Sistem Mekanis, Elektrik dan Elektromagnetis. <i>Review of Dynamics of Mechanical, Electrical, and Electromagnetic Systems.</i></li> </ul> <p>Kontrak kuliah <i>Course contract</i></p> <p>Dinamika Sistem Mekanis-Translasi: <i>Dynamics of Mechanical-Translational System:</i></p> <ul style="list-style-type: none"> <li>- Analisis Dinamika Sistem Mekanis-Translasi.</li> </ul>	10%





						<p><i>Analysis of Dynamics of Mechanical-Translational System.</i></p> <p>[1] : Law</p>	
2-3	<p>Mahasiswa mampu menganalisis dinamika sistem mekanis translasi (lanjutan) dan membangun state variable model-nya, serta mampu membangun Digram Blok Simulasi</p> <p><i>Students are able to analyze the dynamics of mechanical translational system (advanced) and construct its state variable model, as well as able to construct Simulation Block Diagrams.</i></p>	<p>Mampu menganalisis dan terampil menyelesaikan permasalahan dinamika sistem mekanis translasi, membangun model state variable dan blok diagram simulasinya</p> <p><i>Able to analyze and skillfully solve problems of dynamics of mechanical translational system and construct its state variable model and Simulation Block Diagrams.</i></p>	<p>Latihan soal <i>Practice problems</i></p> <p>Tugas rumah <i>Homework</i></p>	<p>Kuliah <i>Lecture</i></p> <p>Latihan soal <i>Practice problems</i></p>	<p>Handout di myITS Classroom</p> <p>Handout in myITS Classroom</p>	<p><b>Dinamika Sistem Mekanis-Translasi (lanjutan):</b> <b><i>Dynamics of Mechanical-Translational System (Advanced):</i></b></p> <ul style="list-style-type: none"> <li>- Analisis Dinamika Sistem Mekanis-Translasi (lanjutan). <i>Analysis of Dynamics of Mechanical-Translational System.</i></li> <li>- Membangun model variabel keadaan (state variable model). <i>Constructing state variable model</i></li> <li>- Membangun Diagram Blok Simulasi. <i>Constructing Simulation Block Diagrams.</i></li> </ul> <p>[1: Law]</p>	15%



<p><b>4-5</b></p>	<p>Mahasiswa mampu menganalisis dinamika sistem mekanis translasi (lanjutan) dan membangun state variable model-nya, serta mampu membangun Digram Blok Simulasi <i>Students are able to analyze the dynamics of mechanical translational system (advanced) and construct its state variable model, as well as able to construct Simulation Block Diagrams.</i></p>	<p>Mampu menganalisis dan terampil menyelesaikan permasalahan dinamika sistem mekanis translasi, membangun model state variable dan blok diagram simulasinya <i>Able to analyze and skillfully solve problems of dynamics of mechanical translational system and construct its state variable model and Simulation Block Diagrams.</i></p>	<p>Latihan soal <i>Practice problems</i> Tugas rumah <i>Homework</i></p>	<p>Kuliah <i>Lecture</i> Latihan soal <i>Practice problems</i></p>	<p>Handout di myITS Classroom <i>Handout in myITS Classroom</i></p>	<p><b>Dinamika Sistem Mekanis-Translasi (lanjutan):</b> <b><i>Dynamics of Mechanical-Translational System (Advanced):</i></b></p> <ul style="list-style-type: none"> <li>- Analisis Dinamika Sistem Mekanis-Translasi (lanjutan). <i>Analysis of Dynamics of Mechanical-Translational System.</i></li> <li>- Membangun model variabel keadaan (state variable model). <i>Constructing state variable model</i></li> <li>- Membangun Diagram Blok Simulasi. <i>Constructing Simulation Block Diagrams.</i></li> </ul> <p>[1: Law]</p>	<p>15%</p>
<p><b>6-7</b></p>	<p>Mahasiswa mampu menganalisis sistem elektromekanik dan membangun persamaan</p>	<p>Mampu menganalisis dan terampil menyelesaikan permasalahan dinamika sistem</p>	<p>Latihan soal <i>Practice problems</i> Tugas rumah</p>	<p>Kuliah <i>Lecture</i> Latihan soal <i>Practice problems</i></p>	<p>Handout di myITS Classroom</p>	<p><b>Dinamika Sistem Elektromagnetik:</b> <b><i>Dynamics of Electromechanic System:</i></b></p>	<p>10%</p>



	<p>dinamisnya. Mahasiswa mampu membangun state variable model-nya, serta mampu membangun Digram Blok Simulasinya. <i>Students are able to analyze electromechanical system and build its dynamic equations. Students are able to construct its state variable model and Simulation Block Diagrams</i></p>	<p>elektromekanik, membangun model state variable dan blok diagram simulasinya <i>Able to analyze and skillfully solve problems of dynamics of electromechanical system and construct its state variable model and Simulation Block Diagrams.</i></p>	<p><i>Homework</i></p>		<p><i>Handout in myITS Classroom</i></p>	<ul style="list-style-type: none"> <li>- Analisis Dinamika Sistem Elektromekanik. <i>Analysis of Dynamics of Electromechanical System.</i></li> <li>- Membangun model variabel keadaan (state variable model). <i>Constructing state variable model.</i></li> <li>- Membangun Diagram Blok Simulasi. <i>Constructing Simulation Block Diagrams.</i></li> </ul> <p>[1: Law]</p>	
<b>8</b>	<b>Evaluasi Tengah Semester / Ujian Tengah Semester</b> <b>Midterm Exam</b>						
<b>9-10</b>	<p>Mahasiswa mampu membangun persamaan fungsi transfer dari sistem dinamis. Mahasiswa mampu menganalisis Sistem Non Linear dan</p>	<p>Mampu menganalisis dan terampil menyelesaikan permasalahan sistem non linear, membangun blok diagram simulasinya</p>	<p>Latihan soal <i>Practice problems</i> Tugas rumah <i>Homework</i></p>	<p>Kuliah <i>Lecture</i> Latihan soal <i>Practice problems</i></p>	<p>Handout di myITS Classroom <i>Handout in myITS Classroom</i></p>	<p><b>Fungsi Transfer: Transfer Function</b></p> <ul style="list-style-type: none"> <li>- Membangun Fungsi Transfer dari Persamaan Dinamis. <i>Constructing transfer function for dynamic equations.</i></li> </ul>	15%



	<p>membangun persamaan linearisasinya. <i>Students are able to construct transfer function equations for dynamic systems. Students are able to analyze Nonlinear System and develop its linearized equations.</i></p>	<p><i>Able to analyze and skillfully solve problems of non-linear system and construct its Simulation Block Diagrams.</i></p>				<ul style="list-style-type: none"> <li>- Membangun Digram Blok Simulasi dari fungsi transfer. <i>Constructing Simulation Block Diagrams for transfer function.</i></li> </ul> <p><b>Sistem Non Linear:</b> <b><i>Non-linear System</i></b></p> <ul style="list-style-type: none"> <li>- Analisis Dinamika Sistem Non Linear. <i>Analysis of Dynamics of Non-linear system.</i></li> <li>- Membangun model lienarisasi. <i>Constructing linearization model.</i></li> <li>- Membangun Digram Blok Simulasi. <i>Constructing Simulation Block Diagrams.</i></li> </ul> <p><b>[1: Law]</b></p>	
<b>11-12</b>	<p>Mahasiswa mampu menganalisis dinamika system hidrolis dan elektris, membangun state</p>	<p>Mampu dan terampil menyelesaikan permasalahan sistem hidrolis dan elektris, serta membangun</p>	<p>Latihan soal <i>Practice problems</i> Tugas rumah</p>	<p>Kuliah <i>Lecture</i> Latihan soal <i>Practice problems</i></p>	<p>Handout di myITS Classroom</p>	<p><b>Sistem hidrolis dan elektris:</b> <b><i>Hydraulic and electrical systems</i></b></p>	<p>15%</p>




	<p>varibale model-nya dan mampu membangun Digram Blok Simulasi</p> <p><i>Students are able to analyze the dynamics of hydraulic and electrical systems, construct their state variable models, and their Simulation Block Diagrams.</i></p>	<p>state variable model, transfer function dan blok diagram simulasinya</p> <p><i>Able to and skillfully solve problems of hydraulic and electrical systems and construct their state variable models, transfer function, and Simulation Block Diagrams.</i></p>	<i>Homework</i>		<p><i>Handout in myITS Classroom</i></p>	<ul style="list-style-type: none"> <li>- Membangun persamaan sistem hidrolis dan elektris. <i>Constructing equations of hydraulic and electric systems.</i></li> <li>- Membangun model variabel keadaan (state variable) dan fungsi transfer (transfer function). <i>Constructing state variable models and transfer functions.</i></li> <li>- Membangun diagram blok simulasi. <i>Constructing Simulation Block Diagrams.</i></li> </ul> <p><b>[1: Law]</b></p>	
<b>13-14</b>	<p>Mahasiswa mampu menggunakan software MATLAB simulink untuk menyelesaikan problem sistem dinamis</p>	<p>Mampu dan terampil menyelesaikan permasalahan simulasi sistem dinamis dengan software MATLAB-Simulink</p>	<p>Latihan <i>Practice</i></p>	<p>Kuliah <i>Lecture</i></p> <p>Praktek simulasi sistem dinamis <i>Practice of dynamic system simulation</i></p>	<p>Handout di myITS Classroom <i>Handout in myITS Classroom</i></p>	<p>Praktek penggunaan Software MATLAB untuk menyelesaikan problem sistem dinamis. <i>Practice utilizing MATLAB Software to solve dynamic system problems</i></p>	<p>10%</p>



	<i>Students are able to utilize MATLAB Simulink software to solve dynamic system problems.</i>	<i>Able to and skillfully solve problems of dynamic system simulation with MATLAB Simulink software</i>					
<b>15</b>	<p>Mahasiswa mampu menggunakan software MATLAB simulink untuk menyelesaikan problem riil sistem dinamis.</p> <p><i>Students are able to utilize MATLAB Simulink software to solve real-world dynamic system problems</i></p>	<p>Mampu dan terampil menyelesaikan permasalahan simulasi sistem dinamis dengan software MATLAB-Simulink</p> <p><i>Able to and skillfully solve problems of dynamic system simulation with MATLAB Simulink software</i></p>	<p>Latihan <i>Practice</i> Presentasi proyek <i>Project presentation</i></p>	<p>Praktek simulasi Sistem Dinamis I <i>Practice of dynamic system simulation I</i></p>	<p>Handout di myITS Classroom <i>Handout in myITS Classroom</i></p>	<p>Menyelesaikan Project terkait Problem riil sistem dinamis dengan software MATLAB Simulink <i>Completing a project related to real-world dynamic system problems using MATLAB Simulink software</i></p>	10%
<b>16</b>	<b>Evaluasi Akhir Semester / Ujian Akhir Semester</b> <b><i>Final Exam</i></b>						



		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b>SEMESTER LEARNING PLAN</b>						
MATA KULIAH COURSE	KODE CODE	RUMPUN MK COURSE CLUSTER	BOBOT (SKS) CREDITS		SEMESTER SEMESTER	TGL PENYUSUNAN DATE
REKAYASA KUALITAS QUALITY ENGINEERING	TM235221	REKAYASA PRODUKSI PRODUCTION ENGINEERING	T=3	P=0	PILIHAN ELECTIVE	26 NOVEMBER 2023
OTORISASI AUTHORIZATION	Pengembang RPS Developer of Semester Learning Plan	Koordinator RMK Course Cluster Coordinator			Ketua PRODI Head of Postgraduate Program	
	M. Khoirul Effendi	Arif Wahjudi			Prof. Dr.Eng. Harus Laksana Guntur, S.T., M.Eng.	
Capaian Pembelajaran Learning Outcomes	CPL-PRODI yang dibebankan pada MK PLO Charged to the Course					
	CPL-5 PLO-5	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin <i>Able to understand and utilize the theory of engineering sciences in mechanical engineering</i>				
	CPL-6 PLO-6	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin <i>Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields</i>				



	CPL-7 PLO-7	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin <i>Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach</i>												
<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>														
CPMK-1	Mahasiswa mampu memahami ANOVA, orthogonal array, parameter design, eksperimen konfirmasi <i>Students are able to understand ANOVA, orthogonal array, parameter design, and confirmation experiments</i>													
CPMK-2	Mahasiswa mampu mengidentifikasi, merumuskan, menganalisis serta menyelesaikan persoalan optimasi pada bidang teknik menggunakan software komputasi <i>Students are able to identify, formulate, analyze, and solve optimization problems in engineering using computational software</i>													
CPMK-3	Mahasiswa mampu memahami dan menggunakan software komputasi (MATLAB) untuk menyelesaikan permasalahan optimasi menggunakan neural network dan metode optimasi (Genetic Algorithm) dan Partikel Swarm Optimization <i>Students are able to understand and utilize computational software (MATLAB) to solve optimization problems using neural networks and optimization method (Genetic Algorithms) and Particle Swarm Optimization</i>													
CPMK-4	Mahasiswa mampu menampilkan komparasi hasil optimasi menggunakan graphical user interface <i>Students are able to display comparisons of optimization results using a graphical user interface</i>													
	<b>Matrik CPL – CPMK PLO – CLO Matrix</b> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>CPMK CLO</th> <th>CPL-5 PLO-5</th> <th>CPL-6 PLO-6</th> <th>CPL-7 PLO-7</th> </tr> </thead> <tbody> <tr> <td>CPMK-1 CLO-1</td> <td>V</td> <td>V</td> <td>V</td> </tr> <tr> <td>CPMK-2 CLO-2</td> <td>V</td> <td>V</td> <td>V</td> </tr> </tbody> </table>		CPMK CLO	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7	CPMK-1 CLO-1	V	V	V	CPMK-2 CLO-2	V	V	V
CPMK CLO	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7											
CPMK-1 CLO-1	V	V	V											
CPMK-2 CLO-2	V	V	V											





		CPMK-3 CLO-3	V	V	
		CPMK-4 CLO-4	V	V	
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	<p>Mata kuliah ini memberikan dasar-dasar optimasi menggunakan metode Taguchi dan metaheuristic untuk melakukan optimasi yang berkaitan dengan keilmuan yang diajarkan di teknik mesin ITS seperti optimasi desain, optimasi proses manufaktur, optimasi parameter PID dalam proses control, dll.</p> <p><i>This course provides the basics of optimization using Taguchi method and metaheuristic methods to optimize various aspects related to mechanical engineering at ITS, such as design optimization, manufacturing process optimization, PID parameter optimization in control processes, etc.</i></p>				
<b>Bahan Kajian Materi Pembelajaran</b> <i>Course Materials</i>	<p>Dasar-dasar penggunaan software MATLAB, Neural network, metode optimasi metaheuristic (<i>genetic algoritma</i> dan <i>particle swarm optimization</i>) dan penggunaan graphical user interface untuk komparasi hasil optimasi</p> <p><i>The basics of using MATLAB software, Neural Networks, metaheuristic optimization methods (such as Genetic Algorithm and Particle Swarm Optimization), and the utilization of graphical user interfaces for comparing optimization results</i></p>				
<b>Pustaka References</b>	<b>Utama Main</b>				
		<ol style="list-style-type: none"> <li>1. Martin T. Hagan, dkk., "Neural network Design 2<sup>nd</sup> Edition", Hagan and Demuth, 2014.</li> <li>2. Mark Hudson Beale, dkk., "Neural Network Toolbox User's Guide R2017a" The Matworks, Inc., 2017.</li> <li>3. S.R. Otto and J.P Denier, "An introduction to Programming and Numerical Methods in MATLAB", Springer, 2005.</li> <li>4. Andrew Chipperfield, dkk., "Genetic Algorithm Toolbox for Use with MATLAB"</li> <li>5. Mark A. Abramson, "Genetic Algorithm and Direct Search Toolbox", The Mathwork, 2004.</li> <li>6. Xin-She Yang, "Nature-Inspired Optimization Algorithm", Elsevier, 2014.</li> <li>7. Ross, P. J., "Taguchi Techniques for Qiality Engineering"</li> </ol>			
	<b>Pendukung Supporting</b>				



	8. Chehour, A. Dkk, "A Constraint-Handling Technique for Genetic Algorithms using a Violation Factor" Journal of computer science, 2016, 12 (7)						
<b>Dosen Pengampu Lecturers</b>	Mohammad Khoirul Effendi						
<b>Mata Kuliah Syarat Prerequisites</b>	-						
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assessment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <i>[Estimasi Waktu] Form of Learning, Learning Method, Student Assignment [Time Estimation]</i>		Materi Pembelajaran <i>[Pustaka] Learning Material [Reference]</i>	Bobot Penilaian (%) <i>Assessment Load (%)</i>
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria &amp; Model</i>	Luring <i>Offline</i>	Daring <i>Online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Review ANOVA dan orthogonal array <i>Review of ANOVA and orthogonal array</i>					[7: Ross, P. J., – BAB ]	1%
2	Parameters design <i>Parameters design</i>					[7: Ross, P. J., – BAB ]	1%



3	Eksperimen konfirmasi <i>Confirmation experiments</i>					[7: Ross, P. J., – BAB ]	1%
4	Paper review <i>Paper review</i>					[7: Ross, P. J., – BAB ]	1%
5	Project <i>Project</i>						25%
6	Mahasiswa mampu memahami implementasi AI dan optimasi dalam bidang teknik mesin <i>Students are able to understand the implementation of AI and optimization in the field of mechanical engineering</i>	Bisa menjelaskan contoh-contoh implementasi AI dan optimasi di bidang teknik mesin <i>Able to explain examples of AI and optimization implementations in the field of mechanical engineering</i>	Tugas: Mencari dan mempresentasikan implementasi AI dan optimasi di bidang teknik mesin <i>Assignment: Searching for and presenting implementations of AI and optimization in the field of mechanical engineering</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"] Self-Directed Learning Cooperative Learning <i>Self-Directed Learning Cooperative Learning</i>		Kontrak kuliah <i>Course contract</i> Kuliah Pengantar & Brainstorming <i>Introductory lecture &amp; Brainstorming</i> - Intro AI dan optimasi metaheuristik <i>Introduction to AI and metaheuristic optimization</i> - Implementasi AI dan optimasi metaheuristik dalam bidang teknik mesin <i>Implementation of AI and metaheuristic</i>	



						<i>optimization in the field of mechanical engineering</i>  <b>[1: Martin T. Hagan – BAB 1]</b>	
<b>7</b>	Mahasiswa mampu memahami dasar-dasar mengoperasikan MATLAB <i>Students are able to understand the basics of operating MATLAB</i>	Mahasiswa mampu mengoperasikan tool-tool pada MATLAB termasuk Graphical User interface (GUI) untuk menyelesaikan kasus optimasi sederhana <i>Students are able to operate MATLAB tools, including Graphical User Interface (GUI), to solve simple optimization cases</i>	Tugas: Mempresentasikan penggunaan fitur MATLAB serta Graphical User interface (GUI) untuk menyelesaikan kasus sederhana <i>Assignment: Presenting the use of MATLAB features and Graphical User Interface (GUI) to solve simple cases</i>	Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i>		- Retooling dasar-dasar MATLAB <i>Basic MATLAB retooling</i> - Graphical User Interface with MATLAB <i>Graphical User Interface with MATLAB</i>  <b>[2: S.R. Otto and J.P Denier – BAB 2&amp;3]</b>	1%
<b>8</b>	Mahasiswa mampu memahami prinsip dasar single perceptron dan implementasinya untuk kasus clustering <i>Students are able to understand the</i>	Mahasiswa mengerti dan bisa mengimplementasikan single perceptron untuk kasus clustering 2 buah data sederhana <i>Students understand and able to implement single perceptron for case of</i>	Tugas: Mempresentasikan penggunaan coding single perceptron untuk kasus clustering dan menjawab beberapa pertanyaan berikut: <i>Assignment:</i>	Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning <i>Self-Directed Learning</i>		Single perceptron dan implementasinya untuk kasus clustering <i>Single perceptron and its implementation for clustering cases</i>  <b>[1: Martin T. Hagan – BAB 4]</b>	1%



	<i>basic principles of single perceptron and its implementation for clustering cases</i>	<i>clustering two simple data sets</i>	<i>Presenting the use of single perceptron coding for clustering cases and answering the following questions:</i> a. Berapa epoch sampai berhenti <i>How many epochs until stopping</i> b. Pengaruh fungsi aktivasi terhadap konvergensi. <i>The effect of activation function on convergence</i> c. Perubahan nilai weight dan bias untuk 3x epoch pertama <i>Changes in weight and bias values for the first 3 epochs</i>	Cooperative Learning Cooperative Learning		- [2: Mark Hudson Beale – BAB 1]	
9	Mahasiswa mampu mendefinisikan data input-output dalam sebuah NN, serta memilih topology, fungsi aktivasi	Mahasiswa mampu mendefinisikan: <i>Students are able to define:</i> a. input-output <i>input-output</i>	Tugas : Mempresentasikan penggunaan NN MATLAB toolbox untuk generate fungsi $Y = f(\sin x)$	Perkuliahan <i>Lecture</i> [TM: 3x50"] Self-Directed Learning		Diskusi dan implementasi NN MATLAB toolbox untuk kasus yang akan dipresentasikan dalam project 1	1%



	<p>sehingga didapatkan NN dengan Mean Squared Error (MSE) yang terkecil</p> <p><i>Students are able to define input-output data in an NN, as well as select topology and activation functions to obtain an NN with the smallest Mean Squared Error (MSE)</i></p>	<p>b. jumlah hidden layer dan node</p> <p><i>number of hidden layers and nodes</i></p> <p>c. fungsi aktivasi dan learning algorithm</p> <p><i>activation function and learning algorithm</i></p> <p>sehingga didapatkan NN dengan Mean Squared Error (MSE) yang terkecil</p> <p><i>so that the NN with the smallest Mean Squared Error (MSE) is obtained</i></p>	<p>dengan variasi jumlah hidden layer, jumlah node, fungsi aktivasi dan learning algorithm</p> <p><i>Assignment:</i></p> <p><i>Presenting the use of NN MATLAB toolbox to generate the function <math>Y = f(\sin x)</math> with variations in the number of hidden layers, number of nodes, activation functions, and learning algorithms</i></p>	<p><i>Self-Directed Learning</i></p> <p><i>Cooperative Learning</i></p> <p><i>Cooperative Learning</i></p>	<p><i>Discussion and implementation of NN MATLAB toolbox for the case to be presented in project 1</i></p> <p><b>[1: Martin T. Hagan – BAB 4]</b></p> <p><b>[2: Mark Hudson Beale – BAB 3]</b></p>	
<b>10</b>	KUIS 1 QUIZ 1					25%
<b>11</b>	<p>Mahasiswa mampu mendefinisikan tujuan optimasi, serta memahami langkah-langkah pencarian nilai optimasi dengan Genetic Algoritma (GA)</p> <p><i>Students are able to define optimization</i></p>	<p>Mahasiswa mampu memahami Langkah-langkah optimasi menggunakan GA:</p> <p><i>Students are able to understand the optimization steps using GA:</i></p> <p>a. Mengenerate populasi</p> <p><i>Generating population</i></p>	<p>Tugas: mempresentasikan bagaimana:</p> <p><i>Assignment:</i></p> <p><i>Presenting how to:</i></p> <p>a. generate populasi</p> <p><i>generate population</i></p> <p>b. menentukan nilai fitness</p> <p><i>determine fitness values</i></p>	<p>Perkuliahan</p> <p><i>Lecture</i></p> <p><b>[TM: 3x50"]</b></p> <p>Self-Directed Learning</p> <p><i>Self-Directed Learning</i></p> <p>Cooperative Learning</p>	<p>- Overview GA</p> <p><i>Overview of GA</i></p> <p>- Proses seleksi, cross-over dan mutase pada GA</p> <p><i>Selection, crossover, and mutation processes in GA</i></p>	1%



	<i>objectives and understand the steps of searching for optimization values using Genetic Algorithms (GA)</i>	<p>b. Menentukan nilai fitness <i>Determining fitness value</i></p> <p>c. Filtering (roulette wheel dan tournament) <i>Filtering (roulette wheel and tournament)</i></p> <p>d. Proses seleksi <i>Selection process</i></p> <p>e. Crossover dan mutasi <i>Crossover and mutation</i></p>	<p>c. filtering (roulette wheel dan tournament) <i>perform filtering (roulette wheel and tournament)</i></p> <p>d. proses seleksi crossover dan mutasi <i>perform selection, crossover, and mutation processes</i></p> <p>pada coding yang telah diberikan <i>on the given coding</i></p>	<i>Cooperative Learning</i>		<b>[4: Andrew Chipperfield – 1-1 s/d 1-18]</b>	
<b>12</b>	<p>Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB mulai dari kasus yang sederhana sampai kasus multiobjective optimization <i>Students are able to operate the Genetic Algorithm toolbox in MATLAB, starting</i></p>	<p>Simulasi penggunaan toolbox Genetic Algorithm untuk beberapa kasus: <i>Simulation of using the Genetic Algorithm toolbox for several cases:</i></p> <ol style="list-style-type: none"> <li>Single input single output (SISO) <i>Single input single output (SISO)</i></li> <li>Single input multi output (SIMO)</li> </ol>	<p>Tugas: Mempresentasikan bagaimana mencari nilai optimum pada fungsi <math>Y = f(\sin x)</math> pada constraint sudut tertentu <math>0 &lt; x &lt; 90</math> <i>Assignment: Presenting how to find the optimum value for the function <math>Y = f(\sin x)</math></i></p>	<p>Perkuliahhan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i></p>		<ul style="list-style-type: none"> <li>- Membuat fitness function <i>Determining fitness function</i></li> <li>- Menentukan setting parameter <i>Determining setting parameter</i></li> <li>- Menampilkan dan membaca hasil optimasi</li> </ul>	1%



	<i>from simple cases to multi-objective optimization cases</i>	<p>Single input multi output (SIMO)</p> <p>3. Multi input single output (MISO) <i>Multi input single output (MISO)</i></p> <p>4. Multi input multi output (MIMO) <i>Multi input multi output (MIMO)</i></p>	<i>with a specific angle constraint</i> $0 < x < 90$			<p><i>Displaying and interpreting optimization results</i></p> <p><b>[5: Mark A. Abramson – Bab 4]</b></p>	
<b>13</b>	<p>Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB untuk tuning parameter serta pemecahan kasus yang memerlukan constraint handling <i>Students are able to operate the Genetic Algorithm toolbox in MATLAB for parameter tuning and solving cases requiring constraint handling</i></p>	<p>Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB dengan constraint handling: penalty tipe static, dynamic dan adaptive <i>Students are able to operate the Genetic Algorithm toolbox in MATLAB with constraint handling: static, dynamic, and adaptive penalty types</i></p>	<p>Tugas: Mempresentasikan bagaimana mencari nilai optimum menggunakan GA pada fungsi <math>Y = f(a, b, c, d)</math> dengan constrain yang berbeda <i>Assignment: Presenting how to find the optimum value using GA for the function <math>Y = f(a, b, c, d)</math> with different constraints</i></p>	<p>Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i></p>		<ul style="list-style-type: none"> <li>- Membuat fitness function <i>Determining fitness function</i></li> <li>- Menentukan setting parameter <i>Determining setting parameter</i></li> <li>- Menentukan constraint handling <i>Determining constraint handling</i></li> <li>- Menampilkan dan membaca hasil optimasi <i>Displaying and interpreting optimization results</i></li> </ul>	1%






						<b>[8. Chehouri, A. Dkk]</b>	
<b>14</b>	Mahasiswa mampu mendefinisikan tujuan optimasi, serta memahami langkah-langkah pencarian nilai optimasi dengan Particle Swarm Optimization (PSO) <i>Students are able to define optimization objectives and understand the steps of searching for optimization values using Particle Swarm Optimization (PSO)</i>	Mahasiswa mampu memahami langkah-langkah pencarian nilai optimasi dengan Particle Swarm Optimization (initialize, evaluasi fitness, update local and global best, update velocity and position) <i>Students are able to understand the optimization steps with Particle Swarm Optimization (initialize, evaluate fitness, update local and global best, update velocity and position)</i>	Tugas: Mempresentasikan setiap baris coding PSO serta bisa menjelaskan fungsi dari coding tersebut pada PSO <i>Assignment: Presenting each line of PSO coding and explaining the function of the coding in PSO.</i>	Perkuliahan <i>Lecture</i> <b>[TM: 3x50"]</b> Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i>		- Overview PSO <i>Overview of PSO</i> - Proses penentuan posisi, kecepatan, Pbest dan GBest pada PSO <i>Process of determining position, velocity, Pbest, and GBest in PSO</i>  <b>[6: Xin She Yang – Bab 7]</b>	1%
<b>15</b>	Mahasiswa mampu menjelaskan secara jelas dan runtut contoh perhitungan tiap langkah pada metode PSO menggunakan MATLAB	Mahasiswa mampu memahami langkah-langkah pencarian nilai optimasi serta menerapkan constraint handling pada PSO <i>Students are able to understand the</i>	Tugas: Mempresentasikan bagaimana mencari nilai optimum menggunakan PSO pada fungsi $Y = f(a, b, c, d)$ dengan constrain yang berbeda	Perkuliahan <i>Lecture</i> <b>[TM: 3x50"]</b> Self-Directed Learning <i>Self-Directed Learning</i>		- Proses perhitungan posisi, kecepatan, Pbest dan GBest pada PSO menggunakan MATLAB <i>Process of calculating position,</i>	1%



	<p><i>Students are able to clearly and systematically explain the calculation examples for each step in the PSO method using MATLAB</i></p>	<p><i>optimization steps and apply constraint handling in PSO</i></p>	<p><i>Assignment: Presenting how to find the optimum value using PSO for the function <math>Y = f(a, b, c, d)</math> with different constraints</i></p>	<p>Cooperative Learning Cooperative Learning</p>		<p><i>velocity, Pbest, and GBest in PSO using MATLAB</i></p> <p><b>[6: Xin She Yang – Bab 7]</b></p>	
<b>16</b>	<b>Evaluasi Akhir Semester / Ujian Akhir Semester/Project team - collaborative learning</b>						<b>25%</b>



		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				<b>Kode Dokumen</b>	
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b>SEMESTER LEARNING PLAN</b>							
MATA KULIAH <i>COURSE</i>		KODE <i>CODE</i>	RUMPUN MK <i>COURSE CLUSTER</i>	BOBOT (SKS) <i>CREDITS</i>		SEMESTER <i>SEMESTER</i>	TGL PENYUSUNAN <i>DATE</i>
METALURGI MANUFAKTUR <i>MANUFACTURING METALLURGY</i>		TM235222	METALURGI <i>METALLURGY</i>	T= 3	P= 0	PILIHAN <i>ELECTIVE</i>	25 NOVEMBER 2023
OTORISASI <i>AUTHORIZATION</i>		Pengembang RPS <i>Developer of Semester Learning Plan</i>		Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Postgraduate Program</i>	
		Ika Dewi Wijayanti		Sutikno		Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng	
Capaian Pembelajaran <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>PLO Charged to the Course</i>						
	CPL-3 <i>PLO-3</i>	Mampu mengelola pembelajaran diri sendiri, dan mengembangkan diri sebagai pribadi pembelajar sepanjang hayat untuk bersaing di tingkat nasional, maupun internasional, dalam rangka berkontribusi nyata untuk menyelesaikan masalah dengan mengimplementasikan teknologi informasi dan komunikasi dan memperhatikan prinsip keberlanjutan <i>Able to manage self-learning and develop oneself as a lifelong learner to compete at national and international levels, in order to make a real contribution to solving problems by implementing information and communication technology and paying attention to the principles of sustainability</i>					
	CPL-4	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam					



	PLO-4	<i>Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth</i>
	CPL-5 PLO-5	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin <i>Able to understand and utilize the theory of engineering sciences in mechanical engineering</i>
	CPL-6 PLO-6	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin <i>Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields</i>
	CPL-8 PLO-8	Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik <i>Able to formulate new ideas from the previous research for the development of technology and mechanical systems</i>
	<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>	
	CPMK-1 CLO-1	Mampu merencanakan, menyelesaikan, dan mengevaluasi tugas berdasarkan analisis data dan informasi <i>Able to plan, complete, and evaluate tasks based on data and information analysis</i>
	CPMK-2 CLO-2	Mampu memahami dasar-dasar mechanical properties dan nature (sifat intrinsik) dari suatu material beserta jenis-jenis dari material <i>Able to understand the fundamentals of mechanical properties and the nature (intrinsic characteristics) of a material along with the types of materials</i>
	CPMK-3 CLO-3	Mampu memahami dasar-dasar proses manufaktur pada material dengan mempertimbangkan propertiesnya <i>Able to understand the fundamentals of manufacturing processes of materials, considering their properties</i>
	CPMK-4 CLO-4	Mampu memahami proses pengecoran, pengelasan, metal forming, metal machining, dan manufacturing system dalam kaitannya dengan properties dari suatu material <i>Able to understand the processes of casting, welding, metal forming, metal machining, and manufacturing systems in relation to the properties of a material</i>
	CPMK-5 CLO-5	Mampu mengevaluasi dan mengembangkan sistem manufaktur yang paling efektif dan efisien <i>Able to evaluate and develop the most effective and efficient manufacturing systems</i>
		<b>Matrik CPL – CPMK PLO – CLO Matrix</b>



		CPMK CLO	CPL-3 PLO-3	CPL-4 PLO-4	CPL-5 PLO-5	CPL-6 PLO-6	CPL-8 PLO-8
		CPMK-1 CLO-1	V	V	V		V
		CPMK-2 CLO-2	V	V	V		
		CPMK-3 CLO-3	V	V	V		V
		CPMK-4 CLO-4	V	V	V	V	V
		CPMK-5 CLO-5	V	V	V	V	V
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	<p>Mata kuliah ini mempelajari proses manufaktur dasar dalam kaitannya dengan metalurgi yaitu properties material. Proses manufaktur yang dipelajari merupakan proses manufaktur fundamental, di antaranya adalah metal processing and manufacturing, proses solidification dan casting, metal machining, sheet metal forming, dan welding process. Masing-masing proses manufaktur tersebut dipelajari konsep dasar dan fundamental prinsip kerjanya serta kelebihan dan kekurangannya.</p> <p><i>This course studies the basic manufacturing processes in relation to metallurgy, specifically material properties. The manufacturing process covered is fundamental manufacturing process, including metal processing and manufacturing, solidification process and casting, metal machining, sheet metal forming, and welding process. Each manufacturing process is studied for its basic concepts, fundamental principles of operation, as well as its advantages and disadvantages.</i></p>						
<b>Bahan Kajian Materi Pembelajaran</b> <i>Course Materials</i>	<ul style="list-style-type: none"> <li>• Metal processing and manufacturing <i>Metal processing and manufacturing</i></li> <li>• Stress dan strain during deformation <i>Stress dan strain during deformation</i></li> <li>• Proses solidification dan casting <i>Solidification process and casting</i></li> </ul>						



	<ul style="list-style-type: none"> <li>• Sheet forming process <i>Sheet forming process</i></li> <li>• Metal machining process <i>Metal machining process</i></li> <li>• Metallurgy of welding <i>Metallurgy of welding</i></li> </ul>				
<b>Pustaka References</b>	<b>Utama Main</b>				
	[1] Mikell P. Groover, FUNDAMENTALS OF MODERN MANUFACTURING: Materials, Processes, and Systems, JOHN WILEY & SONS, INC., 2010.				
	[2] J. Beddoes & M. J. Bibby., Principles of Metal Manufacturing Processes, Carleton University, Canada, 2006.				
	<b>Pendukung Supporting</b>				
	[3] Kalpakjian, Serope, and Steven R. Schmid. "Manufacturing engineering." Technology; Prentice Hall: London, UK (2009): 568-571.				
	[4] Dieter, George E., Mechanical Metallurgy, Singapore: Mc Graw hill Inter-national Book Company, 1981.				
<b>Dosen Pengampu Lecturers</b>	Ika Dewi Wijayanti, PhD				
<b>Mata Kuliah Syarat Prerequisites</b>					
<b>Mg Ke- Week</b>	<b>Kemampuan akhir tiap tahapan belajar (Sub-CPMK) Final ability of each learning stage (LLO)</b>	<b>Penilaian Assessment</b>	<b>Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu] Form of Learning, Learning Method, Student Assignment</b>	<b>Materi Pembelajaran [Pustaka] Learning Material [Reference]</b>	<b>Bobot Penilaian (%) Assessment Load (%)</b>



(1)	(2)	Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria &amp; Model</i>	[Time Estimation]		(7)	(8)
				Luring <i>Offline</i>	Daring <i>Online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami dasar-dasar proses manufaktur dan pemanfaatan material di dalam proses manufaktur <i>Students are able to understand the basics of manufacturing processes and the utilization of materials within the manufacturing process</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam memahami dasar-dasar proses manufaktur dan pemanfaatan material di dalam proses manufaktur <i>Completeness, clarity, accuracy (of material &amp; time), and originality in understanding the basics of manufacturing processes and the utilization of materials within</i>	<ul style="list-style-type: none"> <li>Mampu dan terampil menjelaskan dasar-dasar proses manufaktur dan pemanfaatan material di dalam proses manufaktur <i>Capable and skilled at explaining the basics of manufacturing processes and the utilization of materials within the manufacturing process</i></li> <li>Teknik penilaian: tes dan non-tes</li> </ul>	<ul style="list-style-type: none"> <li>Contextual Teaching &amp; Learning <i>Contextual Teaching &amp; Learning</i></li> <li>Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</p>	<ul style="list-style-type: none"> <li>Latihan soal &amp; Homework di MyITS Classroom <i>Practice problems &amp; Homework in MyITS Classroom</i></li> <li>Tugas Mandiri di MyITS Classroom <i>Individual assignment in MyITS Classroom</i></li> <li>Review &amp; Summary PPT perkuliahan di MyITS Classroom</li> </ul>	<ul style="list-style-type: none"> <li>Kontrak kuliah <i>Course contract</i></li> <li>Perkenalan materi <i>Introduction to the material</i></li> <li>Dasar-dasar proses manufaktur <i>Basics of manufacturing processes</i></li> <li>Material yang dimanfaatkan pada proses manufaktur <i>Materials utilized in manufacturing processes</i></li> </ul> <p>[1], [2], [3] PPT perkuliahan di MyITS Classroom PPT of lecture in MyITS Classroom</p>	



		<i>the manufacturing process</i>	<i>Assessment model: test and non-test</i>		<ul style="list-style-type: none"> <li>• <i>Review &amp; Summary PPT of lecture in MyITS Classroom</i></li> </ul>		
<b>2-3</b>	<p>Mahasiswa mampu menjelaskan sifat mekanik material dan mekanisme perubahan sifat material saat diproses manufaktur <i>Students are able to explain the mechanical properties of materials and the mechanisms of property changes during manufacturing processes</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menjelaskan sifat mekanik material dan mekanisme perubahan sifat material saat diproses manufaktur <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining the mechanical properties of materials and the mechanisms of property changes</i></p>	<ul style="list-style-type: none"> <li>• Mampu dan terampil menjelaskan sifat mekanik material dan mekanisme perubahan sifat material saat diproses manufaktur <i>Capable and skilled at explaining the mechanical properties of materials and the mechanisms of property changes during manufacturing processes</i></li> <li>• Teknik penilaian: tes dan non-tes</li> </ul>	<ul style="list-style-type: none"> <li>• Contextual Teaching &amp; Learning <i>Contextual Teaching &amp; Learning</i></li> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p><b>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</b></p>	<ul style="list-style-type: none"> <li>• Latihan soal &amp; Homework di MyITS Classroom <i>Classroom Practice problems &amp; Homework in MyITS Classroom</i></li> <li>• Tugas Mandiri di MyITS Classroom <i>Individual assignment in MyITS Classroom</i></li> <li>• Review &amp; Summary PPT perkuliahan</li> </ul>	<ul style="list-style-type: none"> <li>• Sifat mekanik material <i>Mechanical properties of materials</i></li> <li>• Engineering stress strain <i>Engineering stress strain</i></li> <li>• True stress strain <i>True stress strain</i></li> <li>• Engineering vs. true stress strain <i>Engineering vs. true stress strain</i></li> <li>• Konsep deformasi plastis di proses manufaktur <i>Concept of plastic deformation in manufacturing processes</i></li> </ul> <p><b>[1], [2], [3], [4] PPT perkuliahan di</b></p>	





		during manufacturing processes	Assessment model: test and non-test		di MyITS Classroom Review & Summary PPT of lecture in MyITS Classroom	MyITS Classroom PPT of lecture in MyITS Classroom	
4	Assignment 1: <i>Assignment 1:</i> Mahasiswa memahami dasar-dasar proses manufaktur dan pemanfaatan material di dalam proses manufaktur serta menjelaskan sifat mekanik material dan mekanisme perubahan sifat material saat diproses manufaktur <i>Students are able to understand the basics of manufacturing</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam memahami dasar-dasar proses manufaktur dan pemanfaatan material di dalam proses manufaktur serta menjelaskan sifat mekanik material dan mekanisme perubahan sifat material saat diproses manufaktur	<ul style="list-style-type: none"> <li>• Mampu dan terampil menjelaskan dasar-dasar proses manufaktur dan pemanfaatan material di dalam proses manufaktur serta menjelaskan sifat mekanik material dan mekanisme perubahan sifat material saat diproses manufaktur</li> </ul> <i>Capable and skilled at explaining the basics of</i>	<ul style="list-style-type: none"> <li>• Presentasi kelompok <i>Group presentation</i></li> <li>• Penyusunan laporan kelompok <i>Group report writing</i></li> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</p>	<ul style="list-style-type: none"> <li>• Submit presentasi PPT dan laporan di MyITS Classroom <i>PPT and report submission in MyITS Classroom</i></li> </ul>	<ul style="list-style-type: none"> <li>• Kontrak kuliah <i>Course contract</i></li> <li>• Perkenalan materi <i>Introduction to the material</i></li> <li>• Dasar-dasar proses manufaktur <i>Basics of manufacturing processes</i></li> <li>• Material yang dimanfaatkan pada proses manufaktur <i>Materials utilized in manufacturing processes</i></li> <li>• Sifat mekanik material <i>Mechanical properties of materials</i></li> <li>• Engineering stress strain <i>Engineering stress strain</i></li> </ul>	25



	<i>processes and the utilization of materials within the manufacturing process, and explain the mechanical properties of materials and the mechanisms of property changes during manufacturing processes</i>	<i>Completeness, clarity, accuracy (of material &amp; time), and originality in understanding the basics of manufacturing processes and the utilization of materials within the manufacturing process and explaining the mechanical properties of materials and the mechanisms of property changes during manufacturing processes</i>	<i>manufacturing processes and the utilization of materials within the manufacturing process and explaining the mechanical properties of materials and the mechanisms of property changes during manufacturing processes</i> <ul style="list-style-type: none"> <li>• Teknik penilaian: presentasi dan laporan Assessment model: <i>presentation and report</i></li> </ul>			<ul style="list-style-type: none"> <li>• True stress strain <i>True stress strain</i></li> <li>• Engineering vs. true stress strain <i>Engineering vs. true stress strain</i></li> <li>• Konsep deformasi plastis di proses manufaktur <i>Concept of plastic deformation in manufacturing processes</i></li> </ul> <p>[1], [2], [3], [4]  <b>PPT perkuliahan di MyITS Classroom</b>  <b>PPT of lecture in MyITS Classroom</b></p>	
<b>5-7</b>	Mahasiswa mampu menjelaskan konsep dan mekanisme	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam	<ul style="list-style-type: none"> <li>• Mampu dan terampil menjelaskan konsep dan mekanisme</li> </ul>	<ul style="list-style-type: none"> <li>• Contextual Teaching &amp; Learning</li> </ul>	<ul style="list-style-type: none"> <li>• Latihan soal &amp; Homework di MyITS Classroom</li> </ul>	<ul style="list-style-type: none"> <li>• Overview casting technology <i>Overview casting technology</i></li> <li>• Heating dan pouring</li> </ul>	



	<p>solidification beserta defect yang dihasilkan selama casting <i>Students are able to explain the concept and mechanism of solidification along with the defects produced during casting</i></p>	<p>memahami konsep dan mekanisme solidification beserta defect yang dihasilkan selama casting <i>Completeness, clarity, accuracy (of material &amp; time), and originality in understanding the concept and mechanism of solidification along with the defects produced during casting</i></p>	<p>solidification beserta defect yang dihasilkan selama casting <i>Capable and skilled at explaining the concept and mechanism of solidification along with the defects produced during casting</i></p> <ul style="list-style-type: none"> <li>• Teknik penilaian: tes dan non-tes <i>Assessment model: test and non-test</i></li> </ul>	<p><i>Contextual Teaching &amp; Learning</i></p> <ul style="list-style-type: none"> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</p>	<p><i>Practice problems &amp; Homework in MyITS Classroom</i></p> <ul style="list-style-type: none"> <li>• Tugas Mandiri di MyITS Classroom <i>Individual assignment in MyITS Classroom</i></li> <li>• Review &amp; Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of lecture in MyITS Classroom</i></li> </ul>	<p><i>Heating dan pouring</i></p> <ul style="list-style-type: none"> <li>• Solidification dan cooling <i>Solidification dan cooling</i></li> <li>• Sand casting <i>Sand casting</i></li> <li>• Permanent-mold casting process <i>Permanent-mold casting process</i></li> <li>• Foundry practice <i>Foundry practice</i></li> <li>• Casting quality <i>Casting quality</i></li> <li>• Metals for casting <i>Metals for casting</i></li> <li>• Product design considerations <i>Product design considerations</i></li> </ul> <p>[1], [2], [3] PPT perkuliahan di MyITS Classroom PPT of lecture in MyITS Classroom</p>	
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<p><b>8</b></p>	<p>Assignment 2: <i>Assignment 2:</i> Mahasiswa mampu memahami konsep dan mekanisme solidification beserta defect yang dihasilkan selama casting <i>Students are able to understand the concept and mechanism of solidification along with the defects produced during casting</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam memahami konsep dan mekanisme solidification beserta defect yang dihasilkan selama casting <i>Completeness, clarity, accuracy (of material &amp; time), and originality in understanding the concept and mechanism of solidification along with the defects produced during casting</i></p>	<ul style="list-style-type: none"> <li>• Mampu dan terampil menjelaskan konsep dan mekanisme solidification beserta defect yang dihasilkan selama casting <i>Capable and skilled at explaining the concept and mechanism of solidification along with the defects produced during casting</i></li> <li>• Teknik penilaian: presentasi dan laporan <i>Assessment model: presentation and report</i></li> </ul>	<ul style="list-style-type: none"> <li>• Presentasi kelompok <i>Group presentation</i></li> <li>• Penyusunan laporan kelompok <i>Group report writing</i></li> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</p>	<ul style="list-style-type: none"> <li>• Submit presentasi PPT dan laporan di MyITS Classroom <i>PPT and report submission in MyITS Classroom</i></li> </ul>	<ul style="list-style-type: none"> <li>• Overview casting technology <i>Overview casting technology</i></li> <li>• Heating dan pouring <i>Heating dan pouring</i></li> <li>• Solidification dan cooling <i>Solidification dan cooling</i></li> <li>• Sand casting <i>Sand casting</i></li> <li>• Permanent-mold casting process <i>Permanent-mold casting process</i></li> <li>• Foundry practice <i>Foundry practice</i></li> <li>• Casting quality <i>Casting quality</i></li> <li>• Metals for casting <i>Metals for casting</i></li> <li>• Product design considerations <i>Product design considerations</i></li> </ul> <p>[1], [2], [3]</p>	<p><b>25</b></p>
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						PPT perkuliahan di MyITS Classroom PPT of lecture in MyITS Classroom	
9-10	Mahasiswa mampu menjelaskan dan memahami konsep dan mekanisme sheet forming proses beserta defect yang dihasilkan selama sheet forming proses <i>Students are able to explain and understand the concept and mechanism of sheet forming process along with the defects produced during the sheet forming process</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan dan memahami konsep dan mekanisme sheet forming proses beserta defect yang dihasilkan selama sheet forming proses <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining and understanding the concept and mechanism of sheet forming</i>	<ul style="list-style-type: none"> <li>Mampu dan terampil menjelaskan konsep dan mekanisme sheet forming proses beserta defect yang dihasilkan selama sheet forming proses <i>Capable and skilled at explaining the concept and mechanism of sheet forming process along with the defects produced during the sheet forming process</i></li> <li>Teknik penilaian: tes dan non-tes</li> </ul>	<ul style="list-style-type: none"> <li>Contextual Teaching &amp; Learning <i>Contextual Teaching &amp; Learning</i></li> <li>Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</p>	<ul style="list-style-type: none"> <li>Latihan soal &amp; Homework di MyITS Classroom <i>Practice problems &amp; Homework in MyITS Classroom</i></li> <li>Tugas Mandiri di MyITS Classroom <i>Individual assignment in MyITS Classroom</i></li> <li>Review &amp; Summary PPT perkuliahan di MyITS Classroom</li> </ul>	<ul style="list-style-type: none"> <li>Teknologi review forming metal <i>Review of metal forming technology</i></li> <li>Karakteristik sheet forming proses <i>Characteristics of sheet forming processes</i></li> <li>Klasifikasi sheet forming proses <i>Classification of sheet forming processes</i></li> <li>Dies dan presses sheet forming proses <i>Dies and presses in sheet forming processes</i></li> <li>Spesial case sheet forming proses <i>Special cases in sheet forming processes</i></li> <li>Defect produced during sheet forming proses <i>Defects produced during sheet forming processes</i></li> </ul>	



		<i>process along with the defects produced during the sheet forming process</i>	<i>Assessment model: test and non-test</i>		<i>Review &amp; Summary PPT of lecture in MyITS Classroom</i>	<b>[1], [2], [3]. [4]</b> <b>PPT perkuliahan di MyITS Classroom</b> <b>PPT of lecture in MyITS Classroom</b>	
<b>11</b>	Mahasiswa mampu menjelaskan dan memahami konsep dan mekanisme metal machining proses beserta defect yang dihasilkan selama metal machining proses <i>Students are able to explain and understand the concept and mechanism of metal machining process along with the defects produced during the metal machining process</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan dan memahami konsep dan mekanisme metal machining proses beserta defect yang dihasilkan selama metal machining proses <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining and understanding the concept and</i>	<ul style="list-style-type: none"> <li>• Mampu dan terampil menjelaskan konsep dan mekanisme metal machining proses beserta defect yang dihasilkan selama metal machining proses <i>Capable and skilled at explaining the concept and mechanism of metal machining process along with the defects produced during the metal machining process</i></li> <li>• Teknik penilaian: tes dan non-tes</li> </ul>	<ul style="list-style-type: none"> <li>• Contextual Teaching &amp; Learning <i>Contextual Teaching &amp; Learning</i></li> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p><b>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</b></p>	<ul style="list-style-type: none"> <li>• Latihan soal &amp; Homework di MyITS Classroom <i>Practice problems &amp; Homework in MyITS Classroom</i></li> <li>• Tugas Mandiri di MyITS Classroom <i>Individual assignment in MyITS Classroom</i></li> <li>• Review &amp; Summary PPT perkuliahan</li> </ul>	<ul style="list-style-type: none"> <li>• Teknologi overview metal machining process <i>Overview of metal machining processes</i></li> <li>• Klasifikasi metal removal proses</li> <li>• Teori chips formation pada machine machining proses <i>Classification of metal removal processes</i></li> <li>• Defect produced during metal machining proses <i>Defect produced during metal machining proses</i></li> </ul> <p><b>[1], [2], [3]. [4]</b> <b>PPT perkuliahan di MyITS Classroom</b> <b>PPT of lecture in MyITS Classroom</b></p>	



		<i>mechanism of metal machining process along with the defects produced during the metal machining process</i>	<i>Assessment model: test and non-test</i>		di MyITS Classroom Review & Summary PPT of lecture in MyITS Classroom		
<b>12</b>	Assignment 3: Mahasiswa mampu menjelaskan dan memahami konsep dan mekanisme sheet forming proses beserta defect yang dihasilkan selama sheet forming proses serta konsep dan mekanisme metal machining proses beserta defect yang dihasilkan selama metal machining proses	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan dan memahami konsep dan mekanisme sheet forming proses beserta defect yang dihasilkan selama sheet forming proses serta konsep dan mekanisme metal machining proses beserta defect yang dihasilkan	<ul style="list-style-type: none"> <li>• Mampu dan terampil menjelaskan dan memahami konsep dan mekanisme sheet forming proses beserta defect yang dihasilkan selama sheet forming proses serta konsep dan mekanisme metal machining proses beserta defect yang dihasilkan selama metal machining proses <i>Capable and skilled at</i></li> </ul>	<ul style="list-style-type: none"> <li>• Presentasi kelompok <i>Group presentation</i></li> <li>• Penyusunan laporan kelompok <i>Group report writing</i></li> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</p>	<ul style="list-style-type: none"> <li>• Submit presentasi PPT dan laporan di MyITS Classroom <i>PPT and report submission in MyITS Classroom</i></li> </ul>	<ul style="list-style-type: none"> <li>• Teknologi review forming metal <i>Review of metal forming technology</i></li> <li>• Karakteristik sheet forming proses <i>Characteristics of sheet forming processes</i></li> <li>• Klasifikasi sheet forming proses <i>Classification of sheet forming processes</i></li> <li>• Dies dan presses sheet forming proses <i>Dies and presses in sheet forming processes</i></li> <li>• Special case sheet forming proses <i>Special cases in sheet forming processes</i></li> </ul>	<b>25</b>



	<p><i>Students are able to explain and understand the concept and mechanism of sheet forming process along with the defects produced during the sheet forming process, as well as the concept and mechanism of metal machining process along with the defects produced during the metal machining process</i></p>	<p><i>selama metal machining proses Completeness, clarity, accuracy (of material &amp; time), and originality in explaining and understanding the concept and mechanism of sheet forming process along with the defects produced during the sheet forming process, as well as the concept and mechanism of metal machining process along with the defects produced during the metal machining process</i></p>	<p><i>explaining and understanding the concept and mechanism of sheet forming process along with the defects produced during the sheet forming process, as well as the concept and mechanism of metal machining process along with the defects produced during the metal machining process</i></p> <ul style="list-style-type: none"> <li>• Teknik penilaian: presentasi dan laporan Assessment model: presentation and report</li> </ul>			<ul style="list-style-type: none"> <li>• Defect produced during sheet forming proses <i>Defects produced during sheet forming processes</i></li> <li>• Teknologi overview metal machining process <i>Overview of metal machining processes</i></li> <li>• Klasifikasi metal removal proses</li> <li>• Teori chips formation pada machine machining proses <i>Classification of metal removal processes</i></li> <li>• Defect produced during metal machining proses <i>Defect produced during metal machining proses</i></li> </ul> <p>[1], [2], [3], [4] PPT perkuliahan di MyITS Classroom PPT of lecture in MyITS Classroom</p>	
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<p><b>13-15</b></p>	<p>Mahasiswa mampu menjelaskan dan memahami konsep dan mekanisme welding proses beserta defect yang dihasilkan selama welding proses <i>Students are able to explain and understand the concept and mechanism of welding process along with the defects produced during the welding process</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menjelaskan dan memahami konsep dan mekanisme welding proses beserta defect yang dihasilkan selama welding proses <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining and understanding the concept and mechanism of welding process along with the defects produced during the welding process</i></p>	<ul style="list-style-type: none"> <li>• Mampu dan terampil menjelaskan dan memahami konsep dan mekanisme welding proses beserta defect yang dihasilkan selama welding proses <i>Capable and skilled at explaining and understanding the concept and mechanism of welding process along with the defects produced during the welding process</i></li> <li>• Teknik penilaian: tes dan non-tes <i>Assessment model: test and non-test</i></li> </ul>	<ul style="list-style-type: none"> <li>• Contextual Teaching &amp; Learning <i>Contextual Teaching &amp; Learning</i></li> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p><b>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</b></p>	<ul style="list-style-type: none"> <li>• Latihan soal &amp; Homework di MyITS Classroom <i>Practice problems &amp; Homework in MyITS Classroom</i></li> <li>• Tugas Mandiri di MyITS Classroom <i>Individual assignment in MyITS Classroom</i></li> <li>• Review &amp; Summary PPT perkuliahan di MyITS Classroom <i>Review &amp; Summary PPT of lecture in</i></li> </ul>	<ul style="list-style-type: none"> <li>• Overview of welding technology <i>Overview of welding technology</i></li> <li>• Klasifikasi dan general karakteristik welding proses <i>Classification and general characteristics of welding processes</i></li> <li>• Heat flow di welding <i>Heat flow in welding</i></li> <li>• Metallurgical effects di weld metal <i>Metallurgical effects in weld metal</i></li> <li>• Solid phase welding <i>Solid phase welding</i></li> <li>• Some materials di welding proses <i>Various materials in welding process</i></li> <li>• Defect during welding proses <i>Defect during welding process</i></li> </ul> <p><b>[1], [2], [3], [4]</b></p>	
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					<i>MyITS Classroom</i>	<b>PPT perkuliahan di MyITS Classroom</b> <i>PPT of lecture in MyITS Classroom</i>	
<b>16</b>	Assignment 4: <i>Assignment 4:</i> Mahasiswa mampu menjelaskan dan memahami konsep dan mekanisme welding proses beserta defect yang dihasilkan selama welding proses <i>Students are able to explain and understand the concept and mechanism of welding process along with the defects produced during the welding process</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan dan memahami konsep dan mekanisme welding proses beserta defect yang dihasilkan selama welding proses <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining and understanding the concept and mechanism of welding process</i>	<ul style="list-style-type: none"> <li>• Mampu dan terampil menjelaskan dan memahami konsep dan mekanisme welding proses beserta defect yang dihasilkan selama welding proses <i>Capable and skilled at explaining and understanding the concept and mechanism of welding process along with the defects produced during the welding process</i></li> </ul>	<ul style="list-style-type: none"> <li>• Presentasi kelompok <i>Group presentation</i></li> <li>• Penyusunan laporan kelompok <i>Group report writing</i></li> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul> <p><b>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</b></p>	<ul style="list-style-type: none"> <li>• Submit presentasi PPT dan laporan di MyITS Classroom <i>PPT and report submission in MyITS Classroom</i></li> </ul>	<ul style="list-style-type: none"> <li>• Overview of welding technology <i>Overview of welding technology</i></li> <li>• Klasifikasi dan general karakteristik welding proses <i>Classification and general characteristics of welding processes</i></li> <li>• Heat flow di welding <i>Heat flow in welding</i></li> <li>• Metallurgical effects di weld metal <i>Metallurgical effects in weld metal</i></li> <li>• Solid phase welding <i>Solid phase welding</i></li> <li>• Some materials di welding proses <i>Various materials in welding process</i></li> <li>• Defect during welding proses</li> </ul>	<b>25</b>



		<i>along with the defects produced during the welding process</i>	<ul style="list-style-type: none"><li>• Teknik penilaian: presentasi dan laporan <i>Assessment model: presentation and report</i></li></ul>			<i>Defect during welding process</i>  <b>[1], [2], [3], [4]</b> <b>PPT perkuliahan di MyITS Classroom</b> <b>PPT of lecture in MyITS Classroom</b>	
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		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b>SEMESTER LEARNING PLAN</b>						
MATA KULIAH COURSE	KODE CODE	RUMPUN MK COURSE CLUSTER	BOBOT (SKS) CREDITS		SEMESTER SEMESTER	TGL PENYUSUNAN DATE
MEKANIKA KOMPOSIT MECHANICS OF COMPOSITE	TM235223	METALURGI METALLURGY	T= 3	P= 0	PILIHAN ELECTIVE	18 JANUARI 2023
OTORISASI AUTHORIZATION	Pengembang RPS Developer of Semester Learning Plan	Koordinator RMK Course Cluster Coordinator			Ketua PRODI Head of Postgraduate Program	
	Sutikno	Sutikno			Prof. Dr.Eng. Harus Laksana Guntur, S.T., M.Eng.	
Capaian Pembelajaran Learning Outcomes	CPL-PRODI yang dibebankan pada MK PLO Charged to the Course					
	CPL-4 PLO-4	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth				
	CPL-5 PLO-5	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin Able to understand and utilize the theory of engineering sciences in mechanical engineering				
	CPL-6 PLO-6	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields				



	CPL-7 PLO-7	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin <i>Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach</i>																									
	<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>																										
	CPMK-1 CLO-1	Mahasiswa mampu memahami dan menjelaskan keunggulan dan kekurangan, faktor yang mempengaruhi sifat mekanik dan klasifikasi material komposit <i>Students are able to understand and explain advantages and drawbacks of composite materials, factors which influence mechanical properties of composite materials, and classification of composite materials</i>																									
	CPMK-2 CLO-2	Mahasiswa mampu menganalisis mikro-mekanikal komposit lamina <i>Students are able to analyze the micro-mechanical of composite lamina</i>																									
	CPMK-3 CLO-3	Mahasiswa mampu menganalisis makro-mekanikal komposit lamina <i>Students are able to analyze the macro-mechanical of composite lamina</i>																									
	CPMK-4 CLO-4	Mahasiswa mampu menganalisis makro-mekanikal komposit laminat, kegagalan dan desain komposit laminat <i>Students are able to analyze the macro-mechanical of composite laminate, failure and design of composite laminate</i>																									
	<b>Matrik CPL – CPMK PLO – CLO Matrix</b> <table border="1" style="margin-left: 40px;"> <thead> <tr> <th></th> <th>CPL-4 PLO-4</th> <th>CPL-5 PLO-5</th> <th>CPL-6 PLO-6</th> <th>CPL-7 PLO-7</th> </tr> </thead> <tbody> <tr> <td>CPMK-1 CLO-1</td> <td>√</td> <td>√</td> <td></td> <td></td> </tr> <tr> <td>CPMK-2 CLO-2</td> <td></td> <td></td> <td>√</td> <td>√</td> </tr> <tr> <td>CPMK-3 CLO-3</td> <td></td> <td></td> <td>√</td> <td>√</td> </tr> <tr> <td>CPMK-4</td> <td></td> <td>√</td> <td></td> <td>√</td> </tr> </tbody> </table>			CPL-4 PLO-4	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7	CPMK-1 CLO-1	√	√			CPMK-2 CLO-2			√	√	CPMK-3 CLO-3			√	√	CPMK-4		√		√
	CPL-4 PLO-4	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7																							
CPMK-1 CLO-1	√	√																									
CPMK-2 CLO-2			√	√																							
CPMK-3 CLO-3			√	√																							
CPMK-4		√		√																							



		CLO-4				
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	Mata kuliah ini membahas tentang material komposit, keunggulan dan kekurangan, faktor-faktor yang mempengaruhi sifat mekanik, klasifikasi material komposit, analisis mikro- dan makro-mekanikal pada lamina, analisis makro-mekanikal pada laminat, serta kegagalan dan desain material komposit laminat. <i>This course studies composite materials, advantages and drawbacks of composite materials, factors which influence mechanical properties of composite materials, classification of composite materials, micro- and macro-mechanical analysis of lamina, macro-mechanical analysis of laminate, failure and design of composite materials.</i>					
<b>Bahan Kajian Materi Pembelajaran</b> <i>Course Materials</i>	<ul style="list-style-type: none"><li>• Kontrak Kuliah <i>Course Contract</i></li><li>• Pengenalan material komposit <i>Introduction to Composite Materials</i><ul style="list-style-type: none"><li>○ Keunggulan dan kekurangan material komposit <i>Advantages and drawbacks of composite materials</i></li><li>○ Faktor-faktor yang mempengaruhi sifat mekanik komposit <i>Factors influencing mechanical properties of composite materials</i></li><li>○ Klasifikasi komposit <i>Classification of composites</i></li><li>○ Tipe-tipe fiber dan matrik dalam komposit <i>Types of fibers and matrix in composites</i></li></ul></li><li>• Analisis makro-mekanikal lamina <i>Macro-mechanical analysis of lamina</i><ul style="list-style-type: none"><li>○ Tegangan, regangan, modulus elastisitas dan strain energy <i>Stress, strain, elastic modulus, and strain energy</i></li><li>○ Tegangan-Regangan pada beberapa tipe material <i>Stress-strain behavior of various types of materials</i></li><li>○ Tegangan-Regangan pada unidirectional/bidirectional lamina</li></ul></li></ul>					



	<p><i>Stress-strain behavior in unidirectional/bidirectional lamina</i></p> <ul style="list-style-type: none"><li>○ Menentukan Engineering constants (stiffness and compliance parameters) dari unidirectional/bidirectional lamina <i>Determining Engineering constants (stiffness and compliance parameters) of unidirectional/bidirectional lamina</i></li><li>○ Hubungan tegangan-regangan, modulus elastisitas, kekuatan, thermal and moisture expansion coefficient pada ply dalam unidirectional/bidirectional lamina <i>Relationship between stress-strain, elastic modulus, strength, thermal and moisture expansion coefficient in plies within unidirectional/bidirectional lamina</i></li></ul> <ul style="list-style-type: none"><li>● Analisis mikro-mekanikal lamina <i>Micro-mechanical analysis of lamina</i><ul style="list-style-type: none"><li>○ Konsep fraksi volume dan fraksi berat fiber dan matrik <i>Concept of volume fraction and weight fraction of fiber and matrix</i></li><li>○ Densitas dan void fraction dalam komposit <i>Density and void fraction in composites</i></li><li>○ Konstanta mekanik <i>Mechanical constants</i></li><li>○ Konstanta higrotermal <i>Hygrothermal constants</i></li></ul></li><li>● Analisis makro-mekanikal laminat <i>Macro-mechanical analysis of laminate</i><ul style="list-style-type: none"><li>○ Kode susunan laminat <i>Laminate layup code</i></li><li>○ Hubungan beban mekanis dan higrotermal pada laminat terhadap tegangan dan regangan setiap lamina <i>Relationship between mechanical and hygrothermal loads on laminates with stress and strain in each lamina</i></li><li>○ Kekakuan laminat berdasar pada modulus elastisitas masing-masing susunan lamina <i>Laminate stiffness based on the elastic modulus of each lamina arrangement</i></li><li>○ Koefisien muai panas dan kelembaban (<i>thermal and moisture expansion coefficient</i>) dari laminat <i>Coefficient of thermal and moisture expansion of laminates</i></li></ul></li><li>● Kegagalan, analisis dan desain laminat</li></ul>
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	<p><i>Failure, analysis, and design of laminates</i></p> <ul style="list-style-type: none"> <li>○ Kriteria kegagalan laminat <i>Laminate failure criteria</i></li> <li>○ Merancang struktur laminat <i>Designing laminate structures</i></li> </ul>						
<b>Pustaka References</b>	<b>Utama Main</b>						
	Slide/Handout/Note						
	<b>Pendukung Supporting</b>						
[1]. Kaw, A.K., <i>Mechanics of Composite Materials</i> , CRC Press, Taylor & Francis, 2006 [2]. Jones R.M., <i>Mechanics of Composite Materials</i> , Taylor & Francis, 1999 [3]. Gibson, R.F., <i>Principles of Composite Material Mechanics</i> , CRC Press, Taylor & Francis, 2016							
<b>Dosen Pengampu Lecturers</b>	Sutikno dan Putu Suwarta <i>Sutikno and Putu Suwarta</i>						
<b>Mata Kuliah Syarat Prerequisites</b>							
<b>Mg Ke- Week</b>	<b>Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i></b>	<b>Penilaian Assessment</b>		<b>Bantuan Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu] <i>Form of Learning, Learning Method, Student Assignment [Time Estimation]</i></b>		<b>Materi Pembelajaran [Pustaka] <i>Learning Material [Reference]</i></b>	<b>Bobot Penilaian (%) Assessment Load (%)</b>
		<b>Indikator</b>	<b>Kriteria &amp; Bentuk</b>	<b>Luring</b>	<b>Daring</b>		





(1)	(2)	<i>Indicator</i> (3)	<i>Criteria &amp; Model</i> (4)	<i>Offline</i> (5)	<i>Online</i> (6)	(7)	(8)
1	Mahasiswa memahami material komposit, keunggulan dan kekurangan material komposit, faktor-faktor yang mempengaruhi sifat mekanik komposit, klasifikasi komposit, tipe-tipe fiber dan matrik dalam komposit. <i>Students understand composite materials, the advantages and drawbacks of composite materials, factors influencing the mechanical properties of composites,</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan material komposit, keunggulan dan kekurangan material komposit, faktor-faktor yang mempengaruhi sifat mekanik komposit, klasifikasi komposit, tipe-tipe fiber dan matrik dalam komposit. <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining composite materials, the advantages and drawbacks of composite materials, factors influencing the mechanical properties of composites, classification of composites, types of</i>	<ul style="list-style-type: none"> <li>• Mampu menjelaskan material komposit, keunggulan dan kekurangan material komposit, faktor-faktor yang mempengaruhi sifat mekanik komposit, klasifikasi komposit, tipe-tipe fiber dan matrik dalam komposit. <i>Able to explain composite materials, the advantages and drawbacks of composite materials, factors influencing the mechanical properties of composites, classification of composites, types of fibers, and matrix in composites</i></li> </ul>	<ul style="list-style-type: none"> <li>• Contextual Teaching &amp; Learning <i>Contextual Teaching &amp; Learning</i></li> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> <li>• Review &amp; Summary <i>Review &amp; Summary</i></li> <li>• Oral Post-test (acak) <i>Oral Post-test (random)</i></li> <li>• [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</li> </ul>		<ul style="list-style-type: none"> <li>• Kontrak Kuliah <i>Course Contract</i></li> <li>• Pengenalan material komposit <i>Introduction to composite materials</i></li> <li>• Keunggulan dan kekurangan material komposit <i>Advantages and drawbacks of composite materials</i></li> <li>• Faktor-faktor yang mempengaruhi sifat mekanik komposit <i>Factors influencing mechanical properties of composite materials</i></li> <li>• Klasifikasi komposit</li> </ul>	



	<i>classification of composites, types of fibers and matrix in composites.</i>	<i>fibers, and matrix in composites</i>	<ul style="list-style-type: none"> <li>• Bentuk penilaian: tes dan non-tes</li> <li><i>Assesment model: test and non-test</i></li> </ul>			<i>Classification of composites</i> <ul style="list-style-type: none"> <li>• Tipe-tipe fiber dan matrik dalam komposit</li> <li><i>Types of fibers and matrix in composites</i></li> <li>• [1]:1; [2]:1; [3]:1</li> <li>• [Handout di myITS Classroom]</li> </ul>	
2 - 3	Mahasiswa memahami analisis makro-mekanikal lamina tentang tegangan, regangan, modulus elastisitas dan strain energy, tegangan-Regangan pada beberapa tipe material, tegangan-Regangan pada unidirectional/bidirectional lamina, menentukan Engineering constants (stiffness	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan analisis makro-mekanikal lamina tentang tegangan, regangan, modulus elastisitas dan strain energy, tegangan-Regangan pada beberapa tipe material, tegangan-Regangan pada unidirectional/bidirectional lamina,	<ul style="list-style-type: none"> <li>• Mampu menjelaskan analisis makro-mekanikal lamina tentang tegangan, regangan, modulus elastisitas dan strain energy, tegangan-Regangan pada beberapa tipe material, tegangan-Regangan pada unidirectional/bidirectional lamina, menentukan Engineering constants (stiffness</li> </ul>	<ul style="list-style-type: none"> <li>• Contextual Teaching &amp; Learning</li> <li><i>Contextual Teaching &amp; Learning</i></li> <li>• Problem-based learning</li> <li><i>Problem-based learning</i></li> <li>• Diskusi &amp; Brainstorming</li> <li><i>Discussion &amp; Brainstorming</i></li> <li>• Latihan soal &amp; PR</li> <li><i>Practice problems &amp; homework</i></li> <li>• Tugas mandiri</li> </ul>		<ul style="list-style-type: none"> <li>• Analisis makro-mekanikal lamina</li> <li><i>Macro-mechanical analysis of lamina</i></li> <li>• Tegangan, regangan, modulus elastisitas dan strain energy</li> <li><i>Stress, strain, elastic modulus, and strain energy</i></li> <li>• Tegangan-Regangan pada beberapa tipe material</li> </ul>	



	<p>and compliance parameters) dari unidirectional/bidirectional lamina, hubungan tegangan-regangan, modulus elastisitas, kekuatan, thermal and moisture expansion coefficient pada ply dalam unidirectional/bidirectional lamina. <i>Students understand macro-mechanical analysis of lamina regarding stress, strain, elastic modulus, and strain energy, stress-strain behavior of various types of materials, stress-strain behavior in unidirectional/bidirectional lamina,</i></p>	<p>menentukan Engineering constants (stiffness and compliance parameters) dari unidirectional/bidirectional lamina, hubungan tegangan-regangan, modulus elastisitas, kekuatan, thermal and moisture expansion coefficient pada ply dalam unidirectional/bidirectional lamina. <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining analysis of lamina regarding stress, strain, elastic modulus, and strain energy, stress-strain behavior of various types of materials, stress-strain behavior in</i></p>	<p>and compliance parameters) dari unidirectional/bidirectional lamina, hubungan tegangan-regangan, modulus elastisitas, kekuatan, thermal and moisture expansion coefficient pada ply dalam unidirectional/bidirectional lamina <i>Able to explain macro-mechanical analysis of lamina regarding stress, strain, elastic modulus, and strain energy, stress-strain behavior of various types of materials, stress-strain behavior in unidirectional/bidirectional lamina, determining</i></p>	<p><i>Individual assignment</i></p> <ul style="list-style-type: none"> <li>• Review &amp; Summary <i>Review &amp; Summary</i></li> <li>• Oral Post-test (acak) <i>Oral Post-test (random)</i></li> <li>• [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</li> </ul>	<p><i>Stress-strain behavior of various types of materials</i></p> <ul style="list-style-type: none"> <li>• Tegangan-Regangan pada unidirectional/bidirectional lamina <i>Stress-strain behavior in unidirectional/bidirectional lamina</i></li> <li>• Menentukan Engineering constants (stiffness and compliance parameters) dari unidirectional/bidirectional lamina <i>Determining Engineering constants (stiffness and compliance parameters) of unidirectional/bidirectional lamina</i></li> <li>• Hubungan tegangan-regangan, modulus</li> </ul>	
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	<p>determining engineering constants (stiffness and compliance parameters) of unidirectional/bidirectional lamina, relationship between stress-strain, elastic modulus, strength, thermal and moisture expansion coefficient in ply within unidirectional/bidirectional lamina.</p>	<p>unidirectional/bidirectional lamina, determining engineering constants (stiffness and compliance parameters) of unidirectional/bidirectional lamina, relationship between stress-strain, elastic modulus, strength, thermal and moisture expansion coefficient in ply within unidirectional/bidirectional lamina.</p>	<p>engineering constants (stiffness and compliance parameters) of unidirectional/bidirectional lamina, relationship between stress-strain, elastic modulus, strength, thermal and moisture expansion coefficient in ply within unidirectional/bidirectional lamina.</p> <ul style="list-style-type: none"> <li>• Bentuk penilaian : tes dan non-tes</li> <li>Assesment model: test and non-test</li> </ul>			<p>elastisitas, kekuatan, thermal and moisture expansion coefficient pada ply dalam unidirectional/bidirectional lamina</p> <p>Relationship between stress-strain, elastic modulus, strength, thermal and moisture expansion coefficient in plies within unidirectional/bidirectional lamina</p> <ul style="list-style-type: none"> <li>• [1]:2; [2]:2; [3]:2, 4, 5</li> <li>• [Handout di myITS Classroom]</li> </ul>	
4	<p>Evaluasi 1 (EV-1) <i>Evaluation 1 (EV-1)</i> Mahasiswa memahami:</p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menjelaskan</p>	<ul style="list-style-type: none"> <li>• Mampu menjelaskan <i>Able to explain:</i> (1) material komposit,</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluasi tertulis (analisis/sintesis) <i>Written evaluation (analysis/synthesis)</i></li> <li>• Case study</li> </ul>		<ul style="list-style-type: none"> <li>• Pengenalan material komposit <i>Introduction to composite materials</i></li> </ul>	25 %



	<p><i>Students understand:</i>          (1) material komposit, keunggulan dan kekurangan material komposit, faktor-faktor yang mempengaruhi sifat mekanik komposit, klasifikasi komposit, tipe-tipe fiber dan matrik dalam komposit.  <i>(1) composite materials, the advantages and drawbacks of composite materials, factors influencing the mechanical properties of composites, classification of composites, types</i></p>	<p><i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining:</i>          (1) material komposit, keunggulan dan kekurangan material komposit, faktor-faktor yang mempengaruhi sifat mekanik komposit, klasifikasi komposit, tipe-tipe fiber dan matrik dalam komposit.  <i>(1) composite materials, the advantages and drawbacks of composite materials, factors influencing the mechanical properties of composites, classification of composites, types of fibers and matrix in composites</i>          (2) analisis makro-mekanikal lamina tentang tegangan,</p>	<p>keunggulan dan kekurangan material komposit, faktor-faktor yang mempengaruhi sifat mekanik komposit, klasifikasi komposit, tipe-tipe fiber dan matrik dalam komposit.  <i>(1) composite materials, the advantages and disadvantages of composite materials, factors influencing the mechanical properties of composites, classification of composites, types of fibers and matrix in composites</i>          (2) analisis makro-mekanikal lamina tentang tegangan,</p>	<p><i>Case study</i>          • Presentasi  <i>Presentation</i>          • Kognitif – Tugas  <i>Cognitive – Assignment</i>          • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</p>	<ul style="list-style-type: none"> <li>• Keunggulan dan kekurangan material komposit  <i>Advantages and drawbacks of composite materials</i></li> <li>• Faktor-faktor yang mempengaruhi sifat mekanik komposit  <i>Factors influencing mechanical properties of composite materials</i></li> <li>• Klasifikasi komposit  <i>Classification of composites</i></li> <li>• Tipe-tipe fiber dan matrik dalam komposit  <i>Types of fibers and matrix in composites</i></li> <li>• Analisis makro-mekanikal lamina</li> </ul>	
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	<p><i>of fibers and matrix in composites</i>          (2) analisis makro-mekanikal lamina tentang tegangan, regangan, modulus elastisitas dan strain energy, tegangan-Regangan pada beberapa tipe material, tegangan-Regangan pada unidirectional/bidirectional lamina, menentukan Engineering constants (stiffness and compliance parameters) dari unidirectional/bidirectional lamina, hubungan tegangan-regangan, modulus elastisitas, kekuatan, thermal and moisture expansion coefficient pada ply dalam unidirectional/bidirectional lamina.  <i>(2) macro-mechanical analysis of lamina regarding stress, strain, elastic modulus, and</i></p>	<p>regangan, modulus elastisitas dan strain energy, tegangan-Regangan pada beberapa tipe material, tegangan-Regangan pada unidirectional/bidirectional lamina, menentukan Engineering constants (stiffness and compliance parameters) dari unidirectional/bidirectional lamina, hubungan tegangan-regangan, modulus elastisitas, kekuatan, thermal and moisture expansion coefficient pada ply dalam unidirectional/bidirectional lamina.  <i>(2) macro-mechanical analysis of lamina regarding stress, strain, elastic modulus, and</i></p>	<p>regangan, modulus elastisitas dan strain energy, tegangan-Regangan pada beberapa tipe material, tegangan-Regangan pada unidirectional/bidirectional lamina, menentukan Engineering constants (stiffness and compliance parameters) dari unidirectional/bidirectional lamina, hubungan tegangan-regangan, modulus elastisitas, kekuatan, thermal and moisture expansion coefficient pada ply dalam unidirectional/bidirectional lamina.</p>			<p><i>Macro-mechanical analysis of lamina</i></p> <ul style="list-style-type: none"> <li>• Tegangan, regangan, modulus elastisitas dan strain energy  <i>Stress, strain, elastic modulus, and strain energy</i></li> <li>• Tegangan-Regangan pada beberapa tipe material  <i>Stress-strain behavior of various types of materials</i></li> <li>• Tegangan-Regangan pada unidirectional/bidirectional lamina  <i>Stress-strain behavior in unidirectional/bidirectional lamina</i></li> <li>• Menentukan Engineering constants (stiffness and compliance)</li> </ul>	
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	<p>coefficient pada ply dalam unidirectional/bidirectional lamina.</p> <p>(2) macro-mechanical analysis of lamina regarding stress, strain, elastic modulus, and strain energy, stress-strain behavior of various types of materials, stress-strain behavior in unidirectional/bidirectional lamina, determining Engineering constants (stiffness and compliance parameters) of unidirectional/bidirectional lamina, relationship between stress-strain, elastic modulus, strength, thermal and moisture expansion coefficient in ply within unidirectional/bidirectional lamina</p>	<p>strain energy, stress-strain behavior of various types of materials, stress-strain behavior in unidirectional/bidirectional lamina, determining Engineering constants (stiffness and compliance parameters) of unidirectional/bidirectional lamina, relationship between stress-strain, elastic modulus, strength, thermal and moisture expansion coefficient in ply within unidirectional/bidirectional lamina</p>	<p>(2) macro-mechanical analysis of lamina regarding stress, strain, elastic modulus, and strain energy, stress-strain behavior of various types of materials, stress-strain behavior in unidirectional/bidirectional lamina, determining Engineering constants (stiffness and compliance parameters) of unidirectional/bidirectional lamina, relationship between stress-strain, elastic modulus, strength, thermal and moisture expansion coefficient in ply within</p>			<p>parameters) dari unidirectional/bidirectional lamina</p> <p>Determining Engineering constants (stiffness and compliance parameters) of unidirectional/bidirectional lamina</p> <ul style="list-style-type: none"> <li>• Hubungan tegangan-regangan, modulus elastisitas, kekuatan, thermal and moisture expansion coefficient pada ply dalam unidirectional/bidirectional lamina</li> </ul> <p>Relationship between stress-strain, elastic modulus, strength, thermal and moisture expansion</p>	
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	<i>modulus, strength, thermal and moisture expansion coefficient in ply within unidirectional/bidirectional lamina</i>		<i>unidirectional/bidirectional lamina</i> <ul style="list-style-type: none"> <li>• Bentuk penilaian: tes dan non-tes</li> </ul> <i>Assesment model: test and non-test</i>			<i>coefficient in plies within unidirectional/bidirectional lamina</i> <ul style="list-style-type: none"> <li>• [1]:1-2; [2]:1-2; [3]:1, 2, 4, 5</li> <li>• [Handout di myITS Classroom]</li> </ul>
5 - 7	Mahasiswa memahami analisis mikro-mekanikal lamina tentang konsep fraksi volume dan fraksi berat fiber dan matrik, densitas dan void fraction dalam komposit, konstanta mekanik, konstanta higrotermal <i>Students understand micro-mechanical analysis of lamina regarding the concept of volume fraction and</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan analisis mikro-mekanikal lamina tentang konsep fraksi volume dan fraksi berat fiber dan matrik, densitas dan void fraction dalam komposit, konstanta mekanik, konstanta higrotermal <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining micro-mechanical analysis of lamina regarding the</i>	<ul style="list-style-type: none"> <li>• Mampu menjelaskan analisis mikro-mekanikal lamina tentang konsep fraksi volume dan fraksi berat fiber dan matrik, densitas dan void fraction dalam komposit, konstanta mekanik, konstanta higrotermal</li> </ul> <i>Able to explain micro-mechanical analysis of lamina regarding the concept of volume fraction and weight fraction of fiber and</i>	<ul style="list-style-type: none"> <li>• Contextual Teaching &amp; Learning</li> <li>• Problem-based learning</li> <li>• Diskusi &amp; Brainstorming</li> <li>• Latihan soal &amp; PR</li> <li>• Tugas mandiri</li> <li>• Review &amp; Summary</li> </ul>		<ul style="list-style-type: none"> <li>• Analisis mikro-mekanikal lamina</li> <li>• Konsep fraksi volume dan fraksi berat fiber dan matrik</li> <li>• Densitas dan void fraction dalam komposit</li> <li>• Konstanta mekanik</li> </ul>





	<i>weight fraction of fiber and matrix, density and void fraction in composites, mechanical constants, hygrothermal constants.</i>	<i>concept of volume fraction and weight fraction of fiber and matrix, density and void fraction in composites, mechanical constants, hygrothermal constants.</i>	<i>matrix, density and void fraction in composites, mechanical constants, hygrothermal constants.</i> • Bentuk penilaian: tes dan non-tes <i>Assesment model: test and non-test</i>	<i>Review &amp; Summary</i> • Oral Post-test (acak) <i>Oral Post-test (random)</i> • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		<i>Mechanical constant</i> • Konstanta higrotermal <i>Hygrothermal constant</i> • [1]:3; [2]:3; [3]:3, 6 • [Handout di myITS Classroom]	
8	Evaluasi 2 (EV-2) <i>Evaluation 2 (EV-2)</i> Mahasiswa memahami analisis mikro-mekanikal lamina tentang konsep fraksi volume dan fraksi berat fiber dan matrik, densitas dan void fraction dalam komposit, konstanta mekanik, konstanta higrotermal <i>Students understand micro-</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan analisis mikro-mekanikal lamina tentang konsep fraksi volume dan fraksi berat fiber dan matrik, densitas dan void fraction dalam komposit, konstanta mekanik, konstanta higrotermal <i>Completeness, clarity, accuracy (of material &amp;</i>	• Mampu menjelaskan analisis mikro-mekanikal lamina tentang konsep fraksi volume dan fraksi berat fiber dan matrik, densitas dan void fraction dalam komposit, konstanta mekanik, konstanta higrotermal <i>Able to explain micro-mechanical analysis of lamina regarding the</i>	• Evaluasi tertulis (analisis/sintesis) <i>Written evaluation (analysis/synthesis)</i> • Case study <i>Case study</i> • Presentasi <i>Presentation</i> • Kognitif – Kuis <i>Cognitive – Quiz</i> • [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]		• Analisis mikro-mekanikal lamina <i>Micro-mechanical analysis of lamina</i> • Konsep fraksi volume dan fraksi berat fiber dan matrik <i>Concept of volume fraction and weight fraction of fiber and matrix</i> • Densitas dan void fraction dalam komposit	25 %



	<p><i>mechanical analysis of lamina regarding the concept of volume fraction and weight fraction of fiber and matrix, density and void fraction in composites, mechanical constants, hygrothermal constants.</i></p>	<p><i>time), and originality in explaining micro-mechanical analysis of lamina regarding the concept of volume fraction and weight fraction of fiber and matrix, density and void fraction in composites, mechanical constants, hygrothermal constants.</i></p>	<p><i>concept of volume fraction and weight fraction of fiber and matrix, density and void fraction in composites, mechanical constants, hygrothermal constants.</i></p> <ul style="list-style-type: none"> <li>• Bentuk penilaian: tes dan non-tes</li> </ul> <p><i>Assesment model: test and non-test</i></p>			<p><i>Density and void fraction in composites</i></p> <ul style="list-style-type: none"> <li>• Konstanta mekanik <i>Mechanical constant</i></li> <li>• Konstanta higrotermal <i>Hygrothermal constant</i></li> <li>• [1]:3; [2]:3; [3]:3, 6</li> <li>• [Handout di myITS Classroom]</li> </ul>	
9 - 11	<p>Mahasiswa memahami analisis makro-mekanikal laminat tentang kode susunan laminat, hubungan beban mekanis dan higrotermal pada laminat terhadap tegangan dan regangan setiap lamina, kekakuan laminat berdasar</p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menjelaskan analisis makro-mekanikal laminat tentang kode susunan laminat, hubungan beban mekanis dan higrotermal pada laminat terhadap tegangan dan regangan setiap lamina, kekakuan</p>	<ul style="list-style-type: none"> <li>• Mampu menjelaskan analisis makro-mekanikal laminat tentang kode susunan laminat, hubungan beban mekanis dan higrotermal pada laminat terhadap tegangan dan regangan setiap lamina, kekakuan laminat berdasar</li> </ul>	<ul style="list-style-type: none"> <li>• Contextual Teaching &amp; Learning <i>Contextual Teaching &amp; Learning</i></li> <li>• Problem-based learning <i>Problem-based learning</i></li> <li>• Diskusi &amp; Brainstorming <i>Discussion &amp; Brainstorming</i></li> </ul>		<ul style="list-style-type: none"> <li>• Analisis makro-mekanikal laminat <i>Macro-mechanical analysis of laminate</i></li> <li>• Kode susunan laminat <i>Laminate layup code</i></li> <li>• Hubungan beban mekanis dan higrotermal pada</li> </ul>	



	<p>pada modulus elastisitas masing-masing susunan lamina, koefisien muai panas dan kelembaban (<i>thermal and moisture expansion coefficient</i>) dari laminat</p> <p><i>Students understand macro-mechanical analysis of laminate regarding laminate layup code, relationship between mechanical and hygrothermal loads on laminates with stress and strain in each lamina, laminate stiffness based on the elastic modulus of each lamina</i></p>	<p>laminat berdasar pada modulus elastisitas masing-masing susunan lamina, koefisien muai panas dan kelembaban (<i>thermal and moisture expansion coefficient</i>) dari laminat</p> <p><i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining macro-mechanical analysis of laminate regarding laminate layup code, relationship between mechanical and hygrothermal loads on laminates with stress and strain in each lamina, laminate stiffness based on the elastic modulus of each lamina arrangement, coefficient of thermal and moisture expansion of laminates.</i></p>	<p>pada modulus elastisitas masing-masing susunan lamina, koefisien muai panas dan kelembaban (<i>thermal and moisture expansion coefficient</i>) dari laminat</p> <p><i>Able to explain macro-mechanical analysis of laminate regarding laminate layup code, relationship between mechanical and hygrothermal loads on laminates with stress and strain in each lamina, laminate stiffness based on the elastic modulus of each lamina arrangement, coefficient of</i></p>	<ul style="list-style-type: none"> <li>• Latihan soal &amp; PR <i>Practice problems &amp; homework</i></li> <li>• Tugas mandiri <i>Individual assignment</i></li> <li>• Review &amp; Summary <i>Review &amp; Summary</i></li> <li>• Oral Post-test (acak) <i>Oral Post-test (random)</i></li> <li>• [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</li> </ul>	<p>laminat terhadap tegangan dan regangan setiap lamina</p> <p><i>Relationship between mechanical and hygrothermal loads on laminates with stress and strain in each lamina</i></p> <ul style="list-style-type: none"> <li>• Kekakuan laminat berdasar pada modulus elastisitas masing-masing susunan lamina <i>Laminate stiffness based on the elastic modulus of each lamina arrangement</i></li> <li>• Koefisien muai panas dan kelembaban (<i>thermal and moisture</i></li> </ul>	
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	<i>arrangement, coefficient of thermal and moisture expansion of laminates.</i>		<i>thermal and moisture expansion of laminates.</i> <ul style="list-style-type: none"> <li>• Bentuk penilaian: tes dan non-tes</li> </ul> <i>Assesment model: test and non-test</i>			<i>expansion coefficient) dari laminat</i> <i>Coefficient of thermal and moisture expansion of laminates</i> <ul style="list-style-type: none"> <li>• [1]:4; [2]:4; [3]:7</li> <li>• [Handout di myITS Classroom]</li> </ul>	
12	Evaluasi 3 (EV-3) <i>Evaluation 3 (EV-3)</i> Mahasiswa memahami analisis makro-mekanikal laminat tentang kode susunan laminat, hubungan beban mekanis dan higrotermal pada laminat terhadap tegangan dan regangan setiap lamina, kekakuan laminat berdasar pada modulus	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan analisis makro-mekanikal laminat tentang kode susunan laminat, hubungan beban mekanis dan higrotermal pada laminat terhadap tegangan dan regangan setiap lamina, kekakuan laminat berdasar pada modulus elastisitas masing-masing susunan	<ul style="list-style-type: none"> <li>• Mampu menjelaskan analisis makro-mekanikal laminat tentang kode susunan laminat, hubungan beban mekanis dan higrotermal pada laminat terhadap tegangan dan regangan setiap lamina, kekakuan laminat berdasar pada modulus elastisitas masing-</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluasi tertulis (analisis/sintesis) <i>Written evaluation (analysis/synthesis)</i></li> <li>• Case study <i>Case study</i></li> <li>• Presentasi <i>Presentation</i></li> <li>• Studi Kasus <i>Case Method</i></li> <li>• [TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</li> </ul>		<ul style="list-style-type: none"> <li>• Analisis makro-mekanikal laminat <i>Macro-mechanical analysis of laminate</i></li> <li>• Kode susunan laminat <i>Laminate layup code</i></li> <li>• Hubungan beban mekanis dan higrotermal pada laminat terhadap tegangan dan</li> </ul>	25 %



	<p>elastisitas masing-masing susunan lamina, koefisien muai panas dan kelembaban (<i>thermal and moisture expansion coefficient</i>) dari laminat.</p> <p><i>Students understand macro-mechanical analysis of laminate regarding laminate layup code, relationship between mechanical and hygrothermal loads on laminates with stress and strain in each lamina, laminate stiffness based on the elastic modulus of each lamina arrangement,</i></p>	<p>lamina, koefisien muai panas dan kelembaban (<i>thermal and moisture expansion coefficient</i>) dari laminat</p> <p><i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining macro-mechanical analysis of laminate regarding laminate layup code, relationship between mechanical and hygrothermal loads on laminates with stress and strain in each lamina, laminate stiffness based on the elastic modulus of each lamina arrangement, coefficient of thermal and moisture expansion of laminates</i></p>	<p>masing susunan lamina, koefisien muai panas dan kelembaban (<i>thermal and moisture expansion coefficient</i>) dari laminat</p> <p><i>Able to explain macro-mechanical analysis of laminate regarding laminate layup code, relationship between mechanical and hygrothermal loads on laminates with stress and strain in each lamina, laminate stiffness based on the elastic modulus of each lamina arrangement, coefficient of thermal and</i></p>			<p>regangan setiap lamina</p> <p><i>Relationship between mechanical and hygrothermal loads on laminates with stress and strain in each lamina</i></p> <ul style="list-style-type: none"> <li>• Kekakuan laminat berdasar pada modulus elastisitas masing-masing susunan lamina <i>Laminate stiffness based on the elastic modulus of each lamina arrangement</i></li> <li>• Koefisien muai panas dan kelembaban (<i>thermal and moisture expansion</i>)</li> </ul>	
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	<i>coefficient of thermal and moisture expansion of laminates.</i>		<i>moisture expansion of laminates.</i> <ul style="list-style-type: none"> <li>Bentuk penilaian: tes dan non-tes</li> </ul> <i>Assesment model: test and non-test</i>			coefficient) dari laminat <i>Coefficient of thermal and moisture expansion of laminates</i> <ul style="list-style-type: none"> <li>[1]:4; [2]:4; [3]:7</li> <li>[Handout di myITS Classroom]</li> </ul>	
13 - 15	Mahasiswa memahami kegagalan, analisis dan desain laminat, kriteria kegagalan laminat, merancang struktur laminat. <i>Students understand failure, analysis, and design of laminates, laminate failure criteria, designing laminate structures.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan kegagalan, analisis dan desain laminat, kriteria kegagalan laminat, merancang struktur laminat. <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining failure, analysis, and design of laminates, laminate failure criteria,</i>	<ul style="list-style-type: none"> <li>Mampu menjelaskan kegagalan, analisis dan desain laminat, kriteria kegagalan laminat, merancang struktur laminat.  <i>Able to explain failure, analysis, and design of laminates, laminate failure criteria, designing laminate structures</i></li> <li>Bentuk penilaian: tes dan non-tes</li> </ul>	<ul style="list-style-type: none"> <li>Contextual Teaching &amp; Learning  <i>Contextual Teaching &amp; Learning</i></li> <li>Problem-based learning  <i>Problem-based learning</i></li> <li>Diskusi &amp; Brainstorming  <i>Discussion &amp; Brainstorming</i></li> <li>Latihan soal &amp; PR  <i>Practice problems &amp; homework</i></li> <li>Tugas mandiri</li> </ul>		<ul style="list-style-type: none"> <li>Kegagalan, analisis dan desain laminat  <i>Failure, analysis, and design of laminates</i></li> <li>Kriteria kegagalan laminat  <i>Laminate failure criteria</i></li> <li>Merancang struktur laminat  <i>Designing laminate structures</i></li> <li>[1]:5; [2]:5-7; [3]:8-10</li> </ul>	



		<i>designing laminate structures.</i>	<i>Assesment model: test and non-test</i>	<i>Individual assignment</i> <ul style="list-style-type: none"> <li>Review &amp; Summary <i>Review &amp; Summary</i></li> <li>Oral Post-test (acak) <i>Oral Post-test (random)</i></li> <li>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</li> </ul>		<ul style="list-style-type: none"> <li>[Handout di myITS Classroom]</li> </ul>	
16	Evaluasi 4 (EV-4) <i>Evaluation 4 (EV-4)</i> Mahasiswa memahami kegagalan, analisis dan desain laminat, kriteria kegagalan laminat, merancang struktur laminat. <i>Students understand failure, analysis, and design of laminates, laminate failure criteria, designing laminate structures.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan kegagalan, analisis dan desain laminat, kriteria kegagalan laminat, merancang struktur laminat. <i>Completeness, clarity, accuracy (of material &amp; time), and originality in explaining failure, analysis, and design of laminates, laminate failure criteria, designing laminate structures.</i>	<ul style="list-style-type: none"> <li>Mampu menjelaskan kegagalan, analisis dan desain laminat, kriteria kegagalan laminat, merancang struktur laminat. <i>Able to explain failure, analysis, and design of laminates, laminate failure criteria, designing laminate structures</i></li> <li>Bentuk penilaian: tes dan non-tes <i>Assesment model: test and non-test</i></li> </ul>	<ul style="list-style-type: none"> <li>Evaluasi tertulis (analisis/sintesis) <i>Written evaluation (analysis/synthesis)</i></li> <li>Case study <i>Case study</i></li> <li>Presentasi <i>Presentation</i></li> <li>Hasil proyek <i>Team-based project</i></li> <li>[TM: 3x50"] - [PT: 3x60"] - [BM: 3x60"]</li> </ul>		<ul style="list-style-type: none"> <li>Kegagalan, analisis dan desain laminat <i>Failure, analysis, and design of laminates</i></li> <li>Kriteria kegagalan laminat <i>Laminate failure criteria</i></li> <li>Merancang struktur laminat <i>Designing laminate structures</i></li> <li>[1]:5; [2]:5-7; [3]:8-10</li> </ul>	25 %



						<ul style="list-style-type: none"><li>• [Handout di myITS Classroom]</li></ul>	
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		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b><i>SEMESTER LEARNING PLAN</i></b>						
<b>MATA KULIAH</b> <b><i>COURSE</i></b>	<b>KODE</b> <b><i>CODE</i></b>	<b>RUMPUN MK</b> <b><i>COURSE CLUSTER</i></b>	<b>BOBOT</b> <b>(SKS)</b> <b><i>CREDITS</i></b>		<b>SEMESTER</b> <b><i>SEMESTER</i></b>	<b>TGL</b> <b>PENYUSUNAN</b> <b><i>DATE</i></b>
MEKANIKA FLUIDA <i>FLUID MECHANICS</i>	TM235225	MEKANIKA DAN MESIN- MESIN FLUIDA <i>FLUID MECHANICS AND MACHINERY</i>	T= 3	P= 0	PILIHAN <i>ELECTIVE</i>	25 NOVEMBER 2023
<b>OTORISASI</b> <b><i>AUTHORIZATION</i></b>	<b>Pengembang RPS</b> <b><i>Developer of Semester Learning Plan</i></b>	<b>Koordinator RMK</b> <b><i>Course Cluster Coordinator</i></b>			<b>Ketua PRODI</b> <b><i>Head of Postgraduate Program</i></b>	
	Tri Yogi Yuwono	Tri Yogi Yuwono			Prof. Dr.Eng. Harus Laksana Guntur, S.T., M.Eng.	
<b>Capaian</b> <b>Pembelajaran</b> <b><i>Learning Outcomes</i></b>	<b>CPL-PRODI yang dibebankan pada MK</b> <b><i>PLO Charged to the Course</i></b>					
	CPL-2 <i>PLO-2</i>	Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi				



		<i>Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars</i>
CPL-4 PLO-4		Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth</i>
CPL-5 PLO-5		Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin <i>Able to understand and utilize the theory of engineering sciences in mechanical engineering</i>
CPL-8 PLO-8		Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik <i>Able to formulate new ideas from the previous research for the development of technology and mechanical systems</i>
<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>		
CPMK-1 CLO-1		Mampu memahami konsep dasar tentang mekanika fluida. <i>Able to understand the basic concepts of fluid mechanics.</i>
CPMK-2 CLO-2		Mampu menganalisis model matematika dan aplikasi yang berkaitan aliran dengan menerapkan persamaan-persamaan dasar dalam bentuk integral untuk volume atur. <i>Able to analyze mathematical models and applications related to flow by applying basic equations in integral form for control volumes.</i>
CPMK-3 CLO-3		Mampu menerapkan persamaan-persamaan dasar dalam bentuk diferensial dalam aplikasi gerakan fluida secara detail, khususnya persamaan konservasi massa dan Navier-Stokes. <i>Able to apply basic equations in differential form in detailed fluid motion applications, particularly the equations of mass conservation and Navier-Stokes.</i>
CPMK-4 CLO-4		Mampu menganalisis model matematika dan aplikasinya yang berkaitan dengan penerapan persamaan Euler untuk fluida inviscid. <i>Able to analyze mathematical models and applications related to the application of Euler equations for inviscid fluids.</i>
CPMK-5 CLO-5		Mampu menganalisis model matematika dan aplikasi aliran internal incompressibel. <i>Able to analyze mathematical models and applications of incompressible internal flow.</i>
CPMK-6 CLO-6		Mampu menganalisis model matematika dan aplikasi aliran external incompressibel. <i>Able to analyze mathematical models and applications of incompressible external flow.</i>



		<b>Matrik CPL – CPMK</b> <b>PLO – CLO Matrix</b>				
		CPMK CLO	CPL-2 PLO-2	CPL-4 PLO-4	CPL-5 PLO-5	CPL-8 PLO-8
		CPMK-1 CLO-1	V	V	V	V
		CPMK-2 CLO-2	V	V	V	V
		CPMK-3 CLO-3	V	V	V	V
		CPMK-4 CLO-4	V	V	V	V
		CPMK-5 CLO-5	V	V	V	V
		CPMK-6 CLO-6	V	V	V	V
<b>Deskripsi Singkat MK</b> <b>Short Description of Course</b>	<p>Mata kuliah ini mempelajari sifat dan perilaku fluida yang berinteraksi dengan wadahnya, baik dalam kondisi diam maupun bergerak. Mata kuliah ini memegang peranan penting dalam bidang rekayasa keteknikan, khususnya teknik mesin. Secara keseluruhan mata kuliah ini menyajikan dasar-dasar teoritis dan analisis perhitungan yang komprehensif meliputi kinematika fluida, dinamika fluida, serta penerapannya untuk aliran inkompresibel internal maupun eksternal.</p> <p><i>This course studies the properties and behavior of fluids interacting with their containers, both in static and dynamic conditions. It plays a significant role in engineering, especially Mechanical Engineering. Overall, the course presents comprehensive theoretical fundamentals and computational analysis covering fluid kinematics, fluid dynamics, and their applications for both internal and external incompressible flows.</i></p>					



<p><b>Bahan Kajian Materi Pembelajaran Course Materials</b></p>	<ul style="list-style-type: none"> <li>- Review tentang definisi fluida, lingkup mekanika fluida, konsep fundamental, dan statika fluida. <i>Review about the definition of fluids, the scope of fluid mechanics, fundamental concepts, and fluid statics.</i></li> <li>- Pengembangan dan aplikasi bentuk-bentuk dari lima persamaan dasar dalam bentuk integral untuk volume atur yang meliputi persamaan konservasi massa, momentum linear, momentum angular, kekekalan energi, dan entropi. <i>Development and application of the five basic equations in integral form for control volumes, including the equations of mass conservation, linear momentum, angular momentum, energy conservation, and entropy.</i></li> <li>- Pengembangan dan aplikasi bentuk-bentuk dari lima persamaan dasar dalam bentuk diferensial yang meliputi persamaan konservasi massa, momentum linear, momentum angular, kekekalan energi, dan entropi. <i>Development and application of the five basic equations in differential form, including the equations of mass conservation, linear momentum, angular momentum, energy conservation, and entropy.</i></li> <li>- Pengembangan dan aplikasi Euler untuk fluida inviscid. <i>Development and application of Euler's equations for inviscid fluids.</i></li> <li>- Pengembangan dan aplikasi aliran internal incompressible. <i>Development and application of incompressible internal flow.</i></li> <li>- Pengembangan dan aplikasi aliran external incompressible. <i>Development and application of incompressible external flow.</i></li> </ul>	
<p><b>Pustaka References</b></p>	<p><b>Utama Main</b></p>	
	<p>1. John W. Mitchell, Fox and Alan T. McDonald, Introduction to Fluid Mechanics, 10<sup>th</sup> Edition, John Wiley &amp; Sons Inc., New York, 2020.</p>	
	<p><b>Pendukung Supporting</b></p>	<p>2. Irving Herman Shames, Mechanics of Fluid, 4<sup>th</sup> edition, McGraw-Hill, New York, 2002.            3. Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, Alric P. Rothmayer, Fundamentals of Fluid Mechanics, 9<sup>th</sup> edition, John Wiley &amp; Sons Inc., New York, 2016.            4. Frank M. White, Fluid mechanics, 9<sup>th</sup> edition, McGraw-Hill, New York, 2020.</p>
<p><b>Dosen Pengampu Lecturers</b></p>	<p>Tri Yogi Yuwono</p>	



<b>Mata Kuliah</b>		Mekanika Fluida Dasar di tahap Sarjana <i>Basic Fluid Mechanics in the Undergraduate Program</i>					
<b>Syarat Prerequisites</b>							
<b>Mg Ke-Week</b>	<b>Kemampuan akhir tiap tahapan belajar (Sub-CPMK) Final ability of each learning stage (LLO)</b>	<b>Penilaian Assessment</b>		<b>Bantuan Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu] Form of Learning, Learning Method, Student Assignment [Time Estimation]</b>		<b>Materi Pembelajaran [Pustaka] Learning Material [Reference]</b>	<b>Bobot Penilaian (%) Assessment Load (%)</b>
		<b>Indikator Indicator</b>	<b>Kriteria &amp; Bentuk Criteria &amp; Model</b>	<b>Luring Offline</b>	<b>Daring Online</b>		
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>	<b>(7)</b>	<b>(8)</b>
<b>1-2</b>	Mahasiswa mampu memahami definisi fluida, lingkup mekanika fluida, persamaan dasar, metode analisis, konsep dasar mekanika fluida, medan kecepatan, medan tegangan, viskositas, deskripsi gerakan fluida.	Mampu memahami fenomena mekanika fluida yang terkait dengan lingkup, persamaan dasar, metode menganalisis, konsep dasar mekanika fluida, medan kecepatan, medan tegangan, viskositas, deskripsi gerakan fluida.	Diskusi <i>Discussion</i>	- Menyajikan video tentang aplikasi fenomena mekanika fluida dalam kehidupan di sekitar kita, misal: Failure of Tacoma Narrow Bridges, mobil	-	- Definisi dan ruang lingkup mekanika fluida, persamaan dasar, metode analisa <i>Definition and scope of fluid mechanics, basic equations, analysis methods</i> - Konsep-konsep dasar mekanika	5



	<p><i>Students are able to understand the definition of fluids, the scope of fluid mechanics, basic equations, analysis methods, fundamental concept of fluid mechanics, velocity fields, stress fields, viscosity, and fluid motion description.</i></p>	<p><i>Able to understand fluid mechanics phenomena related to scope, basic equations, analysis methods, fundamental concept of fluid mechanics, velocity fields, stress fields, viscosity, and fluid motion description.</i></p>		<p>formula-1, balap sepeda, puting beliung, dsb. Presenting videos about the application of fluid mechanics phenomena in our surroundings, such as: Failure of Tacoma Narrows Bridge, Formula-1 cars, bicycle racing, tornadoes, etc.</p> <p>- Kuliah pengantar &amp; brainstorming</p>		<p>fluida: fluida sebagai suatu kontinum</p> <p><i>Fundamental concept of fluid mechanics: fluid as a continuum</i></p> <ul style="list-style-type: none"> <li>- Medan kecepatan, medan tegangan, viskositas, tegangan permukaan</li> <li><i>Velocity field, stress field, viscosity, surface tension</i></li> <li>- Deskripsi dan klasifikasi gerakan fluida</li> <li><i>Description and classification of fluid motion</i></li> </ul> <p><b>[1: Fox dkk, Bab 1]</b></p>	
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				<i>Introductory lecture &amp; brainstorming</i> - Latihan soal <i>Practice problems</i>  [TM: 2x(3x50'')]			
<b>3-4</b>	<p>Mahasiswa mampu menggunakan persamaan dasar dalam bentuk integral untuk volume atur untuk menyelesaikan problem kekekalan massa, persamaan momentum untuk seluruh kondisi control volume, untuk menganalisis problem mekanika fluida terkait volume atur.</p> <p><i>Students are able to use basic equations in integral form for control volumes to</i></p>	<p>Mampu menggunakan lima persamaan dasar untuk diubah menjadi persamaan transportasi Reynolds, dan menggunakan persamaan konservasi massa dan persamaan momentum baik untuk control volume diam, bergerak dengan kecepatan konstan, bergerak dengan percepatan konstan maupun bergerak dengan percepatan yang tidak konstan untuk menganalisis problem mekanika fluida terkait volume atur.</p>	<p>Diskusi <i>Discussion</i> Tugas <i>Assignment</i></p>	<p>- Kuliah tatap muka <i>Face-to-face lecture</i> - Latihan soal <i>Practice problems</i>  [TM: 2x(3x50'')]</p>		<p>Persamaan-persamaan dasar dalam bentuk integral untuk sebuah volume atur: Persamaan konservasi massa, persamaan momentum untuk control volume: diam, bergerak dengan kecepatan konstan, bergerak dengan percepatan konstan <i>Basic equations in integral form for control volumes: Equation of mass conservation and equation of momentum for control volumes: stationary, moving with</i></p>	<b>10</b>



	<i>solve problems of mass conservation, momentum equations for all control volume conditions, to analyze fluid mechanics problems related to control volumes.</i>	<i>Able to use the five basic equations to be transformed into Reynolds transport equations, and use the equations of mass conservation and momentum for stationary, moving with constant velocity, moving with constant acceleration, and moving with non-constant acceleration control volumes, to analyze fluid mechanics problems related to control volumes.</i>				<i>constant velocity, moving with constant acceleration</i>  <b>[1: Fox dkk, Bab 4]</b>	
<b>5</b>	<b>Evaluasi 1 (Quis I)</b> <b>Evaluation 1 (Quiz 1)</b>						<b>10</b>
<b>6-7</b>	Mahasiswa mampu menggunakan persamaan dasar dalam bentuk integral untuk volume atur untuk menyelesaikan problem kekekalan	Mampu menggunakan lima persamaan dasar untuk diubah menjadi persamaan transportasi Reynolds, dan menggunakan persamaan moment of momentum untuk	Diskusi <i>Discussion</i> Tugas <i>Assignment</i>	- Kuliah tatap muka <i>Face-to-face lecture</i> - Latihan soal <i>Practice problems</i>		Persamaan-persamaan dasar dalam bentuk integral untuk sebuah volume atur: <i>Basic equations in integral form for control volumes:</i>	<b>10</b>





	<p>massa, persamaan moment of momentum untuk seluruh kondisi control volume, persamaan energi dan persamaan hukum termodinamika II tentang entropi untuk menganalisis problem mekanika fluida terkait volume atur.</p> <p><i>Students are able to use basic equations in integral form for control volumes to solve problems of mass conservation, moment of momentum equations for all control volume conditions, energy equation, and the second law of thermodynamics</i></p>	<p>control volume diam, bergerak dengan kecepatan konstan, persamaan hukum termodinamika I tentang energi dan persamaan hukum termodinamika II tentang entropi, untuk menganalisis problem mekanika fluida terkait volume atur.</p> <p><i>Able to use the five basic equations to be transformed into Reynolds transport equations, and use the equations of moment of momentum for stationary control volumes, moving with constant velocity, the first law of thermodynamics regarding energy, and the second law of thermodynamics regarding entropy to</i></p>		<p>[TM: 2x(3x50'')]</p>		<ul style="list-style-type: none"> <li>- Persamaan moment of momentum control volume: diam, bergerak dengan kecepatan konstan. <i>Equation of moment of momentum for control volumes: stationary, moving with constant velocity</i></li> <li>- Persamaan hukum termodinamika I dan II <i>The first and second law of thermodynamics</i></li> </ul> <p>[1: Fox dkk, Bab 4]</p>	
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	<i>regarding entropy to analyze fluid mechanics problems related to control volumes.</i>	<i>analyze fluid mechanics problems related to control volumes.</i>					
<b>8</b>	<b>Evaluasi Tengah Semester / Ujian Tengah Semester Midterm Exam</b>						<b>10</b>
<b>9</b>	<p>Mahasiswa mampu mendalami tentang: <i>Students are capable of delving into</i></p> <ul style="list-style-type: none"> <li>- Penerapan ilmu mekanika fluida dalam inovasi maupun pengembangan riset <i>The application of fluid mechanics in innovation and research development</i></li> <li>- Tata tulis ilmiah dalam jurnal ilmiah</li> </ul>	<p>Mampu melakukan review jurnal ilmiah dengan cara: <i>Capable of conducting a review of scientific journals by:</i></p> <ul style="list-style-type: none"> <li>- Menyerap dan menyampaikan ide paper dalam jurnal ilmiah <i>Absorbing and conveying paper ideas from scientific journals</i></li> <li>- Melakukan kritik dan peluang pengembangan riset ke depan dalam topik terkait <i>Providing critiques and opportunities for</i></li> </ul>	<p>Hasil review jurnal ilmiah untuk topik tentang mekanika fluida <i>The results of reviewing scientific journals regarding fluid mechanics</i></p>	<ul style="list-style-type: none"> <li>- Presentasi hasil review jurnal <i>Presentation of journal review results</i></li> </ul> <p><b>[TM: 1x(3x50'')]</b></p>		<p>Tugas: <i>Assignment:</i> Review paper tentang mekanika fluida dalam jurnal internasional terindex <i>Review on fluid mechanics paper in indexed international journal</i></p>	<b>5</b>



	<i>Scientific writing in scientific journals</i>	<i>future research development in related topics</i>					
<b>10-11</b>	<p>Mahasiswa mampu mengubah persamaan-persamaan dasar mekanika fluida dalam bentuk integral untuk control volume menjadi persamaan diferensial dan menarapkan untuk menyelesaikan persoalan mekanika fluida</p> <p><i>Students are able to convert basic fluid mechanics equations in integral form for control volumes into differential equations and apply them to solve fluid mechanics problems.</i></p>	<p>Mampu menerapkan kelima persamaan dasar mekanika fluida: konservasi masa, persamaan momentum, persamaan moment of momentum, persamaan hukum termodinamika-I dan II untuk menyelesaikan persoalan-persoalan mekanika fluida</p> <p><i>Able to use the five basic equations of fluid mechanics: mass conservation, momentum equation, moment of momentum equation, the first and second law of thermodynamics to analyze fluid mechanics problems</i></p>	<p>Diskusi <i>Discussion</i> Tugas <i>Assignment</i></p>	<p>- Kuliah tatap muka <i>Face-to-face lecture</i> - Latihan soal <i>Practice problems</i></p> <p><b>[TM: 2x(3x50'')]</b></p>	<p>Persamaan-persamaan dasar dalam bentuk diferensial yang meliputi: <i>Basic equations in differential form which includes:</i></p> <ul style="list-style-type: none"> <li>- konservasi massa <i>mass conservation</i></li> <li>- momentum (Navier-Stokes) <i>momentum (Navier-Stokes)</i></li> <li>- moment of momentum <i>moment of momentum</i></li> <li>- hukum termodinamika I <i>the first law of thermodynamics</i></li> <li>- hukum termodinamika II <i>the second law of thermodynamics</i></li> </ul>	<b>10</b>	



						[1: Fox dkk, Bab 4]	
12	<p>Mahasiswa mampu menggunakan persamaan aliran inviscid incompressible untuk menyelesaikan persoalan-persoalan mekanika fluida</p> <p><i>Students are able to use the equations of inviscid incompressible flow to solve fluid mechanics problems</i></p>	<p>Mampu memahami dan menerapkan persamaan aliran inviscid incompressible:</p> <p><i>Able to understand and apply the equations of inviscid incompressible flow:</i></p> <ul style="list-style-type: none"> <li>- Persamaan Euler Euler's equation</li> <li>- Persamaan Bernoulli Bernoulli's equation</li> </ul>	<p>Diskusi Discussion Tugas Assignment</p>	<ul style="list-style-type: none"> <li>- Kuliah tatap muka <i>Face-to-face lecture</i></li> <li>- Latihan soal <i>Practice problems</i></li> </ul> <p>[TM: 1x(3x50'')]</p>		<p>Persamaan aliran inviscid incompressible:</p> <p><i>Equations of inviscid incompressible flow:</i></p> <ul style="list-style-type: none"> <li>- Persamaan Euler Euler's equation</li> <li>- Persamaan Bernoulli Bernoulli's equation</li> <li>- Energy, hydraulic grade line <i>Energy, hydraulic grade line</i></li> </ul> <p>[1: Fox dkk, Bab 4]</p>	5
13	<p>Mahasiswa mampu menggunakan persamaan aliran internal viscous incompressible untuk menyelesaikan persoalan-persoalan mekanika fluida</p> <p><i>Students are able to use the equations of internal viscous</i></p>	<p>Mampu memahami dan menerapkan persamaan aliran internal viscous incompressible:</p> <p><i>Able to understand and apply the equations of internal viscous incompressible flow:</i></p> <ul style="list-style-type: none"> <li>- Aliran melalui plat paralel</li> </ul>	<p>Diskusi Discussion Tugas Assignment</p>	<ul style="list-style-type: none"> <li>- Kuliah tatap muka <i>Face-to-face lecture</i></li> <li>- Latihan soal <i>Practice problems</i></li> </ul> <p>[TM: 1x(3x50'')]</p>		<p>Persamaan aliran internal viscous incompressible:</p> <p><i>Equations of internal viscous incompressible flow:</i></p> <ul style="list-style-type: none"> <li>- Aliran melalui plat paralel, baik keduanya diam maupun salah satu bergerak</li> </ul>	5




	<i>incompressible flow to solve fluid mechanics problems</i>	<i>Flow through parallel plates</i> - Aliran melalui pipa <i>Flow through pipe</i>				<i>Flow through parallel plates, both stationary and with one moving</i> - Aliran melalui pipa <i>Flow through pipe</i>  <b>[1: Fox dkk, Bab 4]</b>	
<b>14</b>	<b>Evaluasi 4 (Quis II)</b> <b>Evaluation 4 (Quiz II)</b>						<b>10</b>
<b>15</b>	Mahasiswa mampu menggunakan persamaan aliran viscous external incompressible untuk menyelesaikan persoalan-persoalan mekanika fluida <i>Students are able to use the equations of external viscous incompressible flow to solve fluid mechanics problems</i>	Mampu menggunakan persamaan aliran viscous external incompressible untuk menyelesaikan persoalan-persoalan mekanika fluida: <i>Able to apply the equations of external viscous incompressible flow to solve fluid mechanics problems:</i> - Tebal boundary layer aliran melintasi plat datar, maupun body dengan gradien tekanan <i>Boundary layer thickness in flow past</i>	Diskusi <i>Discussion</i> Tugas <i>Assignment</i>	- Kuliah tatap muka <i>Face-to-face lecture</i> - Latihan soal <i>Practice problems</i>  <b>[TM: 1x(3x50")]</b>		Persamaan aliran external viscous incompressible: <i>Equations of external viscous incompressible flow:</i> - Konsep boundary layer <i>The concept of boundary layer</i> - Aliran melalui plat datar (tanpa gradien tekanan) <i>Flow through flat plates (withut pressure gradient)</i>	<b>10</b>



		<p><i>flat plates, as well as bodies with pressure gradients.</i></p> <ul style="list-style-type: none"><li>- Aliran tentang body tercelup (gaya lift dan drag) <i>Flow around submerged bodies (lift and drag forces)</i></li></ul>				<ul style="list-style-type: none"><li>- Aliran melalui body dengan gradien tekanan <i>Flow through bodies with pressure gradient</i></li><li>- Aliran tentang body tercelup (gaya lift dan drag) <i>Flow around submerged bodies (lift and drag forces)</i></li></ul> <p>[1: Fox dkk, Bab 4]</p>	
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>Final Exam</i>						10



		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b>SEMESTER LEARNING PLAN</b>						
MATA KULIAH COURSE	KODE CODE	RUMPUN MK COURSE CLUSTER	BOBOT (SKS) CREDITS		SEMESTER SEMESTER	TGL PENYUSUNAN DATE
OPTIMASI PROSES PROCESS OPTIMIZATION	TM235329	REKAYASA PRODUKSI PRODUCTION ENGINEERING	T=3	P=0	PILIHAN ELECTIVE	26 NOVEMBER 2023
OTORISASI AUTHORIZATION	Pengembang RPS Developer of Semester Learning Plan	Koordinator RMK Course Cluster Coordinator		Ketua PRODI Head of Postgraduate Program		
	M. Khoirul Effendi	Arif Wahjudi		Prof. Dr.Eng. Harus Laksana Guntur, S.T., M.Eng.		
Capaian Pembelajaran Learning Outcomes	CPL-PRODI yang dibebankan pada MK PLO Charged to the Course					
	CPL-5 PLO-5	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin Able to understand and utilize the theory of engineering sciences in mechanical engineering				
	CPL-6 PLO-6	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields				



	CPL-7 PLO-7	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin <i>Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach</i>												
<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>														
CPMK-1 CLO-1	Mahasiswa mampu mengidentifikasi, merumuskan, menganalisis serta menyelesaikan persoalan optimasi pada bidang teknik menggunakan software komputasi <i>Students are able to identify, formulate, analyze, and solve optimization problems in engineering using computational software</i>													
CPMK-2 CLO-2	Mahasiswa mampu memahami dan menggunakan software komputasi (MATLAB) untuk menyelesaikan permasalahan optimasi menggunakan neural network dan Genetic Algorithm <i>Students are able to understand and utilize computational software (MATLAB) to solve optimization problems using neural networks and Genetic Algorithms</i>													
CPMK-3 CLO-3	Mahasiswa mampu memahami dan menggunakan software komputasi (MATLAB) untuk menyelesaikan permasalahan optimasi menggunakan neural network dan partikel swarm optimization <i>Students are able to understand and utilize computational software (MATLAB) to solve optimization problems using neural networks and Particle Swarm Optimization</i>													
CPMK-4 CLO-4	Mahasiswa mampu menampilkan komparasi hasil optimasi menggunakan graphical user interface <i>Students are able to display comparisons of optimization results using a graphical user interface</i>													
	<b>Matrik CPL – CPMK PLO – CLO Matrix</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">CPMK CLO</th> <th style="width: 25%;">CPL-5 PLO-5</th> <th style="width: 25%;">CPL-6 PLO-6</th> <th style="width: 25%;">CPL-7 PLO-7</th> </tr> </thead> <tbody> <tr> <td>CPMK-1 CLO-1</td> <td style="text-align: center;">V</td> <td style="text-align: center;">V</td> <td style="text-align: center;">V</td> </tr> <tr> <td>CPMK-2</td> <td style="text-align: center;">V</td> <td style="text-align: center;">V</td> <td></td> </tr> </tbody> </table>		CPMK CLO	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7	CPMK-1 CLO-1	V	V	V	CPMK-2	V	V	
CPMK CLO	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7											
CPMK-1 CLO-1	V	V	V											
CPMK-2	V	V												





		CLO-2			
		CPMK-3 CLO-3	V	V	
		CPMK-4 CLO-4	V	V	
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	<p>Mata kuliah ini memberikan dasar-dasar tool optimasi metaheuristic untuk melakukan optimasi yang berkaitan dengan keilmuan yang diajarkan di teknik mesin ITS seperti optimasi desain, optimasi proses manufaktur, optimasi parameter PID dalam proses control, dll.</p> <p><i>This course provides the basics of metaheuristic optimization tools for optimizing various aspects related to mechanical engineering at ITS, such as design optimization, manufacturing process optimization, PID parameter optimization in control processes, etc.</i></p>				
<b>Bahan Kajian Materi Pembelajaran</b> <i>Course Materials</i>	<p>Dasar-dasar penggunaan software MATLAB, Neural network, metode optimasi metaheuristic (<i>genetic algoritma dan particle swarm optimization</i>) dan penggunaan graphical user interface untuk komparasi hasil optimasi</p> <p><i>The basics of using MATLAB software, Neural Networks, metaheuristic optimization methods (such as Genetic Algorithms and Particle Swarm Optimization), and the utilization of graphical user interfaces for comparing optimization results</i></p>				
<b>Pustaka References</b>	<b>Utama Main</b>				
		<p>9. Martin T. Hagan, dkk., "Neural network Design 2<sup>nd</sup> Edition", Hagan and Demuth, 2014.</p> <p>10. Mark Hudson Beale, dkk., "Neural Network Toolbox User's Guide R2017a" The Matworks, Inc., 2017.</p> <p>11. S.R. Otto and J.P Denier, "An introduction to Programming and Numerical Methods in MATLAB", Springer, 2005.</p> <p>12. Andrew Chipperfield, dkk., "Genetic Algorithm Toolbox for Use with MATLAB"</p> <p>13. Mark A. Abramson, "Genetic Algorithm and Direct Search Toolbox", The Mathwork, 2004.</p> <p>14. Xin-She Yang, "Nature-Inspired Optimization Algorithm", Elsevier, 2014.</p>			
	<b>Pendukung Supporting</b>	<p>15. Chehour, A. Dkk, "A Constraint-Handling Technique for Genetic Algorithms using a Violation Factor" Journal of computer science, 2016, 12 (7)</p>			



<b>Dosen Pengampu</b> <i>Lecturers</i>		Mohammad Khoirul Effendi					
<b>Mata Kuliah</b> <b>Syarat</b> <i>Prerequisites</i>		-					
Mg Ke- Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assessment</i>		Bantuk Pembelajaran, Metode Pembelajaran, PenugasanMahasiswa, <i>[Estimasi Waktu]</i> <i>Form of Learning, Learning Method, Student Assignment</i> <i>[Time Estimation]</i>		Materi Pembelajaran <i>[Pustaka]</i> <i>Learning Material</i> <i>[Reference]</i>	Bobot Penilaian (%) <i>Assessment Load (%)</i>
		Indikator <i>Indicator</i>	Kriteria & Bentuk <i>Criteria &amp; Model</i>	Luring <i>Offline</i>	Daring <i>Online</i>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami implementasi AI dan optimasi dalam bidang teknik mesin <i>Students are able to understand the implementation of AI and optimization in the field of mechanical engineering</i>	Bisa menjelaskan contoh-contoh implementasi AI dan optimasi di bidang teknik mesin <i>Able to explain examples of AI and optimization implementations in the field of mechanical engineering</i>	Tugas: Mencari dan mempresentasikan implementasi AI dan optimasi di bidang teknik mesin <i>Assignment: Searching for and presenting implementations of AI and optimization in the</i>	Perkuliahan <i>Lecture</i> <i>[TM: 3x50"]</i> Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i>		Kontrak kuliah <i>Course contract</i> Kuliah Pengantar & Brainstorming <i>Introductory lecture &amp; Brainstorming</i> - Intro AI dan optimasi metaheuristik <i>Introduction to AI and metaheuristic optimization</i>	



			<i>field of mechanical engineering</i>			<ul style="list-style-type: none"> <li>- Implementasi AI dan optimasi metaheuristic dalam bidang teknik mesin <i>Implementation of AI and metaheuristic optimization in the field of mechanical engineering</i></li> </ul> <p><b>[1: Martin T. Hagan – BAB 1]</b></p>	
<b>2</b>	<p>Mahasiswa mampu memahami dasar-dasar mengoperasikan MATLAB <i>Students are able to understand the basics of operating MATLAB</i></p>	<p>Mahasiswa mampu mengoperasikan tool-tool pada MATLAB termasuk Graphical User interface (GUI) untuk menyelesaikan kasus optimasi sederhana <i>Students are able to operate MATLAB tools, including Graphical User Interface (GUI), to solve simple optimization cases</i></p>	<p>Tugas: Mempresentasikan penggunaan fitur MATLAB serta Graphical User interface (GUI) untuk menyelesaikan kasus sederhana <i>Assignment: Presenting the use of MATLAB features and Graphical User Interface (GUI) to solve simple cases</i></p>	<p>Perkuliahan <i>Lecture [TM: 3x50”]</i> Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i></p>		<ul style="list-style-type: none"> <li>- Retooling dasar-dasar MATLAB <i>Basic MATLAB retooling</i></li> <li>- Graphical User Interface with MATLAB <i>Graphical User Interface with MATLAB</i></li> </ul> <p><b>[2: S.R. Otto and J.P Denier – BAB 2&amp;3]</b></p>	1%



3	Mahasiswa mampu memahami parameter dalam NN (activation function, hopfield network) <i>Students are able to understand the parameters in NN (activation function, Hopfield network)</i>	Mahasiswa mengerti berbagai macam fungsi aktivasi pada NN (purelin, hardlim, tansig dll) dan implementasi Hopfield network <i>Students understand various activation functions in NN (purelin, hardlim, tansig, etc.) and the implementation of Hopfield network</i>	Tugas: Mempresentasikan penggunaan toolbox Hopfield untuk mengidentifikasi huruf dan menganalisa pengaruh noise pada proses training dan testing <i>Assignment: Presenting the use of the Hopfield toolbox to identify letters and analyze the influence of noise on the training and testing processes</i>	Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning Cooperative Learning		Parameter dalam NN (activation function, hopfield network) <i>Parameters in NN (activation function, Hopfield network)</i>  [1: Martin T. Hagan – BAB 2] [2: Mark Hudson Beale – BAB 1]	1%
4	Mahasiswa mampu memahami prinsip dasar single perceptron dan implementasinya untuk kasus clustering <i>Students are able to understand the basic principles of single perceptron and its</i>	Mahasiswa mengerti dan bisa mengimplementasikan single perceptron untuk kasus clustering 2 buah data sederhana <i>Students understand and able to implement single perceptron for case of clustering two simple data sets</i>	Tugas: Mempresentasikan penggunaan coding single perceptron untuk kasus clustering dan menjawab beberapa pertanyaan berikut: <i>Assignment: Presenting the use of single perceptron coding for clustering</i>	Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning Cooperative Learning		Single perceptron dan implementasinya untuk kasus clustering <i>Single perceptron and its implementation for clustering cases</i>  [1: Martin T. Hagan – BAB 4] [2: Mark Hudson Beale – BAB 1]	1%



	<i>implementation for clustering cases</i>		<i>cases and answering the following questions:</i> d. Berapa epoch sampai berhenti <i>How many epochs until stopping</i> e. Pengaruh fungsi aktivasi terhadap konvergensi. <i>The effect of activation function on convergence</i> f. Perubahan nilai weight dan bias untuk 3x epoch pertama <i>Changes in weight and bias values for the first 3 epochs</i>				
5	Mahasiswa mampu memahami prinsip dasar multi layer perceptron dan implementasinya untuk kasus clustering	Mahasiswa mampu memahami prinsip dasar multi layer perceptron untuk kasus yang lebih kompleks seperti clustering logika XOR <i>Students are able to understand the basic</i>	Tugas : Mempresentasikan penggunaan multi-layer perceptron untuk clustering kasus XOR <i>Assignment: Presenting the use of multi-layer perceptron</i>	Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning <i>Self-Directed Learning</i>		Multi layer perceptron dan implementasinya untuk kasus clustering <i>Multi layer perceptron and its implementation for clustering cases</i>	1%



	<i>Students are able to understand the basic principles of multi-layer perceptron and its implementation for clustering cases</i>	<i>principles of multi-layer perceptron for more complex cases such as XOR logic clustering</i>	<i>for XOR clustering cases</i>	Cooperative Learning Cooperative Learning		<b>[1: Martin T. Hagan – BAB 4]</b> <b>[2: Mark Hudson Beale – BAB 3]</b>	
<b>6</b>	Mahasiswa mampu memahami Implementasi NN MATLAB toolbox <i>Students are able to understand the implementation of NN MATLAB toolbox</i>	Mahasiswa mampu memahami Implementasi NN MATLAB toolbox untuk menyelesaikan sebuah kasus sederhana dan bisa menjelaskan beberapa parameter berikut: <i>Students are able to understand the implementation of the NN MATLAB toolbox to solve a simple case and able to explain several parameters including:</i> a. Memasukkan input-output <i>Entering input-output</i> b. Mengubah persentase data	Tugas : Mempresentasikan penggunaan NN MATLAB toolbox untuk generate fungsi $Y = f(\sin x)$ <i>Assignment: Presenting the use of NN MATLAB toolbox to generate the function <math>Y = f(\sin x)</math></i>	Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i>		Implementasi NN MATLAB toolbox untuk kasus $f(x) = \sin(x)$ <i>Implementation of NN MATLAB toolbox for the case of <math>f(x) = \sin(x)</math></i>  <b>[1: Martin T. Hagan – BAB 4]</b> <b>[2: Mark Hudson Beale – BAB 3]</b>	1%



		<p>untuk training testing dan validasi <i>Changing the data percentage for training, testing, and validation</i></p> <p>c. Menjelaskan jumlah hidden layer dan node <i>Explaining the number of hidden layers and nodes</i></p> <p>d. Menjelaskan correlation coefficient <i>Explaining correlation coefficient</i></p> <p>e. Menjelaskan stopping criteria <i>Explaining stopping criteria</i></p>					
7	Mahasiswa mampu mendefinisikan data input-output dalam sebuah NN, serta memilih topology, fungsi	<p>Mahasiswa mampu mendefinisikan: <i>Students are able to define:</i></p> <p>d. input-output <i>input-output</i></p>	<p>Tugas : Mempresentasikan penggunaan NN MATLAB toolbox untuk generate fungsi <math>Y = f(\sin x)</math></p>	<p>Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning</p>		<p>Diskusi dan implementasi NN MATLAB toolbox untuk kasus yang akan dipresentasikan dalam project 1</p>	1%



	<p>aktifasi sehingga didapatkan NN dengan Mean Squared Error (MSE) yang terkecil <i>Students are able to define input-output data in an NN, as well as select topology and activation functions to obtain an NN with the smallest Mean Squared Error (MSE)</i></p>	<p>e. jumlah hidden layer dan node <i>number of hidden layers and nodes</i> f. fungsi aktifasi dan learning algorithm <i>activation function and learning algorithm</i> sehingga didapatkan NN dengan Mean Squared Error (MSE) yang terkecil <i>so that the NN with the smallest Mean Squared Error (MSE) is obtained</i></p>	<p>dengan variasi jumlah hidden layer, jumlah node, fungsi aktivasi dan learning algorithm <i>Assignment: Presenting the use of NN MATLAB toolbox to generate the function <math>Y = f(\sin x)</math> with variations in the number of hidden layers, number of nodes, activation functions, and learning algorithms</i></p>	<p><i>Self-Directed Learning</i> <i>Cooperative Learning</i> <i>Cooperative Learning</i></p>	<p><i>Discussion and implementation of NN MATLAB toolbox for the case to be presented in project 1</i>  [1: Martin T. Hagan – BAB 4] [2: Mark Hudson Beale – BAB 3]</p>	
8	<p>ETS: materi perkuliahan minggu 1-8 <i>Midterm Exam: week 1-8 lecture materials</i></p>					25%
9	<p>Mahasiswa mampu mendefinisikan tujuan optimasi, serta memahami langkah-langkah pencarian nilai optimasi dengan Genetic Algoritma (GA) <i>Students are able to define optimization</i></p>	<p>Mahasiswa mampu memahami Langkah-langkah optimasi menggunakan GA: <i>Students are able to understand the optimization steps using GA:</i> f. Mengenerate populasi</p>	<p>Tugas: mempresentasikan bagaimana: <i>Assignment: Presenting how to:</i> e. generate populasi <i>generate population</i> f. menentukan nilai fitness</p>	<p>Perkuliahan Lecture [TM: 3x50"] Self-Directed Learning Self-Directed Learning Cooperative Learning</p>	<p>- Overview GA <i>Overview of GA</i> - Proses seleksi, cross-over dan mutase pada GA <i>Selection, crossover, and mutation processes in GA</i></p>	1%





	<i>objectives and understand the steps of searching for optimization values using Genetic Algorithms (GA)</i>	<i>Generating population</i> g. Menentukan nilai fitness <i>Determining fitness value</i> h. Filtering (roulette wheel dan tournament) <i>Filtering (roulette wheel and tournament)</i> i. Proses seleksi <i>Selection process</i> j. Crossover dan mutasi <i>Crossover and mutation</i>	<i>determine fitness values</i> g. filtering (roulette wheel dan tournament) <i>perform filtering (roulette wheel and tournament)</i> h. proses seleksi crossover dan mutasi <i>perform selection, crossover, and mutation processes</i> pada coding yang telah diberikan <i>on the given coding</i>	Cooperative Learning		[4: Andrew Chipperfield – 1-1 s/d 1-18]	
10	Mahasiswa mampu menjelaskan secara jelas dan runtut contoh perhitungan tiap langkah pada metode Genetic Algoritma <i>Students are able to clearly and systematically</i>	Mahasiswa mampu memahami langkah-langkah optimasi menggunakan GA dan mencari nilai otimum pada kasus sederhana $Y = f(\sin x)$ <i>Students are able to understand the optimization steps using</i>	Tugas: Mempresentasikan bagaimana mencari nilai optimum pada fungsi $Y = f(\sin x)$ pada constraint sudut tertentu $0 < x < 90$ Assignment:	Perkuliahan <i>Lecture</i> [TM: 3x50"] Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning		- Proses seleksi, cross-over dan mutase pada GA menggunakan MATLAB <i>Selection, crossover, and mutation processes in GA using MATLAB</i>	1%



	<i>explain the calculation examples for each step in the Genetic Algorithm method</i>	<i>GA and find optimum values in simple cases <math>Y = f(\sin x)</math></i>	<i>Presenting how to find the optimum value for the function <math>Y = f(\sin x)</math> with a specific angle constraint <math>0 &lt; x &lt; 90</math></i>	<i>Cooperative Learning</i>		<b>[4: Andrew Chipperfield – 1-20 s/d 1-37]</b>	
<b>11</b>	Mahasiswa mampu mengoperasikan toolbox Genetic Algorithm pada MATLAB mulai dari kasus yang sederhana sampai kasus multiobjective optimization <i>Students are able to operate the Genetic Algorithm toolbox in MATLAB, starting from simple cases to multi-objective optimization cases</i>	Simulasi penggunaan toolbox Genetic Algorithm untuk beberapa kasus: <i>Simulation of using the Genetic Algorithm toolbox for several cases:</i> 5. Single input single output (SISO) <i>Single input single output (SISO)</i> 6. Single input multi output (SIMO) <i>Single input multi output (SIMO)</i> 7. Multi input single output (MISO) <i>Multi input single output (MISO)</i> 8. Multi input multi output (MIMO)	Tugas: Mempresentasikan bagaimana mencari nilai optimum pada fungsi $Y = f(\sin x)$ pada constraint sudut tertentu $0 < x < 90$ Assignment: <i>Presenting how to find the optimum value for the function <math>Y = f(\sin x)</math> with a specific angle constraint <math>0 &lt; x &lt; 90</math></i>	Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i>		- Membuat fitness function <i>Determining fitness function</i> - Menentukan setting parameter <i>Determining setting parameter</i> - Menampilkan dan membaca hasil optimasi <i>Displaying and interpreting optimization results</i>  <b>[5: Mark A. Abramson – Bab 4]</b>	1%



		<i>Multi input multi output (MIMO)</i>					
<b>12</b>	Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB untuk tuning parameter serta pemecahan kasus yang memerlukan constraint handling <i>Students are able to operate the Genetic Algorithm toolbox in MATLAB for parameter tuning and solving cases requiring constraint handling</i>	Mahasiswa mampu mengoperasikan toolbox Genetic Algoritma pada MATLAB dengan constraint handling: penalty tipe static, dynamic dan adaptive <i>Students are able to operate the Genetic Algorithm toolbox in MATLAB with constraint handling: static, dynamic, and adaptive penalty types</i>	Tugas: Mempresentasikan bagaimana mencari nilai optimum menggunakan GA pada fungsi $Y = f(a, b, c, d)$ dengan constrain yang berbeda <i>Assignment: Presenting how to find the optimum value using GA for the function <math>Y = f(a, b, c, d)</math> with different constraints</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"] Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i>		- Membuat fitness function <i>Determining fitness function</i> - Menentukan setting parameter <i>Determining setting parameter</i> - Menentukan constraint handling <i>Determining constraint handling</i> - Menampilkan dan membaca hasil optimasi <i>Displaying and interpreting optimization results</i>  [7. Chehour, A. Dkk]	1%
<b>13</b>	KUIS QUIZ			Kuis Quiz [TM: 3x50"]			25%
<b>14</b>	Mahasiswa mampu mendefinisikan tujuan optimasi,	Mahasiswa mampu memahami langkah-langkah pencarian nilai	Tugas: Mempresentasikan setiap baris coding PSO	Perkuliahan <i>Lecture</i> [TM: 3x50"]		- Overview PSO <i>Overview of PSO</i>	1%

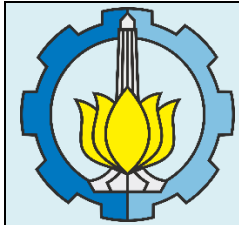


	serta memahami langkah-langkah pencarian nilai optimasi dengan Particle Swarm Optimization (PSO) <i>Students are able to define optimization objectives and understand the steps of searching for optimization values using Particle Swarm Optimization (PSO)</i>	optimasi dengan Particle Swarm Optimization (initialize, evaluasi fitness, update local and global best, update velocity and position) <i>Students are able to understand the optimization steps with Particle Swarm Optimization (initialize, evaluate fitness, update local and global best, update velocity and position)</i>	serta bisa menjelaskan fungsi dari coding tersebut pada PSO <i>Assignment: Presenting each line of PSO coding and explaining the function of the coding in PSO.</i>	Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i>		- Proses penentuan posisi, kecepatan, Pbest dan GBest pada PSO <i>Process of determining position, velocity, Pbest, and GBest in PSO</i>  [6: Xin She Yang – Bab 7]	
15	Mahasiswa mampu menjelaskan secara jelas dan runtut contoh perhitungan tiap langkah pada metode PSO menggunakan MATLAB <i>Students are able to clearly and systematically explain the calculation</i>	Mahasiswa mampu memahami langkah-langkah pencarian nilai optimasi serta menerapkan constraint handling pada PSO <i>Students are able to understand the optimization steps and apply constraint handling in PSO</i>	Tugas: Mempresentasikan bagaimana mencari nilai optimum menggunakan PSO pada fungsi $Y = f(a, b, c, d)$ dengan constrain yang berbeda <i>Assignment: Presenting how to find the optimum value</i>	Perkuliahan <i>Lecture [TM: 3x50"]</i> Self-Directed Learning <i>Self-Directed Learning</i> Cooperative Learning <i>Cooperative Learning</i>		- Proses perhitungan posisi, kecepatan, Pbest dan GBest pada PSO menggunakan MATLAB <i>Process of calculating position, velocity, Pbest, and GBest in PSO using MATLAB</i>	1%



	<i>examples for each step in the PSO method using MATLAB</i>		<i>using PSO for the function <math>Y = f(a, b, c, d)</math> with different constraints</i>			<b>[6: Xin She Yang – Bab 7]</b>	
<b>16</b>	<b>Evaluasi Akhir Semester / Ujian Akhir Semester/Proyek tim – collaborative learning</b> <b>Final Exam/Team project – collaborative learning</b>						<b>38%</b>





**INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)**  
**FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM**  
**DEPARTEMEN TEKNIK MESIN**  
**PROGRAM STUDI S2 TEKNIK MESIN**

**Kode  
Dokumen**

**RENCANA PEMBELAJARAN SEMESTER**  
*(Semester Learning Plan)*

<b>MATA KULIAH (SUBJECTS)</b>	<b>KODE (CODE)</b>	<b>Rumpun MK (Course cluster)</b>	<b>BOBOT (sks) (credits)</b>		<b>SEMESTER</b>	<b>Tgl Penyusunan</b>
<b>Perpindahan Panas dan Masa <i>Heat and Mass Transfer</i></b>	TM235204	Rekayasa Termal dan Sistem Energi <i>Thermal Engineering and Energy Systems</i>	<b>T= 3</b>	<b>P= 0</b>	1	10 Desember 2023
<b>OTORISASI (AUTHORIZATION)</b>	<b>Pengembang RPS (Developer Lecturer of Semester Learning Plan)</b>	<b>Koordinator RMK (Course Cluster Coordinator)</b>			<b>Ketua PRODI (Head of Postgraduate Program)</b>	
	Prof. Dr. Ir. Prabowo, M.Eng	Prof. Dr. Ir. Prabowo, M.Eng			Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng	
<b>Capaian Pembelajaran (Learning Outcomes)</b>	<b>CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)</b>					
	<b>CPL-4 PLO-4</b>	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.</i>				
	<b>CPL-5 PLO-5</b>	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>Able to understand and utilize the theory of engineering sciences in mechanical engineering.</i>				
	<b>CPL-6 PLO-6</b>	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.				



		<i>Able to develop an innovative design mechanical system and its components by utilizing interdisciplinary or multidisciplinary scientific fields.</i>
<b>CPL-7</b> <b>PLO-7</b>		Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin. <i>Able to deepen or broaden knowledge in certain areas related to mechanical systems with an interdisciplinary or multidisciplinary approach.</i>
<b>Capaian Pembelajaran Mata Kuliah (CPMK)</b> <b>Course Learning Outcome (CLO)</b>		
CPMK-1 CLO-1		Mampu memahami, menalar, menganalisis konsep dan fisik perpindahan panas, konduksi tunak satu dan dua dimensi, serta konduksi transien <i>Able to comprehend, rational, and analyze concepts and physical aspects of heat transfer, steady-state one and two-dimensional conduction, as well as transient conduction.</i>
CPMK-2 CLO-2		Mampu memahami, menalar, menganalisis konsep dan fisik perpindahan panas, konveksi paksa dan natural pada aliran dalam maupun luar <i>Able to comprehend, rational, and analyze the concepts and physics of heat transfer, forced and natural convection in both internal and external flows</i>
CPMK-3 CLO-3		Mampu memahami, menalar, menganalisis konsep dan fisik perpindahan panas, konveksi pada perubahan fase boiling dan kondensasi <i>Able to comprehend, rational, and analyze the concepts and physics of heat transfer, convection during phase change involving boiling and condensation</i>
CPMK-4 CLO-4		Mampu menganalisis dan menerapkan prinsip perpindahan massa <i>Able to analyze and apply the principles of mass transfer</i>





	CPMK-5 CLO-5	Mampu merancang peralatan penukar panas <i>Able to design heat exchanger equipment</i>																																														
		<p><b>Matrik CPL – CPMK</b> <b>PLO-CLO Matrix</b></p> <table border="1"> <thead> <tr> <th>CPMK CLO</th> <th>CPL-4 PLO-4</th> <th>CPL-5 PLO-5</th> <th>CPL-6 PLO-6</th> <th>CPL-7 PLO-7</th> <th>Bobot (%) Grade (%)</th> </tr> </thead> <tbody> <tr> <td>CPMK-1 CLO-1</td> <td>v</td> <td>v</td> <td>v</td> <td>v</td> <td>20</td> </tr> <tr> <td>CPMK-2 CLO-2</td> <td>v</td> <td>v</td> <td>v</td> <td>v</td> <td>20</td> </tr> <tr> <td>CPMK-3 CLO-3</td> <td>v</td> <td>v</td> <td>v</td> <td>v</td> <td>20</td> </tr> <tr> <td>CPMK-4 CLO-4</td> <td>v</td> <td>v</td> <td>v</td> <td>v</td> <td>20</td> </tr> <tr> <td>CPMK-5 CLO-5</td> <td></td> <td></td> <td>v</td> <td>v</td> <td>20</td> </tr> <tr> <td><b>Total bobot (%)</b> <b>Total Grade (%)</b></td> <td><b>20</b></td> <td><b>20</b></td> <td><b>30</b></td> <td><b>30</b></td> <td><b>100</b></td> </tr> </tbody> </table>					CPMK CLO	CPL-4 PLO-4	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7	Bobot (%) Grade (%)	CPMK-1 CLO-1	v	v	v	v	20	CPMK-2 CLO-2	v	v	v	v	20	CPMK-3 CLO-3	v	v	v	v	20	CPMK-4 CLO-4	v	v	v	v	20	CPMK-5 CLO-5			v	v	20	<b>Total bobot (%)</b> <b>Total Grade (%)</b>	<b>20</b>	<b>20</b>	<b>30</b>	<b>30</b>	<b>100</b>
CPMK CLO	CPL-4 PLO-4	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7	Bobot (%) Grade (%)																																											
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<b>Total bobot (%)</b> <b>Total Grade (%)</b>	<b>20</b>	<b>20</b>	<b>30</b>	<b>30</b>	<b>100</b>																																											
<b>Deskripsi Singkat MK</b> <i>(Short Description of Course)</i>	<p>Perpindahan panas dan massa yang mencakup berbagai konsep dan hukum proses pemanasan dan pendinginan pada suatu benda dengan mekanisme perpindahan panas konduksi, konveksi maupun radiasi serta analisis perancangan alat penukar panas berdasarkan perbedaan temperature rerata logaritmik dan NTU-efektifitas. <i>Heat and mass transfer which includes various concepts and laws of heating and cooling processes in an object using conduction, convection and radiation heat transfer mechanisms as well as analysis of heat exchanger design based on logarithmic average temperature differences and NTU-effectiveness.</i></p>																																															



<b>Bahan Kajian: Materi Pembelajaran (Course Materials)</b>	<p>Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut:</p> <ul style="list-style-type: none"><li>- Konsep perpindahan panas secara umum yaitu: konduksi, konveksi, dan radiasi.</li><li>- Konsep dan pengertian fisik perpindahan panas konduksi satu dan dua dimensi untuk sistim koordinat Cartesian dan Radial.</li><li>- Konsep tahanan thermal, konduksi dengan energi bangkitan, permukaan yang diperluas, tunak, serta perpindahan panas konduksi dengan proses transien.</li><li>- Praktikum Konduksi dan Konveksi</li><li>- Perpindahan panas dan massa secara konveksi baik aliran luar maupun dalam pada daerah laminar, transisi, dan turbulen.</li><li>- Proses perpindahan panas secara konveksi untuk aliran yang berubah fase: pool boiling dan film boiling serta kondensasi film dan tetes.</li><li>- Analisa dan perancangan alat penukar panas berdasarkan perbedaan temperatur rerata logaritmik, NTU dan menganalisis alat penukar panas kompak.</li><li>- Proses perpindahan panas konveksi natural untuk aliran di luar plat datar, plat vertikal, silinder, di dalam enclosure dan channel.</li></ul> <p><i>This course has the following topics:</i></p> <ul style="list-style-type: none"><li>- <i>The general concept of heat transfer is: conduction, convection and radiation.</i></li><li>- <i>Physical concepts and understanding of one- and two-dimensional conduction heat transfer for Cartesian and Radial coordinate systems.</i></li><li>- <i>The concept of thermal resistance, conduction with generated energy, extended surface, steady state, and conduction heat transfer with transient processes.</i></li><li>- <i>Conduction and Convection Practicum</i></li><li>- <i>Heat and mass transfer by convection, both external and internal flow in laminar, transition and turbulent areas.</i></li><li>- <i>Convection heat transfer process for phase changing flows: pool boiling and film boiling as well as film and droplet condensation.</i></li><li>- <i>Analysis and design of heat exchangers based on logarithmic average temperature differences, NTU and analyzing compact heat exchangers.</i></li><li>- <i>Natural convection heat transfer process for flow outside flat plates, vertical plates, cylinders, inside enclosures and channels.</i></li></ul>				
<b>Pustaka (References)</b>	<table border="1"><tr><td data-bbox="338 1225 618 1294"><b>Utama : (Main)</b></td><td data-bbox="618 1225 2125 1294"></td></tr><tr><td colspan="2" data-bbox="338 1294 2125 1332">1. Cengel, Y.A., " Heat and Mass Transfer : Fundamental and Applications", 5<sup>th</sup> edition, McGraw-Hill, 2015</td></tr></table>	<b>Utama : (Main)</b>		1. Cengel, Y.A., " Heat and Mass Transfer : Fundamental and Applications", 5 <sup>th</sup> edition, McGraw-Hill, 2015	
<b>Utama : (Main)</b>					
1. Cengel, Y.A., " Heat and Mass Transfer : Fundamental and Applications", 5 <sup>th</sup> edition, McGraw-Hill, 2015					



		<b>Pendukung : (supporting)</b>					
				2. Adrian Bejan, “ Heat Transfer: Evolution, Design and Performance”, John Wiley and Sons, New York, 2022 3. Holman, J.P., “Heat Transfer”, 10 <sup>th</sup> Edition, Mc Graw-Hill Inc, New York, 2010 4. Bergmann, T.L., Lavine A.S., Incropera, Frank P., and David P. De Witt, “ Fundamental of Heat and Mass Transfer”, 8 <sup>th</sup> edition, John Wiley and Sons, New York, 2018.			
<b>Dosen Pengampu (Lecturers)</b>		Prabowo					
<b>Matakuliah syarat (Prerequisites)</b>		-					
Mg Ke- / Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assesment</i>		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [ <b>Estimasi Waktu</b> ] <i>(Form of Learning; Learning Method; Student Assignment)</i>		Materi Pembelajaran [ <b>Pustaka</b> ] <i>Learning Material</i>	Bobot Penilaian (%) <i>Assesment Load (%)</i>
		Indikator / <i>indicator</i>	Kriteria & Bentuk <i>Criteria &amp; Model</i>	Luring ( <i>offline</i> )	Daring ( <i>online</i> )		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu mengerti dan memahami: definisi, proses dan mekanisme perpindahan panas dalam berbagai peralatan industri. <i>Students are able to understand and comprehend:</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan definisi, proses dan mekanisme perpindahan panas dalam	Kriteria: - Rubrik - Marking Scheme  Bentuk: non-test (tugas)  Criteria:	Bentuk: kuliah & Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i> Metode: Ekspositori dan <i>discovery learning</i> Metode: Ekspositori dan <i>discovery learning</i>	- Dokumen RPS di MyITS Classroom Review & Summary PPT perkuliahan di MyITS Classroom	- Pengantar Kuliah, - Peran Perpindahan Panas dan Massa dalam Ilmu Teknik Mesin. - Metoda Evaluasi, Norma Kelas - Pengantar Perpindahan Panas	



	<i>definitions, processes and mechanisms of heat transfer in various industrial equipment.</i>	berbagai peralatan industri. <i>Completeness, clarity, accuracy (material &amp; time), and originality in explaining the definition, process and mechanism of heat transfer in various industrial equipment.</i>	- <b>Rubric</b> - <b>Marking Scheme</b>  <i>Form: non-test (assignment)</i>	(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	- <i>RPS documents in MyITS Classroom</i> <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i>	- Mekanisme transport energy - Hukum Kelestarian Energi - <i>Lecture Introduction</i> - <i>The Role of Heat and Mass Transfer in Mechanical Engineering</i> - <i>Evaluation Methods, Class Norms</i> - <i>Introduction to Heat Transfer</i> - <i>Mechanisms of Energy Transport</i> - <i>Laws of Energy Conservation Metode SCL</i>  [1]: Bab 1 <i>Handout di myITS Classroom</i> [1]: <i>Chapter 1 Handouts in myITS Classroom</i>	
2	Mahasiswa mampu dan terampil menyelesaikan permasalahan persamaan Difusi Energi dan Pemilihan bahan dalam perangkat termal.	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan	Kriteria: - Rubrik - Marking Scheme	Bentuk: kuliah & Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i> Metode: Ekspositori dan <i>discovery learning</i>	- <b>Latihan soal &amp; Homework di MyITS Classroom</b>	- Introduction to Conduction. - Thermal Conductivity - Thermal Diffusivity - Energy Diffusion Equation	



	<p><i>Students are able and skilled in solving problems of the Energy Diffusion equation and selection of materials in thermal devices.</i></p>	<p>permasalahan Difusi Energi dan Pemilihan bahan dalam perangkat termal <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving problems of Energy Diffusion and Material Selection in thermal devices</i></p>	<p>Bentuk: non-test (tugas)</p> <p><i>Criteria:</i></p> <ul style="list-style-type: none"> <li>- <b>Rubric</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p><i>Form: non-test (assignment)</i></p>	<p><i>Metode: Ekspositori dan discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <ul style="list-style-type: none"> <li>- <i>Practice questions &amp; Homework in MyITS Classroom</i></li> </ul> <p><i>Review &amp; Summary of PPT lectures in MyITS Classroom</i></p>	<ul style="list-style-type: none"> <li>- Boundary Condition</li> <li>- Initial Condition</li> <li>- <i>Introduction to Conduction.</i></li> <li>- <i>Thermal Conductivity</i></li> <li>- <i>Thermal Diffusivity</i></li> <li>- <i>Energy Diffusion Equation</i></li> <li>- <i>Boundary Condition</i></li> <li>- <i>Initial Condition</i></li> </ul> <p>[1]: Bab 2 <i>Handout di myITS Classroom</i> [1]: <i>Chapter 2 Handouts in myITS Classroom</i></p>	
3	<p>Mahasiswa mampu dan terampil menyusun sistem perpindahan panas konduksi, perancangan tebal insulasi dan system konduksi-konveksi <i>Students are able and skilled in arranging conduction heat transfer systems, designing insulation thickness and</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan sistem perpindahan panas konduksi, perancangan tebal insulasi dan system konduksi-konveksi</p>	<p><i>Kriteria:</i></p> <ul style="list-style-type: none"> <li>- <b>Rubrik</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p>Bentuk: non-test (tugas)</p> <p><i>Criteria:</i></p> <ul style="list-style-type: none"> <li>- <b>Rubric</b></li> <li>- <b>Marking Scheme</b></li> </ul>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i></p> <p>Metode: Ekspositori dan <i>discovery learning</i> <i>Metode: Ekspositori dan discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<ul style="list-style-type: none"> <li>- <b>Latihan soal &amp; Homework di MyITS Classroom</b></li> </ul> <p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <ul style="list-style-type: none"> <li>- <i>Practice questions &amp; Homework in MyITS Classroom</i></li> </ul>	<ul style="list-style-type: none"> <li>- Konduksi kondisi tunak</li> <li>- Dinding datar</li> <li>- Resistansi panas</li> <li>- Dinding Komposit</li> <li>- Porous Media</li> <li>- Sistem radial</li> <li>- Bangkitan energi panas</li> <li>- Fin</li> <li>- <i>Steady State Conduction</i></li> <li>- <i>Plane Wall</i></li> <li>- <i>Thermal Resistance</i></li> </ul>	



	<i>conduction-convection systems</i>	<i>Completeness, clarity, accuracy (material &amp; time), and originality in solving problems of conduction heat transfer systems, designing insulation thickness and conduction-convection systems</i>	<i>Form: non-test (assignment)</i>		<i>Review &amp; Summary of PPT lectures in MyITS Classroom</i>	<ul style="list-style-type: none"> <li>- Composite Wall</li> <li>- Porous Media</li> <li>- Radial System</li> <li>- Heat Generation</li> <li>- Extended Surface</li> </ul> <p>[1]: Bab 3 Handout di myITS Classroom [1]: Chapter 3 Handouts in myITS Classroom</p>	
4	Mahasiswa mampu dan terampil menyusun sistem perpindahan panas konduksi, perancangan tebal insulasi dan system konduksi-konveksi <i>Students are able and skilled in arranging conduction heat transfer systems, designing insulation thickness and</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan sistem perpindahan panas konduksi, perancangan tebal insulasi dan system konduksi-konveksi	Kriteria: <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> Bentuk: non-test (tugas)  Criteria: <ul style="list-style-type: none"> <li>- Rubric</li> <li>- Marking Scheme</li> </ul>	Bentuk: kuliah & Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i> Metode: Ekspositori dan <i>discovery learning</i> <i>Metode: Ekspositori dan discovery learning</i>  (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	<ul style="list-style-type: none"> <li>- - Latihan soal &amp; Homework di MyITS Classroom</li> </ul> Review & Summary PPT perkuliahan di MyITS Classroom  <ul style="list-style-type: none"> <li>- Practice questions &amp; Homework in</li> </ul>	<ul style="list-style-type: none"> <li>- Konduksi kondisi tunak</li> <li>- Dinding datar</li> <li>- Resistansi panas</li> <li>- Dinding Komposit</li> <li>- Porous Media</li> <li>- Sistem radial</li> <li>- Bangkitan energi panas</li> <li>- Steady State Conduction</li> <li>- Plane Wall</li> <li>- Thermal Resistance</li> <li>- Composite Wall</li> </ul>	15



	<i>conduction-convection systems</i>	<i>Completeness, clarity, accuracy (material &amp; time), and originality in solving problems of conduction heat transfer systems, designing insulation thickness and conduction-convection systems</i>	<i>Form: non-test (assignment)</i>		<i>MyITS Classroom Review &amp; Summary of PPT lectures in MyITS Classroom</i>	<ul style="list-style-type: none"> <li>- Porous Media</li> <li>- Radial System</li> <li>- Heat Generation</li> <li>- Extended Surface</li> </ul> <p>[1]: Bab 3 dan 14 Handout di myITS Classroom [1]: Chapter 3 and 14 Handouts in myITS Classroom</p>	
5	Mahasiswa mampu menjelaskan dan menganalisis mekanisme perpindahan panas konduksi multi dimensi <i>Students are able to explain and analyze the mechanism of multi-dimensional conduction heat transfer</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan sistem perpindahan panas konduksi multi dimensi <i>Completeness, clarity, accuracy</i>	Kriteria: <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> Bentuk: non-test (tugas)  Criteria: <ul style="list-style-type: none"> <li>- Rubric</li> <li>- Marking Scheme</li> </ul>	Bentuk: kuliah & Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i> Metode: Ekspositori dan <i>discovery learning</i> Metode: Ekspositori dan <i>discovery learning</i>  (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	<ul style="list-style-type: none"> <li>- Latihan soal &amp; Homework di MyITS Classroom</li> </ul> Review & Summary PPT perkuliahan di MyITS Classroom  <ul style="list-style-type: none"> <li>- Practice questions &amp; Homework in</li> </ul>	<ul style="list-style-type: none"> <li>- Konduksi multi dimensi</li> <li>- Alternatif pendekatan</li> <li>- Metode separasi variabel</li> <li>- Faktor bentuk</li> <li>- Metode Finite Difference</li> <li>- Multi dimension Conduction :</li> <li>- Alternative Approach</li> <li>- The Method of Separation Variables</li> </ul>	



		<i>(material &amp; time), and originality in solving multi-dimensional conduction heat transfer system problems</i>	<i>Form: non-test (assignment)</i>		<i>MyITS Classroom Review &amp; Summary of PPT lectures in MyITS Classroom</i>	<ul style="list-style-type: none"> <li>- <i>The Conduction Shape Factor</i></li> <li>- <i>Finite Difference Method</i></li> </ul> <p>[1]: Bab 5 <i>Handout di myITS Classroom</i> [1]: <i>Chapter 5 Handouts in myITS Classroom</i></p>	
6	<p>Mahasiswa mampu menjelaskan dan menganalisis mekanisme perpindahan panas konduksi multi dimensi <i>Students are able to explain and analyze the mechanism of multi-dimensional conduction heat transfer</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan sistem perpindahan panas konduksi multi dimensi <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving multi-dimensional conduction heat</i></p>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- <b>Rubrik</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p>Bentuk: non-test (tugas)</p> <p>Criteria:</p> <ul style="list-style-type: none"> <li>- <b>Rubric</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p>Form: non-test (assignment)</p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i> Metode: Ekspositori dan <i>discovery learning</i> Metode: <i>Ekspositori dan discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<ul style="list-style-type: none"> <li>- <b>Latihan soal &amp; Homework di MyITS Classroom</b></li> </ul> <p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <ul style="list-style-type: none"> <li>- <i>Practice questions &amp; Homework in MyITS Classroom</i></li> </ul> <p>Review &amp; Summary of PPT lectures in MyITS Classroom</p>	<ul style="list-style-type: none"> <li>- Konduksi multi dimensi</li> <li>- Alternatif pendekatan</li> <li>- Metode separasi variabel</li> <li>- Faktor bentuk</li> <li>- Metode Finite Difference</li> <li>- <i>Multi dimension Conduction</i></li> <li>- <i>Alternative Approach</i></li> <li>- <i>The Method of Separation Variables</i></li> <li>- <i>The Conduction Shape Factor</i></li> <li>- <i>Finite Difference Method</i></li> </ul> <p>[1]: Bab 5</p>	





		<i>transfer system problems</i>				<i>Handout di myITS Classroom [1]: Chapter 5 Handouts in myITS Classroom</i>	
<b>7</b>	Mahasiswa mampu menjelaskan dan menganalisis mekanisme perpindahan panas konduksi transien <i>Students are able to explain and analyze the mechanism of transient conduction heat transfer</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan mekanisme perpindahan panas konduksi transien <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving transient conduction heat transfer mechanism problems</i>	Kriteria: - <b>Rubrik</b> - <b>Marking Scheme</b>  Bentuk: non-test (tugas)  <i>Criteria:</i> - <b>Rubric</b> - <b>Marking Scheme</b>  <i>Form: non-test (assignment)</i>	Bentuk: kuliah & Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i> Metode: Ekspositori dan <i>discovery learning</i> <i>Metode: Ekspositori dan discovery learning</i>  (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	- <b>Latihan soal &amp; Homework di MyITS Classroom</b> Review & Summary PPT perkuliahan di MyITS Classroom  - <i>Practice questions &amp; Homework in MyITS Classroom</i> Review & Summary of PPT lectures in MyITS Classroom	- Konduksi transien - Metode kapasitansi lumped - Analisa Kamplitansi Lumped secara umum - Spatial Effects - Dinding datar dengan konveksi - Sistem radial dengan konveksi - Multi Dimensi - <i>Transient Conduction</i> - <i>The Lumped Capacitance Method</i> - <i>General Lumped Capacitance Analysis</i> - <i>Spatial Effects</i> - <i>Plane Wall with Convection</i> - <i>Radial Systems with Convection</i> - <i>Multi Dimension</i>  [1]: Bab 4 dan 14 <i>Handout di myITS Classroom</i>	



						[1]: Chapter 4 and 14 Handouts in myITS Classroom	
<b>8</b>	<b>Evaluasi Tengah Semester / Ujian Tengah Semester MIDTERM EXAM</b>						<b>30</b>
<b>9</b>	<p>Mahasiswa mampu menjelaskan dan menganalisis mekanisme perpindahan panas konduksi transien</p> <p><i>Students are able to explain and analyze the mechanism of transient conduction heat transfer</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan mekanisme perpindahan panas konduksi transien</p> <p><i>Completeness, clarity, accuracy (material &amp; time), and originality in solving transient conduction heat transfer mechanism problems</i></p>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> <p>Bentuk: non-test (tugas)</p> <p>Criteria:</p> <ul style="list-style-type: none"> <li>- Rubric</li> <li>- Marking Scheme</li> </ul> <p>Form: non-test (assignment)</p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming</p> <p><i>Form: lecture and discussion, brainstorming</i></p> <p>Metode: Ekspositori dan discovery learning</p> <p><i>Metode: Ekspositori dan discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<ul style="list-style-type: none"> <li>- Latihan soal &amp; Homework di MyITS Classroom</li> </ul> <p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <ul style="list-style-type: none"> <li>- Practice questions &amp; Homework in MyITS Classroom</li> </ul> <p>Review &amp; Summary of PPT lectures in MyITS Classroom</p>	<ul style="list-style-type: none"> <li>- Konduksi transien</li> <li>- Metode kapasitansi lumped</li> <li>- Analisa Kamapasitansi Lumped secara umum</li> <li>- Spatial Effects</li> <li>- Dinding datar dengan konveksi</li> <li>- Sistem radial dengan konveksi</li> <li>- Multi Dimensi</li> <li>- Transient Conduction</li> <li>- The Lumped Capacitance Method</li> <li>- General Lumped Capacitance Analysis</li> <li>- Spatial Effects</li> <li>- Plane Wall with Convection</li> <li>- Radial Systems with Convection</li> <li>- Multi Dimension</li> </ul> <p>[1]: Bab 4 dan 14 Handout di myITS Classroom</p>	



						[1]: Chapter 4 and 14 Handouts in myITS Classroom	
10	<p>Mahasiswa mampu membedakan tiga jenis boundary layer dan menjelaskan analogi ketiganya pada perpindahan panas konveksi</p> <p><i>Students are able to distinguish three types of boundary layers and explain the analogy of the three to convection heat transfer</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan dan analogi tiga boundary layer pada perpindahan panas konveksi</p> <p><i>Completeness, clarity, accuracy (material &amp; time), and originality in solving problems and analogy of the three boundary layers in convection heat transfer</i></p>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> <p>Bentuk: non-test (tugas)</p> <p>Criteria:</p> <ul style="list-style-type: none"> <li>- Rubric</li> <li>- Marking Scheme</li> </ul> <p>Form: non-test (assignment)</p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming</p> <p><i>Form: lecture and discussion, brainstorming</i></p> <p>Metode: Ekspositori dan discovery learning</p> <p><i>Metode: Ekspositori dan discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<ul style="list-style-type: none"> <li>- Latihan soal &amp; Homework di MyITS Classroom</li> </ul> <p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <ul style="list-style-type: none"> <li>- Practice questions &amp; Homework in MyITS Classroom</li> </ul> <p>Review &amp; Summary of PPT lectures in MyITS Classroom</p>	<ul style="list-style-type: none"> <li>- Dasar Konveksi</li> <li>- Kondisi batas konveksi</li> <li>- koefisien konveksi</li> <li>- Aliran Laminar dan Turbulen</li> <li>- Analogi kondisi batas</li> <li>- Fundamentals of Convection:</li> <li>- Convection Boundary Layer</li> <li>- Heat Transfer Coefficient</li> <li>- Laminar and Turbulent Flows</li> <li>- Normalizing</li> <li>- Boundary Layer Analogy</li> </ul> <p>[1]: Bab 6 dan 14 Handout di myITS Classroom</p> <p>[1]: Chapter 6 and 14 Handouts in myITS Classroom</p>	
11	<p>Mahasiswa mampu menganalisis berbagai</p>	<p>Kelengkapan, kejelasan, ketepatan (materi</p>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- Rubrik</li> </ul>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming</p>	<ul style="list-style-type: none"> <li>- Latihan soal &amp; Homework</li> </ul>	<ul style="list-style-type: none"> <li>- Aliran luar</li> <li>- Metode analitis dan eksperimen</li> </ul>	



	<p>kasus perpindahan panas dan massa external flow <i>Students are able to analyze various cases of external flow heat and mass transfer</i></p>	<p>&amp; waktu), dan originalitas dalam menyelesaikan permasalahan perpindahan panas dan massa external flow <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving external flow heat and mass transfer problems</i></p>	<p>- <b>Marking Scheme</b></p> <p>Bentuk: non-test (tugas)</p> <p><i>Criteria:</i></p> <p>- <b>Rubric</b></p> <p>- <b>Marking Scheme</b></p> <p><i>Form: non-test (assignment)</i></p>	<p><i>Form: lecture and discussion, brainstorming</i></p> <p>Metode: Ekspositori dan <i>discovery learning</i></p> <p><i>Metode: Ekspositori dan discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<p>di MyITS Classroom</p> <p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <p>- <i>Practice questions &amp; Homework in MyITS Classroom</i></p> <p>Review &amp; Summary of PPT lectures in MyITS Classroom</p>	<p>- Methodologi konveksi</p> <p>- Plat datar pada aliran parallel</p> <p>- Silinder pada aliran silang / Cross Flow</p> <p>- Bola</p> <p>- Packed Bed</p> <p>- Jet Impingement</p> <p>- External Flow</p> <p>- Analytical and Experimental Methods</p> <p>- Methodology</p> <p>- Flat Plate in Parallel Flow</p> <p>- Cylinder in Cross Flow</p> <p>- Sphere</p> <p>- Packed Bed</p> <p>- Jet Impingement</p> <p>[1]: Bab 7 Handout di myITS Classroom [1]: Chapter 7 Handouts in myITS Classroom</p>	
12	<p>Mahasiswa mampu menganalisis berbagai kasus perpindahan panas dan massa external flow <i>Students are able to analyze various cases of</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan</p>	<p>Kriteria:</p> <p>- Rubrik</p> <p>- Marking Scheme</p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming</p> <p><i>Form: lecture and discussion, brainstorming</i></p> <p>Metode: Ekspositori dan <i>discovery learning</i></p>	<p>- Latihan soal &amp; Homework di MyITS Classroom</p>	<p>- Aliran luar</p> <p>- Metode analitis dan eksperimen</p> <p>- Methodologi konveksi</p> <p>- Plat datar pada aliran parallel</p>	25



	<i>external flow heat and mass transfer</i>	permasalahan perpindahan panas dan massa external flow <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving external flow heat and mass transfer problems</i>	Bentuk: non-test (tugas)  <i>Criteria:</i> - <b>Rubric</b> - <b>Marking Scheme</b>  <i>Form: non-test (assignment), Quiz 2</i>	<i>Metode: Ekspositori dan discovery learning</i>  (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	Review & Summary PPT perkuliahan di MyITS Classroom  - <i>Practice questions &amp; Homework in MyITS Classroom</i> <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i>	- Silinder pada aliran silang / Cross Flow - Bola - Packed Bed - Jet Impingement - <i>External Flow</i> - <i>Analytical and Experimental Methods</i> - <i>Methodology</i> - <i>Flat Plate in Parallel Flow</i> - <i>Cylinder in Cross Flow</i> - <i>Sphere</i> - <i>Packed Bed</i> - <i>Jet Impingement</i>  [1]: Bab 7 <i>Handout di myITS Classroom</i> [1]: <i>Chapter 7 Handouts in myITS Classroom</i>	
<b>13</b>	Mahasiswa mampu menganalisis berbagai kasus perpindahan panas dan massa internal flow <i>Students are able to analyze various cases of internal flow heat and mass transfer</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan perpindahan	Kriteria: - <b>Rubrik</b> - <b>Marking Scheme</b>  Bentuk: non-test (tugas)	Bentuk: kuliah & Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i> Metode: Ekspositori dan <i>discovery learning</i> <i>Metode: Ekspositori dan discovery learning</i>	- <b>Latihan soal &amp; Homework di MyITS Classroom</b> <i>Review &amp; Summary PPT perkuliahan di MyITS Classroom</i>	- Aliran dalam - Kondisi aliran - Thermal Considerations - Fully developed flow - tube silinder - tube non-silinder - <i>Internal Flow</i> - <i>Flow Condition</i>	



		panas dan massa internal flow <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving internal flow heat and mass transfer problems</i>	<p><i>Criteria:</i></p> <ul style="list-style-type: none"> <li>- <b>Rubric</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p><i>Form: non-test (assignment)</i></p>	(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	<ul style="list-style-type: none"> <li>- <i>Practice questions &amp; Homework in MyITS Classroom</i></li> <li>- <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i></li> </ul>	<ul style="list-style-type: none"> <li>- <i>Thermal Considerations</i></li> <li>- <i>Fully developed flow</i></li> <li>- <i>Circular tubes</i></li> <li>- <i>Non-circular tubes</i></li> </ul> <p>[1]: Bab 8 <i>Handout di myITS Classroom</i> [1]: <i>Chapter 8 Handouts in myITS Classroom</i></p>	
14	Mahasiswa mampu memahami konsep dasar konveksi bebas dan konsep mekanisme fisik boiling and condensation <i>Students are able to understand the basic concepts of free convection and the concept of physical mechanisms of boiling and condensation</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan konsep dasar konveksi bebas dan konsep mekanisme fisik boiling and condensation <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving</i>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- <b>Rubrik</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p>Bentuk: non-test (tugas)</p> <p><i>Criteria:</i></p> <ul style="list-style-type: none"> <li>- <b>Rubric</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p><i>Form: non-test (assignment)</i></p>	Bentuk: kuliah & Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i> Metode: Ekspositori dan <i>discovery learning</i> <i>Metode: Ekspositori dan discovery learning</i>	<ul style="list-style-type: none"> <li>- <b>Latihan soal &amp; Homework di MyITS Classroom</b></li> <li>- <i>Review &amp; Summary PPT perkuliahan di MyITS Classroom</i></li> <li>- <i>Practice questions &amp; Homework in MyITS Classroom</i></li> <li>- <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i></li> </ul>	<ul style="list-style-type: none"> <li>- Natural Convection :</li> <li>- Physical Considerations</li> <li>- Governing Equations</li> <li>- Similiraty</li> <li>- The Effect of Turbulence</li> <li>- External Flow</li> <li>- Channel</li> <li>- Enclosure</li> <li>- Combined Heat Transfer</li> <li>- Boiling and Condensation</li> <li>- Dimensionless Parameters</li> <li>- Boiling Modes</li> <li>- Pool Boiling</li> <li>- Forced Convection boiling</li> </ul>	



		<i>problems with the basic concept of free convection and the concept of the physical mechanism of boiling and condensation</i>				<ul style="list-style-type: none"><li>- Film Condensation</li><li>- Dropwise Condensation</li><li>- Natural Convection :</li><li>- Physical Considerations</li><li>- Governing Equations</li><li>- Similitude</li><li>- The Effect of Turbulence</li><li>- External Flow</li><li>- Channel</li><li>- Enclosure</li><li>- Combined Heat Transfer</li><li>- Boiling and Condensation</li><li>- Dimensionless Parameters</li><li>- Boiling Modes</li><li>- Pool Boiling</li><li>- Forced Convection boiling</li><li>- Film Condensation</li><li>- Dropwise Condensation</li></ul> <p>[1]: Bab 9 dan 10 Handout di myITS Classroom</p> <p>[1]: Chapter 9 and 10 Handouts in myITS Classroom</p>	
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<p><b>15</b></p>	<p>Mahasiswa mampu menganalisis dan melakukan rancangan termal berbagai heat exchanger. <i>Students are able to analyze and carry out thermal designs of various heat exchangers.</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan heat exchanger / alat penukar kalor <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving heat exchanger problems</i></p>	<p>Kriteria: - Rubrik - Marking Scheme</p> <p>Bentuk: non-test (tugas)</p> <p>Criteria: - Rubric - Marking Scheme</p> <p>Form: non-test (assignment)</p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming <i>Form: lecture and discussion, brainstorming</i> Metode: Ekspositori dan discovery learning <i>Metode: Ekspositori dan discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<p>- Latihan soal &amp; Homework di MyITS Classroom Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <p>- Practice questions &amp; Homework in MyITS Classroom Review &amp; Summary of PPT lectures in MyITS Classroom</p>	<p>- Heat Exchanger - Type &amp; Classification - Overall Heat Transfer Coefficient - LMTD Method - E-NTU Method - Heat Exchanger - Type &amp; Classification - Overall Heat Transfer Coefficient - LMTD Method - E-NTU Method</p> <p>[1]: Bab 13 Handout di myITS Classroom [1]: Chapter 13 Handouts in myITS Classroom</p>	
<p><b>16</b></p>	<p><b>Evaluasi Akhir Semester / Ujian Akhir Semester</b> <b>FINAL EXAM</b></p>						<p><b>30</b></p>





**INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)**  
**FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM**  
**DEPARTEMEN TEKNIK MESIN**  
**PROGRAM STUDI S2 TEKNIK MESIN**

Kode Dokumen

**RENCANA PEMBELAJARAN SEMESTER**  
*(Semester Learning Plan)*

MATA KULIAH (SUBJECTS)	KODE (CODE)	Rumpun MK (Course cluster)	BOBOT (sks) (credits)		SEMESTER SEMESTER	Tgl Penyusunan DATE
ALIRAN DUA FASE <i>TWO-PHASE FLOW</i>	TM235229	Mekanika dan Mesin-Mesin Fluida <i>Fluid Mechanics and Machines</i>	T= 3	P= 0	1	25 Nopember 2023
OTORISASI (AUTHORIZATION)	Pengembang RPS (Developer Lecturer of Semester Learning Plan)	Koordinator RMK (Course Cluster Coordinator)	Ketua PRODI (Head of Postgraduate Program)			
	TRI YOGI YUWONO	TRI YOGI YUWONO	Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng			
Capaian Pembelajaran (Learning Outcomes)	CPL-PRODI yang dibebankan pada MK (PLO Program Charged to The Course)					
	CPL-2 PLO-2	Mampu mengembangkan dan memecahkan permasalahan ilmu pengetahuan dan teknologi dalam bidang Teknik Mesin melalui riset dengan pendekatan inter atau multidisiplin hingga menghasilkan karya inovatif dan teruji dalam bentuk tesis dan makalah yang telah diterima di jurnal ilmiah nasional terakreditasi atau diterima di seminar internasional bereputasi <i>Able to develop and solve scientific and technological problems in the field of Mechanical Engineering through research with an inter- or multidisciplinary approach to produce innovative and tested work in the form of theses and</i>				



		<i>papers that have been accepted in accredited national scientific journals or accepted at reputable international seminars.</i>
<b>CPL-4</b> <b>PLO-4</b>		Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>Able to assess theoretical concepts and methods of system design or mechanical engineering technology in depth.</i>
<b>CPL-5</b> <b>PLO-5</b>		Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>Able to understand and utilize the theory of engineering sciences in mechanical engineering.</i>
<b>CPL-8</b> <b>PLO-8</b>		Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>Able to formulate new ideas from the previous research for the development of technology and mechanical systems.</i>
<b>Capaian Pembelajaran Mata Kuliah (CPMK)</b> <b>Course Learning Outcome (CLO)</b>		
CPMK-1 CLO-1		Mampu memahami konsep dasar tentang aliran dua fase <i>Able to understand the basic concepts of two-phase flow</i>
CPMK-2 CLO-2		Mampu memahami bergai macam tipe aliran dua fase dan penerapannya di dunia teknik <i>Able to understand various types of two-phase flow and their engineering applications</i>
CPMK-3 CLO-3		Mampu mengembangkan persamaan dasar dan model matematik pada berbagai tipe aliran dua fase <i>Able to develop basic equations and mathematical models for various types of two-phase flow</i>
CPMK-4 CLO-4		Mampu memahami teknik pengukuran parameter aliran dua fase <i>Able to understand two-phase flow parameter measurement techniques</i>
		<b>Matrik CPL – CPMK</b> <b>PLO-CLO Matrix</b>



		CPMK CLO	CPL-2 PLO-2	CPL-4 PLO-4	CPL-5 PLO-5	CPL-8 PLO-8
		CPMK-1 CLO-1	V	V	V	V
		CPMK-2 CLO-2	V	V	V	V
		CPMK-3 CLO-3	V	V	V	V
		CPMK-4 CLO-4	V	V	V	V
		CPMK-5 CLO-5	V	V	V	V
		CPMK-6 CLO-6	V	V	V	V
<b>Deskripsi Singkat MK</b> <i>(Short Description of Course)</i>	<p>Matakuliah aliran dua fase mempelajari interaksi aliran antara dua fluida yang berbeda fase; cair dan gas, cair dan padat, gas dan padat. Metode yang diberikan berupa analitis dengan mengembangkan persamaan dasar mekanika fluida yang dikembangkan untuk dua fase. Disamping itu juga mempelajari berbagai metode pengukuran property aliran dua fase.</p> <p><i>Two-phase flow courses study flow interactions between two fluids of different phases; liquid and gas, liquid and solid, gas and solid. The method provided is analytical by developing the basic equations of fluid mechanics which are developed for two phases. Apart from that, we also study various methods of measuring two-phase flow properties.</i></p>					
<b>Bahan Kajian: Materi Pembelajaran</b> <i>(Course Materials)</i>	<ul style="list-style-type: none"> <li>- Klasifikasi Dasar Aliran Dua Fase</li> <li>- Peranan Aliran dua-fase dlm Proses Industri dan Fenomena Alam</li> <li>- Kofigurasi Aliran Dua-Fase</li> <li>- Metode Pengukuran Parameter Aliran Dua Fase</li> <li>- Mekanika Zat Kontinyu Monofase</li> </ul>					



	<ul style="list-style-type: none"><li>- Persamaan lokal sesaat dalam setiap fase dan pada Interfase</li><li>- Persamaan rata-rata aliran dua fase</li><li>- Pemodelan Aliran Dua-Fase</li><li>- Kehilangan Tekanan Akibat Gesekan pada Aliran Dua Fase</li></ul> <ul style="list-style-type: none"><li>- <i>Basic Classification of Two Phase Flow</i></li><li>- <i>The role of two-phase flow in industrial processes and natural phenomena</i></li><li>- <i>Two-Phase Flow Configuration</i></li><li>- <i>Two Phase Flow Parameter Measurement Method</i></li><li>- <i>Mechanics of Monophase Continuous Substances</i></li><li>- <i>Instantaneous local equations in each phase and at Interphase</i></li><li>- <i>Average two-phase flow equation</i></li><li>- <i>Two-Phase Flow Modeling</i></li><li>- <i>Pressure Loss Due to Friction in Two Phase Flow</i></li></ul>
<b>Pustaka (References)</b>	<b>Utama : (Main)</b>
	Delhaye J.M., Giot M. & Riethmuller M.L. Thermohydraulics of Two-phase Systems for Industrial Design and Nuclear Engineering, Hemisphere/McGraw-Hill. 1981
	<b>Pendukung : (supporting)</b>
	1. Bird R.B., Stewart W.E., & Lighthfoot E.N. Transport Phenomena, New York : John Wiley & Sons Inc.,. 1965 2. Bergles A.E., Collier J.G., Delhaye J.M., Hewitt G.F., and Mayinger F. Two-phase Flow and Heat Transfer in the power and Process industries. Hemisphere/McGraw-hill. 1981
<b>Dosen Pengampu (Lecturers)</b>	<a href="#">Tri Yogi Yuwono</a>
<b>Matakuliah syarat</b>	<a href="#">Mekanika Fluida</a>



<i>(Prerequisites)</i>		<i>Fluid Mechanics</i>					
<b>Mg Ke- / Week</b>	<b>Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i></b>	<b>Penilaian <i>Assesment</i></b>		<b>Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, <b>[ Estimasi Waktu ]</b> <i>(Form of Learning; Learning Method; Student Assignment)</i></b>		<b>Materi Pembelajaran <b>[ Pustaka ]</b> <i>Learning Material</i></b>	<b>Bobot Penilaian (%) <i>Assesment Load (%)</i></b>
		<b>Indikator / <i>indicator</i></b>	<b>Kriteria &amp; Bentuk <i>Criteria &amp; Model</i></b>	<b>Luring (<i>offline</i>)</b>	<b>Daring (<i>online</i>)</b>		
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>	<b>(7)</b>	<b>(8)</b>
<b>1</b>	Mahasiswa mampu memahami klasifikasi dasar aliran dua fase dan aplikasinya dalam dunia industri. <i>Students are able to understand the basic classification of two-phase flow and its application in the industrial world.</i>	Mampu membedakan tipe-tipe aliran dua fase, serta aplikasinya di dalam dunia industri <i>Able to differentiate between types of two-phase flow, as well as their applications in the industrial world</i>	Diskusi <i>Discussion</i>	- Menyajikan video tentang aplikasi fenomena aliran dua fase - Kuliah Pengantar & Brainstorming - <i>Presents a video about the application of two-phase flow phenomena</i> - <i>Introductory Lecture &amp; Brainstorming</i> <b>[TM: 1x(3x50")]</b>	-	- Klasifikasi Dasar Aliran Dua Fase - Peranan Aliran dua-fase dlm Proses Industri dan Fenomena Alam - <i>Basic Classification of Two Phase Flow</i> - <i>The Role of Two-phase Flow in Industrial Processes and Natural Phenomena</i> <b>[1:Delhaye dkk.]</b>	5
<b>2</b>	Mahasiswa mampu memahami	Mahasiswa mampu memahami	Diskusi <i>Discussion</i>	- Kuliah tatap muka <i>Offline course</i>		Konfigurasi aliran dua fase:	<b>5</b>



	<p>kofigurasi aliran dua-fase <i>Students are able to understand two-phase flow configuration</i></p>	<p>kofigurasi aliran dua-fase dengan deskripsi parameter-parameter aliran dua-fase dalam saluran <i>Students are able to understand two-phase flow configurations by describing two-phase flow parameters in channels</i></p>		<p>[TM: 1x(3x50'')]</p>		<p>- Diskripsi Parameter-parameter Aliran dua-phase dalam Saluran <i>Two-phase flow configuration:</i> - <i>Description of two-phase flow parameters in the channel</i></p> <p>[1:Delhaye dkk.]</p>	
<p>3</p>	<p>Mahasiswa mampu menentukan pola aliran dua-fase <i>Students are able to determine two-phase flow patterns</i></p>	<p>Mahasiswa memahami metode pengukuran parameter aliran dua-fase dan metode experimental untuk menentukan pola aliran <i>Students understand methods for</i></p>	<p>Diskusi <i>Discussion</i></p>	<p>- Kuliah tatap muka <i>Offline course</i></p> <p>[TM: 1x(3x50'')]</p>		<p>- Metode Pengukuran Parameter Aliran Dua Fase - Metode experimental untuk penentuan pola aliran</p> <p>- <i>Two Phase Flow Parameter Measurement Method</i> - <i>Experimental method for determining flow patterns</i></p> <p>[1:Delhaye dkk.]</p>	<p>10</p>



		<i>measuring two-phase flow parameters and experimental methods for determining flow patterns</i>					
4-5	Mahasiswa mampu memahami kembali konsep dasar aliran monofase <i>Students are able to re-understand the basic concepts of monophasic flow</i>	Mampu memahami kembali persamaan-persamaan dasar aliran monofase <i>Able to re-understand the basic equations of monophasic flow</i>	Diskusi <i>Discussion</i>	- Kuliah tatap muka <i>Offline course</i>  [TM: 2x(3x50'')]		- Mekanika media kontinu monofase <i>Mechanics of monophasic continuous media</i>  [1:Delhaye dkk.]	10
6-7	<b>Presentasi Tugas-I &amp; II (Review paper tentang aliran dua-fase dari jurnal internasional terindex)</b> <b>Assignment Presentation-I &amp; II (Review paper on two-phase flow from indexed international journals)</b>						15
8-9	Mahasiswa mampu memahami persamaan lokal aliran dua-fase <i>Students are able to understand the local equations of two-phase flow</i>	Mampu memahami persamaan lokal sesaat dalam setiap fase dan pada interfase <i>Able to explore instantaneous local equations in</i>	Diskusi <i>Discussion</i>	- Kuliah tatap muka <i>Offline course</i>  [TM: 2x(3x50'')]		- Persamaan lokal sesaat dalam setiap fase dan pada Interfase <i>Instantaneous local equations in each phase and at Interphase</i>  [1:Delhaye dkk.]	10




		<i>each phase and at interphase</i>					
<b>10-11</b>	Mahasiswa mampu memahami persamaan rata-rata aliran dua-fase <i>Students are able to understand the average two-phase flow equation</i>	Mampu mengubah persamaan lokal sesaat menjadi persamaan rata-rata aliran dua-fase <i>Able to convert instantaneous local equations into average two-phase flow equations</i>	Diskusi <i>Discussion</i>	- Kuliah tatap muka <i>Offline course</i> - Latihan soal <i>Exercises</i>  [TM: 2x(3x50'')]		- Persamaan rata-rata aliran dua fase <i>The average equation of two-phase flow</i>  [1:Delhaye dkk.]	<b>10</b>
<b>12-13</b>	Mahasiswa mampu mengenal model aliran dua-fase <i>Students are able to recognize the two-phase flow model</i>	Mampu memahami pemodelan aliran dua-fase <i>Able to understand two-phase flow modeling</i>	Diskusi <i>Discussion</i>	- Kuliah tatap muka <i>Offline course</i>  [TM: 2x(3x50'')]		- Pemodelan Aliran Dua-Fase <i>Two-Phase Flow Modeling</i>  [1:Delhaye dkk.]	<b>10</b>
<b>14</b>	Mahasiswa mampu menentukan kehilangan tekanan akibat gesekan pada aliran dua-fase	Mampu menghitung kehilangan tekanan akibat	Diskusi <i>Discussion</i> Tugas <i>Assignment</i>	- Kuliah tatap muka <i>Offline course</i> - Latihan soal <i>Exercises</i>		- Kehilangan Tekanan Akibat Gesekan pada Aliran Dua Fase <i>Pressure Loss Due to Friction in Two Phase Flow</i>	<b>10</b>





	<i>Students are able to determine pressure loss due to friction in two-phase flow</i>	gesekan pada aliran dua-fase <i>Able to calculate pressure loss due to friction in two-phase flow</i>		[TM: 1x(3x50'')]		[1:Delhaye dkk.]	
15-16	<b>Presentasi Tugas-III &amp; IV (Review paper tentang aliran dua-fase dari jurnal internasional terindex)</b> <b>Assignment Presentation-III &amp; IV (Review paper on two-phase flow from indexed international journals)</b>						<b>15</b>



		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <i>(Semester Learning Plan)</i>						
<b>MATA KULIAH (MK)</b> <i>SUBJECTS</i>	<b>KODE</b> <i>CODE</i>	<b>Rumpun MK</b> <i>COURSE CLUSTER</i>	<b>BOBOT (sks)</b> <i>CREDITS</i>		<b>SEMESTER</b> <i>SEMESTER</i>	<b>Tgl Penyusunan</b> <i>DATE</i>
AERODINAMIKA PROFILE <i>PROFILE AERODYNAMICS</i>	TM 23235301	MEKANIKA FLUIDA DAN MESIN-MESIN FLUIDA <i>FLUID MECHANICS AND FLUID MACHINES</i>	T = 3	P = 0	PILIHAN <i>ELECTIVE</i>	5 Mei 2023
<b>OTORISASI</b> <i>AUTHORIZATION</i>	<b>Pengembang RPS</b> <i>Developer of Semester Learning Plan</i>		<b>Koordinator RMK</b> <i>Course Cluster Coordinator</i>		<b>Ketua PRODI</b> <i>Head of Postgraduate Program</i>	
	Herman Sasongko		Sutardi		Atok Setiyawan	
<b>Capaian Pembelajaran</b> <i>Learning Outcomes</i>	<b>CPL-PRODI yang dibebankan pada MK</b> <i>PLO Charged to The Course</i>					
	CPL-4 <i>PLO-4</i>	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>Able to assess theoretical concepts and systems design methods or mechanical engineering technology deeply</i>				
	CPL-6 <i>PLO-6</i>	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin. <i>Able to develop innovative mechanical design systems and components by utilizing interdisciplinary or multidisciplinary knowledge.</i>				



	CPL-7 PLO-7	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin. <i>Able to deepen or expand knowledge in certain fields related to mechanical systems with an interdisciplinary or multidisciplinary approach.</i>
	CPL-8 PLO-8	Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>Able to discover new ideas from previous research for the development of technology and mechanical systems.</i>
<b>Capaian Pembelajaran Mata Kuliah (CPMK)</b> <b>Course Learning Outcome (CLO)</b>		
	CPMK-1 CLO-1	Mahasiswa mampu menerapkan dasar-dasar mekanika fluida dalam melakukan pemodelan matematis singularitas dan pemodelan numerik panel terkait aliran inviscid incompressible 2 Dimensi yang melintasi bluff body dan airfoil dengan bantuan perangkat lunak. <i>Students are able to apply the basic principles of fluid mechanics in carrying out mathematical modeling of singularities and numerical modeling of panels related to 2-dimensional incompressible inviscid flow across bluff bodies and airfoils with the help of software.</i>
	CPMK-2 CLO-2	Mahasiswa mampu menginterpretasikan pengaruh geometri obyek terhadap medan aliran inviscid incompressible 2 Dimensi (medan kecepatan dan medan tekanan) yang menyelimutinya. <i>Students are able to interpret the influence of an object's geometry on the 2-dimensional incompressible inviscid flow field (velocity field and pressure field) that surrounds it.</i>
	CPMK-3 CLO-3	Mahasiswa mampu menguasai dasar-dasar perancangan geometri airfoil untuk menghasilkan gaya lift <i>Students are able to master the basics of designing airfoil geometry to produce lift force</i>
	CPMK-4 CLO-4	Mahasiswa mampu menjelaskan dasar perhitungan skin friction drag dengan persamaan boundary layer berdasarkan informasi medan kecepatan dan medan tekanan yang diperoleh dari pemodelan aliran 2D inviscid incompressible. <i>Students are able to explain the basis for calculating skin friction drag using the boundary layer equation based on velocity field and pressure field information obtained from 2D inviscid incompressible flow modeling.</i>
		<b>Matrik CPL – CPMK</b> <b>PLO – CLO Matrix</b>



		CPMK <i>CLO</i>	CPL-4 <i>PLO-4</i>	CPL-5 <i>PLO-5</i>	CPL-6 <i>PLO-6</i>	CPL-8 <i>PLO-8</i>
		CPMK-1 <i>CLO-1</i>	√		√	
		CPMK-2 <i>CLO-2</i>	√			√
		CPMK-3 <i>CLO-3</i>		√	√	
		CPMK-4 <i>CLO-4</i>			√	√
<b>Deskripsi Singkat MK Short</b> <i>Description of Course</i>	<p>Penerapan dasar dasar mekanika fluida dalam pemodelan matematis singularitas dan pemodelan numerik panel untuk mengevaluasi pengaruh geometri bluff body serta airfoil terhadap medan kecepatan dan medan tekanan aliran 2D inviscid incompressible yang menyelimutinya. Selanjutnya gaya lift yang terjadi dapat diperoleh dari data medan tekanan luaran pemodelan. Data medan kecepatan dan medan tekanan dapat pula digunakan sebagai dasar perhitungan skin friction drag dengan menggunakan persamaan momentum di dalam boundary layer.</p> <p><i>Application of the basic principles of fluid mechanics in mathematical modeling of singularities and numerical modeling of panels to evaluate the influence of bluff body and airfoil geometry on the velocity field and pressure field of the 2D inviscid incompressible flow that surrounds it. Furthermore, the lift force that occurs can be obtained from the modeling output pressure field data. Velocity field and pressure field data can also be used as a basis for skin friction drag calculations using the momentum equation in the boundary layer.</i></p>					
<b>Bahan Kajian: Materi Pembelajaran Course Materials</b>	<ul style="list-style-type: none"> <li>• pendahuluan: penjelasan tentang aliran inviscid 2D incompressible melintasi airfoil (airfoil theory) yang membedakannya terhadap aliran viscous 3D incompressible melintasi wing (wing theory) yang dipengaruhi skin friction &amp; pressure drag, tip vortex, horseshoe vortex dan induced down wash flow.</li> </ul>					



*Introduction: explanation of 2D incompressible inviscid flow across the airfoil (airfoil theory) which differentiates it from 3D incompressible viscous flow across the wing (wing theory) which is influenced by skin friction & pressure drag, tip vortex, horseshoe vortex and induced down wash flow.*

- review mekanika fluida : persamaan differential kekekalan massa, persamaan differential momentum, stream function, rotasi fluida, potential function, persamaan laplace untuk aliran inviscid incompressible.  
*review of fluid mechanics: differential equation for conservation of mass, differential momentum equation, stream function, fluid rotation, potential function, Laplace's equation for incompressible inviscid flow.*
- aliran aliran singular: horizontal freestream flow, inclined freestream flow, source & sink flow, doublet flow dan vortex flow.  
*singular flow streams: horizontal freestream flow, inclined freestream flow, source & sink flow, doublet flow and vortex flow.*
- super posisi dari beberapa aliran singular : rankine oval, aliran melintasi ellips, aliran melintasi circular cylinder, aliran melintasi rotated cylinder.  
*super position of several singular flows: rankine oval, flow across an ellipse, flow across a circular cylinder, flow across a rotated cylinder.*
- kutta – jokowsky theorem (dasar teori terjadinya gaya lift), kelvin theorem, starting vortex (syarat kinematis pada trailing edge) dan syarat kinematis pada kontur.  
*Kutta – Jokowsky theorem (theoretical basis for lift forces), Kelvin theorem, starting vortex (kinematic conditions on the trailing edge) and kinematic conditions on contours.*
- pemodelan airfoil simetris tipis tanpa angle of attack (droplet model)  
*thin symmetrical airfoil modeling without angle of attack (droplet model)*
- pemodelan airfoil tipis simetris dengan angle of attack kecil.  
*symmetrical thin airfoil modeling with a small angle of attack.*
- pemodelan airfoil tipis kelengkungan lemah dengan angle of attack kecil.  
*modeling thin airfoils of weak curvature with small angle of attack.*
- pemodelan numerik panel : source / sink sheet, vortex sheet.  
*panel numerical modeling: source / sink sheet, vortex sheet.*
- perhitungan gaya drag : total drag dengan persamaan momentum pada global control volume, skin friction drag dengan persamaan momentum pada differential control volume di dalam boundary layer.



	<p><i>drag force calculation: total drag with the momentum equation in the global control volume, skin friction drag with the momentum equation in the differential control volume in the boundary layer.</i></p> <ul style="list-style-type: none"> <li>• tinjauan kualitatif pengaruh kelengkungan dan pengaruh peningkatan angle of attack terhadap lift drag ratio airfoil. <i>qualitative review of the influence of curvature and the influence of increasing the angle of attack on the lift drag ratio of the airfoil.</i></li> </ul>						
<b>Pustaka References</b>	<b>Utama : Main</b>						
	<ol style="list-style-type: none"> <li>1. John D. Anderson. JR, 1988, "Fundamentals Aerodyamics", MCGRAW-HILL INTERNATIONAL EDITIONS</li> <li>2. Dietrich Hummel, 1991, Vorlesung Manuskript der Aerodynamik 1, TU BRAUNSCHWEIG</li> </ol>						
	<b>Pendukung : Supporting</b>						
	3. Robert, W. Fox & Alan T. McDonald, 2010, "Introduction to Fluid Mechanics", 7 <sup>th</sup> ed., John Wiley & Sons, Inc, Asia.						
<b>Dosen Pengampu Lecturers</b>	Herman Sasongko						
<b>Matakuliah syarat Prerequisiters</b>	Mekanika Fluida Dasar 1, Mekanika Fluida Dasar 2 <i>Basic Fluid Mechanics 1, Basic Fluid Mechanics 2</i>						
<b>Mg Ke Week</b>	<b>Kemampuan akhir tiap tahapan belajar (Sub-CPMK) Final ability of each learning stage (LLO)</b>	<b>Penilaian Assessment</b>		<b>Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [ Estimasi Waktu ] Form of Learning, Learning Method, Student Assignment [ Time Estimation ]</b>		<b>Materi Pembelajaran [ Pustaka ] Leaning Material [References]</b>	<b>Bobot Penilaian (%) Assessment Loas (%)</b>
		<b>Indikator Indicator</b>	<b>Kriteria &amp; Bentuk</b>	<b>Luring Offline</b>	<b>Daring Online</b>		



			<i>Criteria &amp; Model</i>				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami esensi teori airfoil. <i>Students are able to understand the essence of airfoil theory.</i>	Mampu memahami aliran 2D melintasi airfoil, dan mampu membedakannya dengan wing teori <i>Able to understand 2D flow across an airfoil, and be able to differentiate it from wing theory.</i>	Diskusi <i>Discussion</i>	<ul style="list-style-type: none"> <li>• Video: Contoh struktur streamline melintasi airfoil &amp; wing <i>Video: example of a streamlined structure across the airfoil &amp; wing</i></li> </ul> Kuliah <i>Lecture</i> <b>[TM: 1 x (3x50”)]</b>		2D flow & 3D flow Inviscid & viscous flow, incompressible flow & compressible flow. 2D flow & 3D flow. Inviscid & viscous flow, incompressible flow & compressible flow. <b>[3]</b>	
2	Mahasiswa mampu memahami dan menganalisa persamaan differential konservasi massa, stream function, rotasi	Mampu menganalisa dan memahami korelasi PD konservasi massa dengan stream function, korelasi rotasi fluida dengan potential	Diskusi <i>Discussion</i>	Kuliah <i>Lecture</i> <b>[TM: 1 x (3x50”)]</b>		PD konsevasi massa, stream function, rotasi fluida dan potential function. <i>DP mass conservation, stream function,</i>	



	<p>fluida dan potential function. <i>Students are able to understand and analyze differential equations for mass conservation, stream function, fluid rotation and potential function.</i></p>	<p>function serta posisi relative antara streamline. dengan potential line. <i>Able to analyze and understand the correlation between mass conservation PD and stream function, fluid rotation correlation with potential function and the relative position between streamlines with potential line discussion</i></p>				<p><i>fluid rotation and potential function.</i> <b>[3]</b></p>	
<b>3</b>	<p>Mahasiswa mampu memahami &amp; menganalisa beberapa aliran singular. <i>Students are able to</i></p>	<p>Mampu menganalisa dan memahami struktur streamline, medan kecepatan dan medan</p>	<p>Tugas : literature review terkait materi kuliah minggu 1 &amp; 2 <i>Assignment: literature review of</i></p>	<ul style="list-style-type: none"> <li>• Kuliah <i>Lecture</i></li> <li>• Diskusi <i>Discussion</i></li> </ul> <p><b>[TM: 1 x (3 x 50'')]</b></p>		<p>Horizontal free stream flow, inclined free stream flow, source / sink flow, doublet flow, vortex flow <b>[1]</b></p>	<b>5</b>





	<i>understand &amp; analyze several singular flows.</i>	tekanan aliran singular. <i>Able to analyze and understand streamline structures, velocity fields and singular flow pressure fields.</i>	<i>learning material from week 1 and 2</i>				
4	Mahasiswa mampu memahami proses superposisi terbentuknya combined flow <i>Students can understand the superposition process to form combined flow.</i>	Mampu melaksanakan proses superposisi membentuk aliran melintasi rankine oval, ellips, circular cylinder dan rotated circular cylinder. <i>Able to carry out the superposition process to form flow across the Rankine oval, ellipse, circular cylinder and</i>	Tugas : literature review materi kuliah minggu ke 3 <i>Assignment: Literature review of learning material from week 3</i>	<ul style="list-style-type: none"> <li>• Kuliah <i>Lecture</i></li> <li>• Diskusi <i>Discussion</i></li> </ul> <b>[TM: 1 x (3 x 50'')]</b>		Flow around Rankine oval, ellips, circular cylinder, rotated circular cylinder. <i>Flow around Rankine oval, ellipse, circular cylinder, rotated circular cylinder</i> <b>[1]</b>	5



		<i>rotated circular cylinder.</i>					
<b>5</b>	Mahasiswa mampu menganalisa medan aliran combined flow <i>Students are able to analyze combined flow fields</i>	Mampu menganalisa struktur streamline, medan kecepatan dan medan tekanan combined flow. <i>Able to analyze streamline structures, velocity fields and combined flow pressure fields.</i>	Diskusi <i>Discussion</i>	<ul style="list-style-type: none"> <li>• Kuliah <i>Lecture</i></li> <li>• Diskusi <i>Discussion</i></li> </ul> <b>[TM: 1 x (3 x 50'')]</b>		Flow around Rankine oval, ellips, circular cylinder, rotated circular cylinder <i>Flow around Rankine oval, ellipse, circular cylinder, rotated circular cylinder.</i>	<b>[1]</b>
<b>6</b>	Mahasiswa memahami Kutta Jokouwski theorem. <i>Students understand the Kutta Jokouwski theorem.</i>	Memahami keterkaitan harga sirkulasi (total vortex strength) dengan terjadinya gaya lift. <i>Understand the relationship between circulation prices</i>	Diskusi <i>Discussion</i>	<ul style="list-style-type: none"> <li>• Kuliah <i>Lecture</i></li> <li>• Vidio <i>Video</i></li> </ul> <b>[TM: 1 x (3 x 50'')]</b>		Lifting Flow over unsymmetrical body <i>Lifting Flow over unsymmetrical body</i>	<b>[1]</b>



		<i>(total vortex strength) and the occurrence of lift forces.</i>					
7	<p>Mahasiswa mampu memahami dasar dasar pemodelan airfoil</p> <p><i>Students are able to understand the basics of airfoil modeling</i></p>	<p>Mampu memahami keterkaitan ketidak simetrisan body dengan kekuatan sirkulasi, memahami kelvin theorem, starting vortex, syarat kutu pada trailing edge dan syarat Kinematis pada kontur.</p> <p><i>Able to understand the relationship between body asymmetries and circulation forces, understand</i></p>	<p>Diskusi</p> <p><i>Discussion</i></p>	<ul style="list-style-type: none"> <li>• Kuliah <i>Lecture</i></li> <li>• Vidio <i>Video</i></li> </ul> <p><b>[TM: 1 x (3 x 50")]</b></p>		<p>Circulation (total vortex strength), kelvin theorem, starting vortex, syarat kutu pada trailing edge, syarat kinematis pada kontur.</p> <p><i>Circulation (total vortex strength), Kelvin theorem, starting vortex, kutu conditions on the trailing edge, kinematic conditions on contours.</i></p> <p><b>[1]</b></p>	



		<i>Kelvin theorem, starting vortex, kutta conditions at the trailing edge and conditions. Kinematics on contours.</i>					
<b>8</b>	<b>Evaluasi Tengah Semester / MIDTERM EXAM :</b> Presentasi kelompok project pemodelan aliran melintasi ellips, circular cylinder dan rotated cylinder. <i>Presentation of the flow modeling project group across an ellipse, circular cylinder and rotated cylinder.</i>						35
<b>9</b>	Mahasiswa mampu memahami & melaksanakan pemodelan airfoil simetris tipis dengan angle of attack kecil. <i>Students are able to understand &amp; implement thin symmetrical airfoil modeling with a small angle of attack.</i>	Mampu memahami prosedur matematis pemodelan, dan mampu menganalisa pengaruh peningkatan angle of attack terhadap gaya lift. <i>Able to understand mathematical modeling procedures, and</i>	Diskusi <i>Discussion</i>	<ul style="list-style-type: none"> <li>• Kuliah <i>Lecture</i></li> <li>• Diskusi <i>Discussion</i></li> </ul> <b>[TM: 1 x (3 x 50")]</b>		Pemodelan airfoil simetris tipis dengan angle of attack. <i>Modeling a thin symmetrical airfoil with angle of attack.</i> <b>[1]</b>	



		<i>able to analyze the effect of increasing the angle of attack on lift force.</i>					
<b>10</b>	<p>Mahasiswa mampu memahami &amp; melaksanakan pemodelan airfoil simetris tipis tanpa angle of attack (droplet modelling) <i>Students are able to understand &amp; implement thin symmetrical airfoil modeling without angle of attack (droplet modeling)</i></p>	<p>Mampu memahami prosedur matematis pemodelan, dan mampu menganalisa pengaruh ketebalan kontur terhadap kecepatan aliran pada kontur <i>Able to understand mathematical modeling procedures, and able to analyze the effect of contour thickness on flow velocity in the contour</i></p>	<p>Diskusi <i>Discussion</i></p>	<ul style="list-style-type: none"> <li>• Kuliah <i>Lecture</i></li> <li>• Diskusi <i>Discussion</i></li> </ul> <p><b>[TM: 1 x (3 x 50")]</b></p>		<p>Pemodelan airfoil simetris tipis tanpa angle of attack (Tropfen Model) <i>Modeling a thin symmetrical airfoil without angle of attack (Tropfen Model)</i></p> <p style="text-align: center;"><b>[2]</b></p>	



11	Evaluasi Sisipan : Presentasi project pemodelan materi minggu ke 10 <i>Short Exam: Modelling project presentation of week 10 learning material</i>					10
12	Mahasiswa mampu memahami & melaksanakan pemodelan airfoil tidak simetris tipis kelengkungan lemah dengan angle of attack kecil.  <i>Students are able to understand &amp; implement modeling of thin asymmetrical airfoils of weak curvature with a small angle of attack.</i>	Mampu memahami prosedur matematis pemodelan, dan mampu menganalisa pengaruh peningkatan kelengkungan & angle of attack terhadap gaya lift. <i>Able to understand mathematical modeling procedures, and able to analyze the effect of increasing curvature &amp; angle of attack on lift force.</i>	Diskusi <i>Discussion</i>	Kuliah <i>Lecture</i> <b>[TM: 1 x (3 x 50'')]</b>		Pemodelan airfoil tidak simetris tipis lengkung lemah dengan angle of attack. <i>Modeling a thin, weakly curved asymmetrical airfoil with angle of attack.</i> <b>[1] &amp; [2]</b>
13	Mahasiswa mampu	Mampu melaksanakan	Tugas : Project	Kuliah <i>Lecture</i>		Pemodelan numerik source panel



	memahami & melaksanakan pemodelan numerik source / sink panel <i>Students can understand &amp; carry out numerical modeling of source / sink panels</i>	pemodelan numerik panel source untuk bluff body <i>Able to carry out numerical modeling of panel sources for bluff bodies</i>	pemodelan materi minggu ke 12 <i>Assignment: Modelling Projects of learning material from week 12</i>	[TM: 1 x (3 x 50'')]		<i>Source panel numerical modeling</i> [1]	
14	Mahasiswa mampu memahami & melaksanakan pemodelan numerik panel vortex <i>Students can understand &amp; carry out numerical modeling of vortex panels</i>	Mampu melaksanakan pemodelan numerik panel vortex untuk camber line <i>Able to carry out numerical modeling of vortex panels for camber lines</i>	Diskusi <i>Discussion</i>	Kuliah <i>Lecture</i> [TM: 1 x (3 x 50'')]		Pemodelan numerik panel vortex <i>Numerical modeling of vortex panels</i> [1]	
15	Mahasiswa mampu memahami	Mampu melakukan perhitungan skin	Diskusi <i>Discussion</i>	Kuliah <i>Lecture</i> [TM: 1 x (3 x 50'')]		Momentum integral equation inner boundary layer.	



	<p>perhitungan skinfriction drag menggunakan persamaan momentum dalam boundary layer. <i>Students are able to understand skin friction drag calculations using the momentum equation in the boundary layer.</i></p>	<p>friction drag pada airfoil simetris tipis yang diasumsikan sebagai pelat datar. <i>Able to calculate skin friction drag on a thin symmetrical airfoil which is assumed to be a flat plate.</i></p>				<p><i>Momentum integral equation inner boundary layer.</i> <b>[3]</b></p>	
<b>16</b>	<b>Evaluasi Akhir Semester / FINAL EXAM :</b> Presentasi kelompok project pemodelan aliran melintasi airfoil moderate kelengkungan lemah dengan angle of attack kecil. <i>Presentation of the flow modeling project group across a moderate thickness airfoil of weak curvature with a small angle of attack.</i>						35





**INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)**  
**FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM**  
**DEPARTEMEN TEKNIK MESIN**  
**PROGRAM STUDI S2 TEKNIK MESIN**

Kode Dokumen

**RENCANA PEMBELAJARAN SEMESTER**  
*Semester Learning Plan*

MATA KULIAH	KODE CODE	RUMPUN MK COURSE Cluster	BOBOT (Sks) CREDITS		SEMESTER SEMESTER	TGL PENYUSUNAN DATE
ALIRAN FLUIDA VISKOS (KENTAL) <i>VISCOS FLUID FLOW</i>	TM235226	MEKANIKA FLUIDA DAN MESIN-MESIN FLUIDA <i>FLUID MECHANICS AND FLUID MACHINES</i>	<b>T= 3</b>	<b>P= 0</b>	PILIHAN <i>ELECTIVE</i>	5 Mei 2023
<b>OTORISASI</b> <i>AUTHORIZATION</i>	<b>Pengembang RPS</b> <i>Developer Lecturer of Semester Learning Plan</i>	<b>Koordinator RMK</b> <i>Course Cluster Coordinator</i>			<b>Ketua PRODI</b> <i>Head of Postgraduate Program</i>	
	SUTARDI	SUTARDI			Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng	
<b>Capaian Pembelajaran</b> <i>Learning Outcomes</i>	<b>CPL-PRODI yang dibebankan pada MK</b> <i>PLO Program Charged to The Course</i>					
	CPL-4 <i>PLO-4</i>	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>Able to assess theoretical concepts and systems design methods or mechanical engineering technology deeply</i>				
	CPL-5 <i>PLO-5</i>	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>Able to understand and utilize engineering scientific theory in the field of mechanical engineering.</i>				
	CPL-6 <i>PLO-6</i>	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin.				



		<i>Able to develop innovative mechanical design systems and components by utilizing interdisciplinary or multidisciplinary knowledge.</i>				
CPL-8 PLO-8		Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>Able to formulate new ideas from previous research for developing technology and mechanical systems.</i>				
<b>Capaian Pembelajaran Mata Kuliah (CPMK) Course Learning Outcome (CLO)</b>						
CPMK-1 CLO-1		Mahasiswa mampu menganalisa aliran viscous secara fisik dan matematik. <i>Students are able to analyze viscous flow physically and mathematically.</i>				
CPMK-2 CLO-2		Mahasiswa mampu menganalisa Mekanika kontinum, persamaan konservasi dasar, dan persamaan fluida Newton <i>Students are able to analyze continuum mechanics, basic conservation equations and Newton's fluid equations</i>				
CPMK-3 CLO-3		Mahasiswa mampu menganalisa persamaan Navier-Stokes, penyelesaian persamaan Navier-Stokes, dan dinamika vortisitas <i>Students are able to analyze the Navier-Stokes equations, solve the Navier-Stokes equations, and vorticity dynamics</i>				
CPMK-4 CLO-4		Mahasiswa mampu menganalisa lapisan batas dan pengenalan aliran turbulen. <i>Students are able to analyze boundary layers and recognize turbulent flow.</i>				
		<b>Matrik CPL – CPMK PLO – CLO Matrix</b>				
		CPMK CLO	CPL-4 PLO-4	CPL-5 PLO-5	CPL-6 PLO-6	CPL-8 PLO-8
		CPMK-1 CLO-1		V	V	
		CPMK-2 CLO-2	V			
		CPMK-3 CLO-3	V	V		



		CPMK-4 CLO-4				V	
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	Aliran viscous adalah aliran dari suatu fluida yang mempunyai kekentalan. Dalam aliran ini pengaruh tegangan geser sangat besar. <i>Viscous flow is the flow of a fluid that has viscosity. In this flow the influence of shear stress is very large.</i>						
<b>Bahan Kajian: Materi Pembelajaran</b> <i>Course Material</i>	<ol style="list-style-type: none"><li>1. Mekanika kontinum <i>Continuum mechanics</i></li><li>2. Persamaan konservasi dasar: Konservasi massa, konservasi momentum, dan konservasi energi <i>Basic conservation equations: Conservation of mass, conservation of momentum, and conservation of energy</i></li><li>3. Persamaan fluida Newton dan persamaan Navier-Stokes <i>Newton's fluid equations and Navier-Stokes equations</i></li><li>4. Penyelesaian terhadap persamaan Navier-Stokes <i>Solving the Navier-Stokes equations</i></li><li>5. Dinamika vortisitas <i>Vorticity dynamics</i></li><li>6. Lapisan batas (Boundary layer) <i>Boundary layer</i></li><li>7. Pengantar aliran turbulen.</li></ol>						



<i>Introduction of turbulent flow.</i>							
<b>Pustaka References</b>	<b>Utama : Main</b>	<b>White, F. M., Viscous Fluid Flow, 3rd edition, McGraw-Hill, 2006</b>					
	<b>Pendukung : Supporting</b>						
	1). Tennekes, H. and Lumley, J. L., "A First Course in Turbulence", The MIT Press, 1972 2). Panton, R. L., Incompressible Flow, 3rd edition, John Wiley & Sons, New York, 2005						
<b>Dosen Pengampu Lecturers</b>	Sutardi						
<b>Matakuliah syarat Prerequisites</b>	Mekanika Fluida Dasar 1 dan 2 Termodinamika 1 dan 2						
<b>Mg Ke- / Week</b>	<b>Kemampuan akhir tiap tahap belajar (Sub-CPMK) Final ability of each learning stage (LLO)</b>	<b>Penilaian Assesment</b>		<b>Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu] Form of Learning, Learning Method, Student Assignment [Time Estimation]</b>		<b>Materi Pembelajaran [Pustaka] Learning Material [Reference]</b>	<b>Bobot Penilaian (%) Assesment Load (%)</b>
		<b>Indikator / Indicator</b>	<b>Kriteria &amp; Bentuk Criteria &amp; Model</b>	<b>Luring Offline</b>	<b>Daring Online</b>		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)



1	Mahasiswa mampu memahami dan menganalisa Persamaan dasar untuk aliran viscos <i>Students are able to understand and analyze the basic equations for viscous flow</i>	Mampu memahami dan menganalisa Persamaan dasar untuk aliran viscos <i>Able to understand and analyze the basic equations for viscous flow</i>	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i>	Kuliah Pengantar & Brainstorming <i>Introduction Class &amp; Brainstorming</i> [TM: 1 x (3 x 50")]		Persamaan dasar untuk aliran viscos <i>Basic equations for viscous flow</i>	0
2	Mahasiswa mampu memahami dan menganalisa mekanika kontinum dan Persamaan konservasi dasar <i>Students are able to understand and analyze continuum mechanics and basic conservation equations</i>	Mampu memahami dan menganalisa mekanika kontinum dan Persamaan konservasi dasar <i>Able to understand and analyze continuum mechanics and basic conservation equations</i>	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i>	- Kuliah <i>Lecture</i> [TM: 1 x (3 x 50")]		Mekanika kontinum dan Persamaan konservasi dasar <i>Continuum mechanics and basic conservation equations</i>	0



3	Mahasiswa mampu memahami Review dari persamaan diferensial gerakan fluida <i>Students are able to understand the review of differential equations of fluid motion</i>	Mampu memahami Review dari persamaan diferensial gerakan fluida <i>Able to understand the review of differential equations of fluid motion</i>	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i> <b>Tugas</b> <b>Assignment</b>	- Kuliah <i>Lecture</i> - Latihan soal <i>Assignment exercises</i> [TM: 1 x (3 x 50”)]		Memninjau persamaan diferensial gerakan fluida <i>Review the differential equations of fluid motion</i>	<b>5</b>
4	Mahasiswa mampu melakukan analisa dan penyelesaian Persamaan Navier-Stokes <i>Students are able to analyze and solve the Navier-Stokes equations</i>	Mampu melakukan analisa Persamaan Navier-Stokes <i>Able to analyze the Navier-Stokes equations</i>	<b>Kuliah</b> <b>Lecture</b>	Kuliah <i>Lecture</i> [TM: 1 x (3 x 50”)]		Analisa dan penyelesaian Persamaan Navier-Stokes <i>Analysis and solution of the Navier-Stokes Equations</i>	<b>0</b>
5	Mahasiswa mampu melakukan analisa dan penyelesaian Persamaan Navier-Stokes <i>Students are able to analyze and solve the Navier-Stokes equations</i>	Mampu melakukan analisa dan menyelesaikan Persamaan Navier-Stokes <i>Able to analyze and solve the</i>	Kuis 1 <i>Quiz</i>	- Kuis <i>Quiz</i> [TM: 1 x (3 x 50”)]		Penyelesaian Persamaan Nivier Stokes – Kuis 1 <i>Solving the Nivier Stokes Equation – Quiz 1</i>	<b>10</b>



		<i>Navier-Stokes Equations</i>					
<b>6</b>	Mahasiswa mampu melakukan analisa dan perhitungan Aliran fluida viskos di sekitar benda <i>Students are able to analyze and calculate viscous fluid flow around objects</i>	Mampu melakukan analisa dan perhitungan Aliran fluida viskos di sekitar benda <i>Able to analyze and calculate viscous fluid flow around objects</i>	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i> Tugas <i>Assignment</i>	Kuliah <i>Lecture</i> [TM: 1 x (3 x 50”)]		Aliran fluida viskos di sekitar benda – konsep Lapisan Batas <i>Viscous fluid flow around objects – Boundary Layer concept</i>	<b>5</b>
<b>7</b>	Mahasiswa mampu memahami konsep Lapisan Batas Laminer <i>Students are able to understand the concept of Laminar Boundary Layers</i>	Mampu memahami konsep Lapisan Batas Laminer <i>Able to understand the concept of Laminar Boundary Layers</i>	Diskusi <i>Discussion</i>	Presentasi <i>Presentation</i> Diskusi <i>Discussion</i> [TM: 1 x (3 x 50”)]		Lapisan Batas <i>Boundary Layer</i> Laminer <i>Laminary</i>	<b>0</b>
<b>8</b>	<b>Evaluasi Tengah Semester / MIDTERM EXAM</b>						<b>25</b>
<b>9</b>	Mahasiswa mampu memahami konsep Lapisan Batas turbulen	Mampu memahami konsep Lapisan Batas turbulen	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i>	Kuliah <i>Lecture</i> [TM: 1 x (3 x 50”)]		Lapisan Batas turbulen <i>Turbulent Boundary Layer</i>	<b>0</b>



	<i>Students are able to understand the concept of turbulent boundary layers</i>	<i>Able to understand the concept of turbulent boundary layers</i>					
<b>10</b>	Mahasiswa mampu melakukan analisa Aliran fluida viskos di sekitar benda – Gaya Drag <i>Students are able to analyze viscous fluid flow around objects - Drag Force</i>	Mampu melakukan analisa Aliran fluida viskos di sekitar benda – Gaya Drag <i>Able to analyze viscous fluid flow around objects - Drag Force</i>	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i>	- Kuliah <i>Lecture</i> [TM: 1 x (3 x 50”)]		Aliran fluida viskos di sekitar benda – Gaya Drag <i>Viscous fluid flow around an object – Drag Force</i>	<b>0</b>
<b>11</b>	Mahasiswa mampu melakukan analisa Aliran fluida viskos di sekitar benda – Gaya lift <i>Students are able to analyze viscous fluid flow around objects - Lift force</i>	Mampu melakukan analisa Aliran fluida viskos di sekitar benda – Gaya lift <i>Able to analyze viscous fluid flow around objects - Lift force</i>	Kuliah <i>Lecture</i> - Latihan soal <i>Assignment exercises</i> - Tugas <i>Assignment</i>	- Kuliah <i>Lecture</i> - Latihan soal <i>Assignment exercises</i> [TM: 1 x (3 x 50”)]		Aliran fluida viskos di sekitar benda – Gaya Lift <i>Viscous fluid flow around an object – Lift Force</i>	<b>7.5</b>
<b>12</b>	Mahasiswa mampu melakukan analisa Aliran	Mampu melakukan analisa Aliran	Kuis Singkat 2 <i>Short Quiz 2</i>	Kuis <i>Quiz</i>		Aliran fluida viskos di sekitar benda – Gaya Lift – Quiz	<b>15</b>






	fluida viskos di sekitar benda – Gaya lift <i>Students are able to analyze viscous fluid flow around objects - Lift force</i>	fluida viskos di sekitar benda – Gaya lift <i>Able to analyze viscous fluid flow around objects - Lift force</i>		[TM: 1 x (3 x 50”)]		<i>Viscous fluid flow around an object – Lift Force - Quiz</i>	
<b>13</b>	Mahasiswa mampu melakukan analisa gaya aerodinamik pada benda – Gaya drag dan lift <i>Students are able to analyze aerodynamic forces on objects - drag and lift forces</i>	Mampu melakukan analisa gaya aerodinamik pada benda – Gaya drag dan lift <i>Able to analyze aerodynamic forces on objects - drag and lift forces</i>	Kuliah <i>Lecture</i> Diskusi <i>Discussion</i>	- Kuliah <i>Lecture</i> [TM: 1 x (3 x 50”)]		Lapisan batas dan gaya aerodinamik <i>Boundary layers and aerodynamic forces</i>	<b>0</b>
<b>14</b>	Mahasiswa mampu memahami dan menganalisa Dinamika vortisitas <i>Students are able to understand and analyze vorticity dynamics</i>	Mampu memahami dan menganalisa Dinamika vortisitas <i>Able to understand and analyze vorticity dynamics</i>	Kuliah <i>Lecture</i> Tugas <i>Assignment</i>	Kuliah <i>Lecture</i> Latihan soal <i>Assignment exercises</i> [TM: 1 x (3 x 50”)]		Dinamika vortisitas <i>Vorticity dynamics</i>	<b>7.5</b>



15	Mahasiswa mampu memahami konsep Aliran Turbulen <i>Students are able to understand the concept of Turbulent Flow</i>	Mampu memahami konsep Aliran Turbulen <i>Able to understand the concept of Turbulent Flow</i>	Presentasi <i>Presentation</i> Diskusi <i>Discussion</i>	Kuliah <i>Lecture</i> Presentasi <i>Presentation</i> [TM: 1 x (3 x 50")]		Pengenalan Aliran Turbulen <i>Introduction to Turbulent Flow</i>	0
16	Evaluasi Akhir Semester / <i>FINAL EXAM</i>						25



		<b>INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)</b> <b>FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM</b> <b>DEPARTEMEN TEKNIK MESIN</b> <b>PROGRAM STUDI S2 TEKNIK MESIN</b>				Kode Dokumen
<b>RENCANA PEMBELAJARAN SEMESTER</b> <b>SEMESTER LEARNING PLAN</b>						
MATA KULIAH (SUBJECTS)		KODE (CODE)	Rumpun MK COURSE CLUSTER	BOBOT (SKS) CREDITS		SEMESTER SEMESTER
Desain Produk <i>Product Design</i>		TM 235209	Perancangan dan Pengembangan Produk	T= 3	P= 0	1 25 November 2023
OTORISASI AUTHORIZATION		Pengembang RPS <i>Developer Lecturer of Semester Learning Plan</i>	Koordinator RMK <i>Course Cluster Coordinator</i>		Ketua PRODI <i>Head of Postgraduate Program</i>	
		I Made Londen Batan	I Made Londen Batan		Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng	
Capaian Pembelajaran <i>Learning Outcomes</i>	CPL-PRODI yang dibebankan pada MK <i>PLO Charged to The Course</i>					
	CPL-5 PLO-5	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>Able to understand and utilize engineering scientific theory in the field of mechanical engineering.</i>				
	CPL-6 PLO-6	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin. <i>Able to develop innovative mechanical design systems and components by utilizing interdisciplinary or multidisciplinary knowledge.</i>				
	CPL-7 PLO-7	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin.				



		<i>Able to expand knowledge in certain fields related to mechanical systems with an interdisciplinary or multidisciplinary approach.</i>
<b>CPL-8</b> <b>PLO-8</b>		Mampu merumuskan ide-ide baru dari penelitian sebelumnya untuk perkembangan teknologi dan sistem mekanik. <i>Able to discover new ideas from previous research for developing technology and mechanical systems.</i>
<b>Capaian Pembelajaran Mata Kuliah (CPMK)</b> <b>Course Learning Outcome (CLO)</b>		
CPMK-1 CLO-1		Mahasiswa mampu memahami proses perancangan dan pengembangan produk <i>Students are able to understand the product design and development process</i>
CPMK-2 CLO-2		Mahasiswa mampu menganalisa aspek teknik produk seperti fungsi, kekuatan, keamanan, keergonomisan, mampu manufaktur dan perakitan <i>Students are able to analyze product engineering aspects such as function, strength, safety, ergonomics, manufacturing and assembly capabilities</i>
CPMK-3 CLO-3		Mahasiswa mampu mengembangkan produk dari aspek desain, ergonomis, manufaktur dan perakitan <i>Students are able to develop products from design, ergonomics, manufacturing and assembly aspects</i>
CPMK-4 CLO-4		Mahasiswa mampu pengembangan produk berdasarkan kebutuhan konsumen <i>Students are able to develop products based on consumer needs</i>



	<p><b>Matrik CPL – CPMK</b> <b>PLO – CLO Matrix</b></p> <table border="1"><thead><tr><th>CPMK CLO</th><th>CPL-5 PLO-5</th><th>CPL-6 PLO-6</th><th>CPL-7 PLO-7</th><th>CPL-8 PLO-8</th></tr></thead><tbody><tr><td>CPMK-1 CLO-1</td><td>V</td><td>V</td><td>V</td><td></td></tr><tr><td>CPMK-2 CLO-2</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-3 CLO-3</td><td>V</td><td>V</td><td>V</td><td>V</td></tr><tr><td>CPMK-4 CLO-4</td><td></td><td>V</td><td>V</td><td>V</td></tr><tr><td>Total <i>Total</i></td><td></td><td></td><td></td><td></td></tr></tbody></table>	CPMK CLO	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7	CPL-8 PLO-8	CPMK-1 CLO-1	V	V	V		CPMK-2 CLO-2	V	V	V	V	CPMK-3 CLO-3	V	V	V	V	CPMK-4 CLO-4		V	V	V	Total <i>Total</i>				
CPMK CLO	CPL-5 PLO-5	CPL-6 PLO-6	CPL-7 PLO-7	CPL-8 PLO-8																											
CPMK-1 CLO-1	V	V	V																												
CPMK-2 CLO-2	V	V	V	V																											
CPMK-3 CLO-3	V	V	V	V																											
CPMK-4 CLO-4		V	V	V																											
Total <i>Total</i>																															
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	<p>Mata kuliah ini membahas metode perancangan produk, baik dari aspek desain, ergonomi, manufaktur, dan perakitan serta membahas pengembangan produk berdasarkan kebutuhan konsumen melalui metode Quality Function Deployment (QFD). <i>This course discusses product design methods, both from the design, ergonomics, manufacturing and assembly aspects and discusses product development based on consumer needs through the Quality Function Deployment (QFD) method.</i></p>																														
<b>Bahan Kajian: Materi Pembelajaran</b> <i>Course Materials</i>	<p>Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut: <i>In this course, students will study the following topics:</i></p> <ol style="list-style-type: none"><li>1. Proses desain: proses desain kognitif, persuatif, deduktif <i>Design process: cognitive, persuasive, deductive design process</i></li><li>2. Fungsi produk: struktur fungsi, fungsi utama, fungsi tambahan sebuah produk <i>Product function: function structure, main function, additional functions of a product</i></li><li>3. Pengembangan konsep : daftar kebutuhan, pembuatan dan pemilihan konsep <i>Concept development: list of requirements, concept creation and selection</i></li></ol>																														



	<ol style="list-style-type: none"> <li>4. Perancangan komponen: perwujudan desain, perancangan komponen yang ekonomis, perancangan untuk manufaktur dan perakitan <i>Component design: design realization, economical component design, design for manufacturing and assembly</i></li> <li>5. Ergonomi Produk: metode RULA, manfaat dan aplikasinya dalam perancangan dan pengembangan produk <i>Product Ergonomics: RULA method, its benefits and application in product design and development</i></li> <li>6. Pengembangan produk: konsep pengembangan berbasis fungsi produk, quality function deployment (QFD) <i>Product development: product function-based development concept, quality function deployment (QFD)</i></li> </ol>				
<b>Pustaka References</b>	<b>Utama Main</b>				
	Batan, I Made Londen, Desain Produk Edisi 1, Guna Widya, 2012, Surabaya				
	<b>Pendukung Supporting</b>	<ol style="list-style-type: none"> <li>1. Bralla, James G., Design for Manufacturability Handbook, Mc Graw-Hill, 1999.</li> <li>2. Mc-Atamney, Lynn and Corlett, E Nigel; RULA: a survey method for investigation of work-related upper limb disorders, Institute for Occupational Ergonomics, University of Nottingham.</li> <li>3. Otto, Kevin N. and Wood, Kristin L., Product Design – Techniques in Reverse Engineering and New Product Development, Printice Hall, 2000.</li> <li>4. Ulrich, Karl T.; Eppinger, Steven D., Product Design and Development. Mc Graw-Hill, Inc., 2000.</li> <li>5. Boothroyd, Geoffrey; Peter, Dewhurst and Winston, Knight, Product Design For Manufacture and Assembly, 2nd edition, 2002.</li> </ol>			
<b>Dosen Pengampu Lecturers</b>	I Made Londen Batan				
<b>Matakuliah syarat Prerequisites</b>	-				
<b>Mg Ke- Week</b>	<b>Kemampuan akhir tiap tahapan belajar (Sub-CPMK)</b>	<b>Penilaian Assesment</b>	<b>Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]</b>	<b>Materi Pembelajaran Learning Material</b>	<b>Bobot Penilaian (%)</b>



	Final ability of each learning stage (LLO)			Form of Learning, Learning Method, Student Assignment [Time Estimation]		Assesment Load (%)	
		Indikator Indicator	Kriteria & Bentuk Criteria & Model	Luring Offline	Daring Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu memahami faktor-faktor yang berpengaruh dalam pembuatan produk. <i>Students are able to understand the factors that affect product creation.</i>	Mampu dan memahami proses desain, seperti: proses desain kognitif, persuatif, dan deduktif <i>Able and understand the design process, such as: cognitive, persuasive and deductive design processes</i>	Mahasiswa dapat memberikan berbagai contoh permasalahan dalam perancangan <i>Students can provide various examples of design problems</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"] Kuliah Pengantar & Brainstorming <i>Introduction &amp; Brainstorming</i>  Penugasan Terstruktur <i>Structured Assignments</i> [PT: 3x60"]  Belajar Mandiri <i>Self-directed learning</i>		- Kontrak Kuliah <i>Class Contract</i> - Masalah pada perancangan produk <i>Problems in product design</i> - Introduksi Proses desain <i>Introduction to the design process</i>  [1]: Bab 1 <i>Chapter 1</i> [2]: Suplemen (publikasi) <i>Supplements (Publication)</i>	5



				[BM: 3x60"]			
2	Mahasiswa mampu memahami metode perancangan sebuah produk <i>Students are able to understand product design methods</i>	Mampu dan memahami proses desain, seperti: proses desain kognitif, persuatif, deduktif, terpadu, dan metode lainnya <i>Able and understand the design process, such as: cognitive, persuasive, deductive, integrated design process, and other methods</i>	Tugas 1: Mahasiswa menyampaikan rencana produk yang akan dikembangkan <i>Assignment 1: Students submit a product plan to be developed</i>  Tanya jawab <i>Question and answer</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur <i>Structured Assignments</i> [PT: 3x60"]  Belajar Mandiri <i>Self-directed learning</i> [BM: 3x60"]		- Introduksi Proses desain, metode dan aplikasinya dalam perancangan dan pembuatan produk manufaktur <i>Introduction Design process, methods and applications in designing and manufacturing manufactured products</i>  [1]: Bab 2 dan 3 <i>Chapter 2 and 3</i>	10
3	Mahasiswa mampu menyusun fungsi sebuah produk secara berkelanjutan mulai dari fungsi produk, sub bagian hingga fungsi komponen <i>Students are able to organize the function of a product in a sustainable manner starting from product function, sub parts to component function</i>	Mahasiswa Dapat menyusun fungsi komponen dan produk <i>Students can arrange the functions of components and products</i>	Desain produk dilengkapi struktur fungsi masing-masing <i>Product designs are equipped with their respective function structures</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur <i>Structured Assignments</i> [PT: 3x60"]  Belajar Mandiri		- Struktur fungsi <i>Function structure</i> - Output proses desain <i>Design Process Output</i>  [1]: Bab 4 <i>Chapter 4</i> [2]: Handout di myITS Classroom <i>Handout in MyITS Classroom</i>	5





				<i>Self-directed learning</i> [BM: 3x60"]			
<b>4</b>	Mahasiswa mampu dan paham analisis FMEA <i>Students are able and understand FMEA analysis</i>	Mahasiswa mampu dan terampil mengkaji produk eksisting dari analisis FMEA <i>Students are able and skilled in studying existing products from FMEA analysis</i>	Tugas penyusunan FMEA sebuah produk (lanjutan dari tugas 1 – produk eksisting yang dikembangkan) <i>Assigments for preparing FMEA for a product (continuation of task 1 – existing product being developed)</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur <i>Structured Assigments</i> [PT: 3x60"]  Belajar Mandiri <i>Self-directed learning</i> [BM: 3x60"]		Teori FMEA dan aplikasinya dalam pengembangan produk atau sistem <i>FMEA theory and its applications in product or systems development</i>  [3] Bab khusus FMEA [ ] Hand out <i>Handout</i>	<b>5</b>
<b>5</b>	Mahasiswa mampu menganalisis kesalahan produk dengan metode FMEA <i>Students are able to analyze product errors using the FMEA method</i>	Mahasiswa dapat menentukan rekomendasi perbaikan bagian produk yang salah <i>Students can determine recommendations for repairing faulty product parts</i>	Presentasi tugas FMEA  <i>Presentation of FMEA Assigment</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur <i>Structured Assigments</i> [PT: 3x60"]		Mahasiswa menyampaikan bagian penting dari produk yang akan dikembangkan sebagai tugas mandiri <i>Students convey important parts of the product that will be developed as an independent assigment</i>	<b>10</b>



				Belajar Mandiri <i>Self-directed learning</i> [BM: 3x60"]			
<b>6</b>	Mahasiswa mampu membuat dan memilih konsep desain sebuah produk	Terwujud konsep produk baru sebagai konsep terpilih	Diskusi tentang pengembangan produk baru	Perkuliahahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur <i>Structured Assignments</i> [PT: 3x60"]  Belajar Mandiri <i>Self-directed learning</i> [BM: 3x60"]		Konsep baru dari bagian atau komponen yang diprediksi tidak memenuhi fungsi <i>A new concept of a predicted part or component does not fulfill the function</i>	<b>5</b>
<b>7</b>	Mahasiswa mampu merancang komponen sebuah produk dengan menganalisis kekuatan material <i>Students are able to design components of a product by analyzing material strength</i>	Ada perhitungan manual dan simulasi tegangan material <i>There are manual calculations and material stress simulations</i>	Ada hasil simulasi kekuatan material <i>There are material strength simulation results</i>	Perkuliahahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur <i>Structured Assignments</i> [PT: 3x60"]		- Perancangan komponen yang ekonomis <i>Economical component designing</i> - Analisis Perancangan dari aspek kekuatan material <i>Design analysis from material strength aspects</i>	<b>5</b>



				Belajar Mandiri <i>Self-directed learning</i> [BM: 3x60"]		[1]: Bab 6 dan 7 <i>Chapter 6 and 7</i>	
<b>8</b>	<b>Evaluasi Tengah Semester / Ujian Tengah Semester MIDTERM EXAM</b>						<b>10</b>
<b>9</b>	Mahasiswa memahami perwujudan desain dan desain yang ekonomis <i>Students understand the embodiment of economical design and design</i>	Terbentuknya konsep produk yang lengkap, baik dari aspek desain maupun ekonomis <i>Forming a complete product concept, both from design and economic aspects</i>	Ada aspek ekonomis dalam perancangan sebuah produk <i>There is an economic aspect in designing a product</i>	Perkuliahan [TM: 3x50"]  Penugasan Terstruktur [PT: 3x60"]  Belajar Mandiri [BM: 3x60"]		Metode perancangan yang ekonomis dan cara memilih konsep teknoekonomi produk <i>Economical design methods and how to choose a product technoeconomic concept</i>  [3] Bab khusus economical design <i>Specific Chapter for Economical Design</i>	<b>5</b>
<b>10</b>	Mahasiswa mampu <i>Students are Capable</i> Menganalisis aspek ergonomi sebuah produk <i>Analyze the ergonomic aspects of a product</i>	Mahasiswa dapat menghitung nilai resiko cedera tubuh dalam aktifitas manual terkait produk <i>Students can calculate the risk</i>	Perhitungan nilai RULA dan REBA <i>Calculation of RULA and REBA values</i>  [Tugas khusus – presentasi hasil	Perkuliahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur		Metode RULA dan REBA serta aplikasinya pada perancangan produk <i>RULA and REBA methods and their application to product design</i>	<b>10</b>



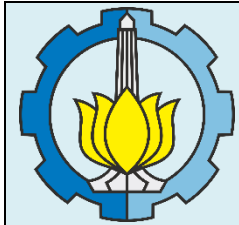
		<i>value of bodily injury in manual activities related to the product.</i>	perhitungan nilai RULA dan REBA] [Special assignment – presentation of RULA and REBA value calculation results]	Structured Assignments [PT: 3x60"]  Belajar Mandiri Self-directed learning [BM: 3x60"]		[1] Bab 9 dan Supplement paper <i>Chapter 9 and Supplements Paper</i>	
<b>11</b>	Mahasiswa mampu menganalisa perancangan untuk manufaktur <i>Students are able to analyze design for manufacturing</i>	Produk dilengkapi dengan analisis manufaktur <i>The product is equipped with manufacturing analysis</i>	Tugas 1 sudah dilengkapi dengan kajian aspek manufaktur <i>1 has been completed with a study of manufacturing aspects</i>  Diskusi kelas <i>Class Discussion</i>	Perkuliahan Lecture [TM: 3x50"]  Penugasan Terstruktur Structured Assignments [PT: 3x60"]  Belajar Mandiri Self-directed learning [BM: 3x60"]		Perancangan untuk Manufaktur <i>Designing for Manufacture</i>  [1] Bab 7 <i>Chapter 7</i>	<b>5</b>
<b>12</b>	Mahasiswa mampu menganalisa perancangan untuk perakitan <i>Students are able to analyze designs for assembly</i>	Produk dilengkapi dengan analisis perakitan <i>Product is equipped with assembly analysis.</i>	Tugas 1 sudah dilengkapi dengan kajian aspek perakitan <i>Assignment 1 is equipped with a</i>	Perkuliahan Lecture [TM: 3x50"]  Penugasan Terstruktur		Perancangan untuk Manufaktur <i>Designing for Manufacture</i>  [1] Bab 8 <i>Chapter 8</i>	<b>5</b>



			<i>study of assembly aspects</i>  Diskusi kelas <i>Class Discussion</i>	<i>Structured Assigments</i> [PT: 3x60"]  Belajar Mandiri <i>Self-directed learning</i> [BM: 3x60"]			
<b>13</b>	Mahasiswa mampu menyelesaikan hasil rancangan sebuah produk <i>Students are able to complete the design of a product</i>	Rancangan produk secara lengkap <i>Complete product design</i>	Presentasi Tugas 1 mulai dari rancangan awal hingga akhir <i>Presentation of Assigment 1 from initial design to final design</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur <i>Structured Assigments</i> [PT: 3x60"]  Belajar Mandiri <i>Self-directed learning</i> [BM: 3x60"]		Mahasiswa melakukan presentasi tugas 1 <i>Student Present Assigment 1</i>	<b>10</b>
<b>14</b>	Mahasiswa mampu memahami teori QFD <i>Students are able to understand QFD theory</i>	Pengembangan produk dari aspek QFD <i>Product development from the QFD aspect</i>	Tanya jawab di kelas dan oral test <i>Questions and answers in class and oral tests</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur		Metode QFD dan aplikasinya dalam pengembangan produk <i>Students present task 1</i>	<b>5</b>



				<i>Structured Assignments</i> [PT: 3x60"]  Belajar Mandiri <i>Self-directed learning</i> [BM: 3x60"]		<i>QFD method and its application in product development</i>  [1] Bab 10 <i>Chapter 10</i>	
15	Mahasiswa Mampu mengembangkan produk hasil analisis QFD <i>Students are able to develop products resulting from QFD analysis</i>	Hasil rancangan lengkap <i>Complete design results</i>	Diskusi hasil analisa QFD pada masing-masing tugas mahasiswa <i>Discussion of QFD analysis results for each student assignment</i>	Perkuliahan <i>Lecture</i> [TM: 3x50"]  Penugasan Terstruktur <i>Structured Assignments</i> [PT: 3x60"]		Pemanfaatan Hasil QFD dalam pengembangan produk berkelanjutan <i>Utilization of QFD Results in sustainable product development</i>	5
16	<b>Evaluasi Akhir Semester / Ujian Akhir Semester</b> <b>FINAL EXAM</b>						20



**INSTITUT TEKNOLOGI SEPULUH NOPEMBER (ITS)**  
**FAKULTAS TEKNOLOGI INDUSTRI DAN REKAYASA SISTEM**  
**DEPARTEMEN TEKNIK MESIN**  
**PROGRAM STUDI S2 TEKNIK MESIN**

**Kode  
Dokumen**

**RENCANA PEMBELAJARAN SEMESTER**  
*Semester Learning Plan*

MATA KULIAH (SUBJECTS)	KODE (CODE)	Rumpun MK (Course cluster)	BOBOT (sks) (credits)		SEMESTER	Tgl Penyusunan
Teknologi Pembangkit Daya <i>Power Generation Technology</i>	TM235217	RTSE <i>Thermal Engineering and Energy Systems</i>	<b>T= 3</b>	<b>P= 0</b>	1	10 Desember 2023
<b>OTORISASI AUTHORIZATION</b>	<b>Pengembang RPS</b> <i>Developer Lecturer of Semester Learning Plan</i>	<b>Koordinator RMK</b> <i>Course Cluster Coordinator</i>			<b>Ketua PRODI</b> <i>Head of Postgraduate Program</i>	
	Prof. Dr. Ir. Prabowo, M.Eng	Prof. Dr. Ir. Prabowo, M.Eng			Prof. Dr.Eng Harus Laksana Guntur, S.T., M.Eng	
<b>Capaian Pembelajaran</b> <i>Learning Outcomes</i>	<b>CPL-PRODI yang dibebankan pada MK</b> <i>PLO Program Charged to The Course</i>					
	<b>CPL-4</b> <i>PLO-4</i>	Mampu menilai konsep teoritis dan metode desain sistem atau teknologi teknik mesin secara mendalam <i>Able to assess theoretical concepts and systems design methods or mechanical engineering technology deeply</i>				
	<b>CPL-5</b> <i>PLO-5</i>	Mampu memahami dan memanfaatkan teori keilmuan teknik dalam bidang teknik mesin. <i>Able to understand and utilize engineering scientific theory in the field of mechanical engineering.</i>				
	<b>CPL-6</b> <i>PLOP-6</i>	Mampu mengembangkan sistem desain mekanik yang inovatif dan komponen-komponen di dalamnya dengan memanfaatkan keilmuan interdisiplin atau multidisiplin. <i>Able to develop innovative mechanical design systems and components in them by utilizing interdisciplinary or multidisciplinary knowledge.</i>				



<b>CPL-7</b> <b>PLO-7</b>	Mampu memperdalam atau memperluas pengetahuan di bidang-bidang tertentu yang berkaitan pada sistem mekanik dengan pendekatan interdisiplin atau multidisiplin. <i>Able to deepen or expand knowledge in certain fields related to mechanical systems with an interdisciplinary or multidisciplinary approach.</i>
<b>Capaian Pembelajaran Mata Kuliah (CPMK)</b> <b>Course Learning Outcome (CLO)</b>	
CPMK-1 CLO-1	Mampu memahami dan menganalisis dan menyelesaikan Siklus Carnot, Siklus Rankine dengan penambahan Superheater, Reheater, Regenerative <i>Able to understand and analyze and complete the Carnot Cycle, Rankine Cycle with the addition of Superheater, Reheater, Regenerative</i>
CPMK-2 CLO-2	Mampu membangun Balance of Plant/Heat and Mass Balance steam power plant untuk mendapatkan NPHR, Boiler Efficiency, Nett Turbin heat rate <i>Able to build Balance of Plant/Heat and Mass Balance steam power plant to get NPHR, Boiler Efficiency, Nett Turbine heat rate</i>
CPMK-3 CLO-3	Mampu memahami dan menganalisa komponen Boiler (Pulverized Coal/PC dan Coal Fluidized Bed/CFB), aliran air-uap, aliran fluegas, aliran udara+batubara <i>Able to understand and analyze Boiler components (Pulverized Coal/PC and Coal Fluidized Bed/CFB), water-steam flow, fluegas flow, air+coal flow</i>
CPMK-4 CLO-4	Mampu memahami dan menganalisa pembakaran bahan bakar padat berdasarkan analisa proximate dan ultimate, Primary Air, Secondary Air <i>Able to understand and analyze solid fuel combustion based on proximate and ultimate analysis, Primary Air, Secondary Air</i>
CPMK-5 CLO-4	Mampu memahami dan menganalisis dan menyelesaikan Siklus Bryton, Intercooler serta Siklus Combined





		<i>Able to understand and analyze and complete the Bryton Cycle, Intercoler and Combined Cycle</i>																																															
	CPMK-6 CLO-6	Mampu membangun Balance of Plant/Heat and Mass Balance Siklus Combined (Gas dan Steam) mendapatkan NPHR, HRSG Efficiency <i>Able to build Balance of Plant/Heat and Mass Balance Combined Cycle (Gas and Steam) to get NPHR, HRSG Efficiency</i>																																															
	CPMK-7 CLO-7	Mampu memahami dan menganalisa komponen HRSG (Vertical dan Horizontal) <i>Able to understand and analyze HRSG components (Vertical and Horizontal)</i>																																															
	CPMK-8 CLO-8	Mampu memahami dan menganalisa pembakaran bahan bakar gas <i>Able to understand and analyze gas fuel combustion</i>																																															
		<p><b>Matrik CPL – CPMK</b> <b>PLO – CLO Matrix</b></p> <table border="1"> <thead> <tr> <th><b>CPMK CLO</b></th> <th><b>CPL-4 PLO-4</b></th> <th><b>CPL-5 PLO-5</b></th> <th><b>CPL-6 PLO-6</b></th> <th><b>CPL-7 PLO-7</b></th> <th><b>Bobot (%) Proportion (%)</b></th> </tr> </thead> <tbody> <tr> <td>CPMK-1 CLO-1</td> <td>V</td> <td>V</td> <td>V</td> <td></td> <td>10</td> </tr> <tr> <td>CPMK-2 CLO-2</td> <td></td> <td></td> <td>V</td> <td>v</td> <td>10</td> </tr> <tr> <td>CPMK-3 CLO-3</td> <td>v</td> <td>V</td> <td>V</td> <td></td> <td>15</td> </tr> <tr> <td>CPMK-4 CLO-4</td> <td>V</td> <td>V</td> <td>V</td> <td></td> <td>10</td> </tr> <tr> <td>CPMK-5 CLO-5</td> <td>V</td> <td>V</td> <td>V</td> <td></td> <td>10</td> </tr> <tr> <td>CPMK-6</td> <td></td> <td></td> <td>V</td> <td>V</td> <td>15</td> </tr> </tbody> </table>						<b>CPMK CLO</b>	<b>CPL-4 PLO-4</b>	<b>CPL-5 PLO-5</b>	<b>CPL-6 PLO-6</b>	<b>CPL-7 PLO-7</b>	<b>Bobot (%) Proportion (%)</b>	CPMK-1 CLO-1	V	V	V		10	CPMK-2 CLO-2			V	v	10	CPMK-3 CLO-3	v	V	V		15	CPMK-4 CLO-4	V	V	V		10	CPMK-5 CLO-5	V	V	V		10	CPMK-6			V	V	15
<b>CPMK CLO</b>	<b>CPL-4 PLO-4</b>	<b>CPL-5 PLO-5</b>	<b>CPL-6 PLO-6</b>	<b>CPL-7 PLO-7</b>	<b>Bobot (%) Proportion (%)</b>																																												
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CPMK-5 CLO-5	V	V	V		10																																												
CPMK-6			V	V	15																																												



		CLO-6					
		CPMK-7 CLO-7	V	V	V		15
		CPMK-8 CLO-8	v	V	V		15
		<b>Total bobot (%) Total Proportion (%)</b>	<b>25</b>	<b>25</b>	<b>37.5</b>	<b>12.5</b>	<b>100</b>
<b>Deskripsi Singkat MK</b> <i>Short Description of Course</i>	<p>Sistem Pembangkit Tenaga merupakan mata kuliah yang mencakup berbagai konsep dan hukum proses termodinamika dan perpindahan panas &amp; massa pada susatu system pembangkit baik itu system pembangkit uap, sisten pembangkit gas, system pembangkit kombinasi (gas &amp; uap)</p> <p><i>Power Generation Systems is a course that covers various concepts and laws of thermodynamic processes and heat &amp; mass transfer in a generating system, be it a steam generating system, a gas generating system, a combination generating system (gas &amp; steam).</i></p>						
<b>Bahan Kajian: Materi Pembelajaran</b> <i>Course Materials</i>	<p>Dalam mata kuliah ini akan mempelajari pokok-pokok bahasan sebagai berikut:</p> <ul style="list-style-type: none"> <li>- Siklus Rankine dengan Superheater, Reheater, Regenerative</li> <li>- Membangun heat and mass balance dari steam power plant dengan software</li> <li>- Komponen Boiler PC, efisensi boiler (direct dan indirect), aliran udara+batubara, aliran flue gas, aliran air dan uap.</li> <li>- Komponen Feedwater (HPH dan LPH, Deaerator), Condenser, Turbin, pompa (condasate pump dan BFP)</li> <li>- Proses pembakaran, ultimate dan proximate analysis, AFR, Air to Coal Ratio, Primary dan Secondary Air.</li> <li>- Konsep dan komponen CFB boiler</li> <li>- Siklus Bryton, Intercooler, Siklus kombinasi, HRSG</li> <li>- Membangun heat and mass balance dari gas power plant serta kombinasi dengan software</li> <li>- Komponen HRSG (Vertical dan Horizontal), Turbin Gas, Combustion Chamber, Kompresor</li> </ul> <p><i>In this course you will study the following topics:</i></p>						



	<ul style="list-style-type: none"> <li>- Rankine cycle with Superheater, Reheater, Regenerative</li> <li>- Building heat and mass balance of steam power plant with software</li> <li>- PC Boiler Components, boiler efficiency (direct and indirect), air+coal flow, flue gas flow, water and steam flow.</li> <li>- Feedwater components (HPH and LPH, Deaerator), Condenser, Turbine, pump (condasate pump and BFP)</li> <li>- Combustion process, ultimate and proximate analysis, AFR, Air to Coal Ratio, Primary and Secondary Air.</li> <li>- CFB boiler concept and components</li> <li>- Bryton cycle, Intercooler, Combination cycle, HRSG</li> <li>- Building heat and mass balance from the gas power plant and combining it with software</li> <li>- HRSG components (Vertical and Horizontal), Gas Turbine, Combustion Chamber, Compressor</li> </ul>						
<b>Pustaka References</b>	<b>Utama : Main</b>						
	5. Dipak K Sarkar, “Thermal Power Plant: Design and Operation ”, Elsevier, 2015.						
	<b>Pendukung : supporting</b>						
	6. Kumar Rayaprolu, “Boiler for Power and Process”, CRC Taylor Francis Group,2009.						
	7. Prabir Basu, “Circulated Fluidized Bed Boiler”, Taylor Francis Group,2006.						
<b>Dosen Pengampu Lecturers</b>	Prabowo						
<b>Matakuliah syarat Prerequisites</b>	-						
Mg Ke- / Week	Kemampuan akhir tiap tahapan belajar (Sub-CPMK) <i>Final ability of each learning stage (LLO)</i>	Penilaian <i>Assesment</i>		Bantuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [ <b>Estimasi Waktu</b> ] <i>Form of Learning; Learning Method; Student Assignment</i>		Materi Pembelajaran [ <b>Pustaka</b> ] <i>Learning Material</i>	Bobot Penilaian (%) <i>Assesment Load (%)</i>
		Indikator / <i>Indicator</i>	Kriteria & Bentuk <i>Criteria &amp; Model</i>	Luring <i>Offline</i>	Daring <i>Online</i>		



(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mahasiswa mampu mengerti dan memahami: steam power plant, gas power plant serta combine cycle. <i>Students are able to understand and comprehend: steam power plant, gas power plant and combined cycle.</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menjelaskan definisi, proses dan jenis-jenis pembangkit listrik. <i>Completeness, clarity, accuracy (material &amp; time), and originality in explaining the definition, process and types of power plants.</i>	Kriteria: - Rubrik - Marking Scheme  <i>Criteria:</i> - <b>Rubric</b> - <b>Marking Scheme</b>  Bentuk: non-test (tugas) <i>Form: non-test (assignment)</i>	Bentuk: kuliah & Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i>  Metode: Ekspositori dan discovery learning <i>Expository and discovery learning</i>  (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	- Dokumen RPS di MyITS Classroom Review & Summary PPT perkuliahan di MyITS Classroom  - <b>Semester Learning Plan Document in MyITS Classroom</b> <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i>	- Pengantar Kuliah, - Kontrak perkuliahan - Steam power plant - Gas power plant - Combine power plant  Video dan PPT Handout di myITS Classroom  - <i>Introduction to Lectures,</i> - <i>Tuition contract</i> - <i>Steam power plant</i> - <i>Gas power plant</i> - <i>Combine power plants</i>  <i>Videos and PPTs Handouts in myITS Classroom</i>	
2	Mahasiswa mampu dan terampil dalam membuat Heat and	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan	Kriteria: - Rubrik	Bentuk: kuliah & Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i>	- Latihan soal & Homework	- Dengan software: membangun simple siklus rankine ditambah	3



	<p>mass balance plant dengan software <i>Students are able and skilled in creating heat and mass balance plants with software</i></p>	<p>originalitas dalam menyelesaikan permasalahan kenaikan NPHR akibat komponen-komponen <i>Completeness, clarity, accuracy (material &amp; time), and originality in resolving the problem of increasing NPHR due to offline generator components pembangkit yang offline</i></p>	<p>- <b>Marking Scheme</b> <i>Criteria:</i> - <b>Rubric</b> - <b>Marking Scheme</b></p> <p>Bentuk: non-test (tugas) <i>Form: non-test (assignment)</i></p>	<p>Metode: Ekspositori dan <i>discovery learning</i> <i>Expository and discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<p>di MyITS Classroom Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <p>- <b>Practice questions &amp; Homework in MyITS Classroom</b> <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i></p>	<p>superheater, reheater dan regenerative - NPHR, GPHR, THR, MCR</p> <p>[1]: Bab 1 <i>Handout di myITS Classroom</i></p> <p>- <b>Software: build a simple Rankine cycle plus superheater, reheater and regenerative</b> - NPHR, GPHR, THR, MCR</p> <p>[1]: Chapter 1 <i>Handouts in myITS Classroom</i></p>	
3	<p>Mahasiswa mampu dan terampil dalam membuat Heat and mass balance plant dengan software <i>Students are able and skilled in creating heat and mass balance plants with software</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan kenaikan NPHR akibat komponen-komponen</p>	<p>Kriteria: - <b>Rubrik</b> - <b>Marking Scheme</b> <i>Criteria:</i> - <b>Rubric</b> - <b>Marking Scheme</b></p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i></p> <p>Metode: Ekspositori dan <i>discovery learning</i> <i>Expository and discovery learning</i></p>	<p>- <b>Latihan soal &amp; Homework di MyITS Classroom</b> Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <p>- <b>Practice questions &amp;</b></p>	<p>- Dengan software: membangun simple siklus rankine ditambah superheater, reheater dan regenerative - NPHR, GPHR, THR, MCR</p> <p>[1]: Bab 1 <i>Handout di myITS Classroom</i></p>	



		<p>pembangkit yang offline</p> <p><i>Completeness, clarity, accuracy (material &amp; time), and originality in resolving the problem of increasing NPHR due to offline generator components</i></p>	<p>Bentuk: non-test (tugas)</p> <p><i>Form: non-test (assignment)</i></p>	<p>(TM: 3 x 50") (PT: 3 x 60")</p> <p>(BM: 3 x 60")</p>	<p><b>Homework in MyITS Classroom</b></p> <p><i>Review &amp; Summary of PPT lectures in MyITS Classroom</i></p>	<p><i>- Software: build a simple Rankine cycle plus superheater, reheater and regenerative</i></p> <p><i>- NPHR, GPHR, THR, MCR</i></p> <p><i>[1]: Chapter 1 Handouts in myITS Classroom</i></p>	
4	<p>Mahasiswa mampu memahami dan menganalisa komponen boiler: tube wall, drum, superheater, reheater, economizer, air heater, PA, SA dan AFR</p> <p><i>Students are able to understand and analyze boiler components: tube wall, drum, superheater, reheater,</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan heat duty untuk masing-masing heating part pada boiler, Efisiensi boiler, aliran udara PA, SA, perhitungan, resident time coal</p> <p><i>Completeness, clarity, accuracy</i></p>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> <p><i>Criteria:</i></p> <ul style="list-style-type: none"> <li>- <b>Rubric</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p>Bentuk: test (dokumen tes, Kuis 1)</p> <p><i>Form: test (document test, quiz 1)</i></p>	<p>Bentuk: kuliah <i>Lecture</i></p> <p>Metode: Ekspositori dan <i>discovery learning</i></p> <p><i>Expository and discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60")</p> <p>(BM: 3 x 60")</p>	-	<ul style="list-style-type: none"> <li>- Komponen dalam boiler</li> <li>- Efisiensi boiler direct dan indirect method</li> <li>- PA, SA, AFR, aliran udara pembakaran, aliran flue gas, aliran air dan uap</li> <li>- resident time coal untuk PC</li> <li>- perbedaan PC dan CFB</li> </ul> <p><i>[1]: Bab 2 dan buku 2 Handout di myITS Classroom</i></p>	10



	<i>economizer, air heater, PA, SA and AFR</i>	<i>(material &amp; time), and originality in solving heat duty problems for each heating part in the boiler, boiler efficiency, air flow PA, SA, calculations, resident time coal</i>				<ul style="list-style-type: none"> <li>- Components in the boiler</li> <li>- Direct and indirect method boiler efficiency</li> <li>- PA, SA, AFR, combustion air flow, flue gas flow, water and steam flow</li> <li>- resident time coal for PC</li> <li>- differences between PC and CFB</li> </ul> <p>[1]: Chapter 2 and book 2 Handouts in myITS Classroom</p>	
5	<p>Mahasiswa mampu memahami dan menganalisa komponen boiler: tube wall, drum, superheater, reheater, economizer, air heater, PA, SA dan AFR</p> <p><i>Students are able to understand and analyze boiler components: tube wall, drum,</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan heat duty untuk masing-masing heating part pada boiler, Efisiensi boiler, aliran udara PA, SA,</p>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> <p>Criteria:</p> <ul style="list-style-type: none"> <li>- <b>Rubric</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p>Bentuk: non-test (tugas) Form: non-test (assignment)</p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i></p> <p>Metode: Ekspositori dan <i>discovery learning</i> <i>Expository and discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<ul style="list-style-type: none"> <li>- Latihan soal &amp; Homework di MyITS Classroom</li> </ul> <p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <ul style="list-style-type: none"> <li>- <b>Practice questions &amp; Homework in MyITS Classroom</b></li> </ul>	<ul style="list-style-type: none"> <li>- Komponen dalam boiler</li> <li>- Efisiensi boiler direct dan indirect method</li> <li>- PA, SA, AFR, aliran udara pembakaran, aliran flue gas, aliran air dan uap</li> <li>- resident time coal untuk PC</li> <li>- perbedaan PC dan CFB</li> </ul> <p>[1]: Bab 2 dan buku 2</p>	



	<i>superheater, reheater, economizer, air heater, PA, SA and AFR</i>	perhitungan, resident time coal <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving heat duty problems for each heating part in the boiler, boiler efficiency, air flow PA, SA, calculations, resident time coal</i>			<i>Review &amp; Summary of PPT lectures in MyITS Classroom</i>	Handout di myITS Classroom  - <i>Components in the boiler</i> - <i>Direct and indirect method boiler efficiency</i> - <i>PA, SA, AFR, combustion air flow, flue gas flow, water and steam flow</i> - <i>resident time coal for PC</i> - <i>differences between PC and CFB</i>  <i>[1]: Chapter 2 and book 2</i> <i>Handouts in myITS Classroom</i>	
<b>6</b>	Mahasiswa mampu dan terampil dalam membuat Heat and mass balance Boiler dengan software <i>Students are able and skilled in making heat and</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan energi dari pembakaran	Kriteria: - <b>Rubrik</b> - <b>Marking Scheme</b>  <i>Criteria:</i> - <b>Rubric</b> - <b>Marking Scheme</b>	Bentuk: kuliah & Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i>  Metode: Ekspositori dan <i>discovery learning</i> <i>Expository and discovery learning</i>	- <b>Latihan soal &amp; Homework di MyITS Classroom</b>  Review & Summary PPT perkuliahan di MyITS Classroom	- Dengan software: membangun heat duty pada boiler yaitu combustion chamber (coal + air), superheater, reheater, economizer, air heater, dan stack	<b>3</b>





	<i>mass balance boilers using software</i>	batubara smp flue gas di stack <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving energy problems from burning coal to flue gas in the stack</i>	Bentuk: non-test (tugas) <i>Form: non-test (assignment)</i>	(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	- <b>Practice questions &amp; Homework in MyITS Classroom</b> <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i>	[1]: Bab 2 dan buku 2 <i>Handout</i> di myITS Classroom  - <i>Software: build heat duty on the boiler, namely combustion chamber (coal + air), superheater, reheater, economizer, air heater, and stack</i>  [1]: Chapter 2 and book 2 <i>Handouts in myITS Classroom</i>	
<b>7</b>	Mahasiswa mampu dan terampil dalam membuat Heat and mass balance Boiler dengan software <i>Students are able and skilled in making heat and mass balance boilers using software</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan energi dari pembakaran batubara smp flue gas di stack <i>Completeness, clarity, accuracy (material &amp;</i>	Kriteria: - Rubrik - Marking Scheme  <i>Criteria:</i> - <b>Rubric</b> - <b>Marking Scheme</b>  Bentuk: non-test (tugas) <i>Form: non-test (assignment)</i>	Bentuk: kuliah & Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i>  Metode: Ekspositori dan discovery learning <i>Expository and discovery learning</i>  (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	- Latihan soal & Homework di MyITS Classroom <i>Review &amp; Summary PPT perkuliahan di MyITS Classroom</i>  - <b>Practice questions &amp; Homework in MyITS Classroom</b>	- Dengan software: membangun heat duty pada boiler yaitu combustion chamber (coal + air), superheater, reheater, economizer, air heater, dan stack  [1]: Bab 2 dan buku 2 <i>Handout</i> di myITS Classroom	



		<i>time), and originality in solving energy problems from burning coal to flue gas in the stack</i>			<i>Review &amp; Summary of PPT lectures in MyITS Classroom</i>	<i>- Software: build heat duty on the boiler, namely combustion chamber (coal + air), superheater, reheater, economizer, air heater, and stack</i>  <i>[1]: Chapter 2 and book 2</i> <i>Handouts in myITS Classroom</i>	
<b>8</b>	<b>Evaluasi Tengah Semester / Ujian Tengah Semester</b> <b>MIDTERM EXAM</b>						<b>30</b>
<b>9</b>	Mahasiswa mampu memahami, menjelaskan dan menganalisis komponen Feedwater (HPH, LPH, Deaerator), condenser, steamTurbin, pompa (condensate pump, BFP), Closed cooling water <i>Students are able to understand, explain and analyze Feedwater</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan konsep kerja dan performance feedwater heater, condenser dan HE serta karakteristik pompa <i>Completeness, clarity, accuracy (material &amp;</i>	Kriteria: - Rubrik - Marking Scheme  <i>Criteria:</i> - <b>Rubric</b> - <b>Marking Scheme</b>  Bentuk: non-test (tugas) <i>Form: non-test (assignment)</i>	Bentuk: kuliah & Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i>  Metode: Ekspositori dan <i>discovery learning</i> <i>Expository and discovery learning</i>  (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	- Latihan soal & Homework di MyITS Classroom  Review & Summary PPT perkuliahan di MyITS Classroom  - <b>Practice questions &amp; Homework in MyITS Classroom</b>  <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i>	- Cara kerja feedwater heater, HE, performance dan design - Cara kerja pompa dan performance - Closed cooling system water  [1]: Bab 4 dan modul training BW <i>Handout di myITS Classroom</i>  - <i>How feedwater heaters work, HE,</i>	3



	<p>components (HPH, LPH, Deaerator), condenser, steam turbine, pump (condensate pump, BFP), Closed cooling water</p>	<p>time), and originality in resolving work concept problems and performance of feedwater heaters, condensers and HE as well as pump characteristics</p>				<p>performance and design</p> <ul style="list-style-type: none"> <li>- How the pump works and performance</li> <li>- Closed water cooling system</li> </ul> <p>[1]: Chapter 4 and BW training module Handouts in myITS Classroom</p>	
10	<p>Mahasiswa mampu memahami, menjelaskan dan menganalisis komponen Feedwater (HPH, LPH, Deaerator), condenser, steamTurbin, pompa (condensate pump, BFP), Closed cooling water</p> <p><i>Students are able to understand, explain and analyze Feedwater components (HPH, LPH, Deaerator),</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan konsep kerja dan performance feedwater heater, condenser dan HE serta karakteristik pompa</p> <p><i>Completeness, clarity, accuracy (material &amp; time), and originality in</i></p>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> <p>Criteria:</p> <ul style="list-style-type: none"> <li>- <b>Rubric</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p>Bentuk: non-test (tugas)</p> <p>Form: non-test (assignment)</p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming</p> <p><i>Lecture &amp; Discussion, Brainstroming</i></p> <p>Metode: Ekspositori dan discovery learning</p> <p><i>Expository and discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<ul style="list-style-type: none"> <li>- Latihan soal &amp; Homework di MyITS Classroom</li> </ul> <p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <ul style="list-style-type: none"> <li>- <b>Practice questions &amp; Homework in MyITS Classroom</b></li> </ul> <p>Review &amp; Summary of PPT lectures in MyITS Classroom</p>	<ul style="list-style-type: none"> <li>- Cara kerja feedwater heater, HE, performance dan design</li> <li>- Cara kerja pompa dan performance</li> <li>- Closed cooling system water</li> </ul> <p>[1]: Bab 4 dan modul training BW Handout di myITS Classroom</p> <ul style="list-style-type: none"> <li>- How feedwater heaters work, HE, performance and design</li> </ul>	



	<i>condenser, steam turbine, pump (condensate pump, BFP), Closed cooling water</i>	<i>resolving work concept problems and performance of feedwater heaters, condensers and HE as well as pump characteristics</i>				<ul style="list-style-type: none"> <li>- How the pump works and performance</li> <li>- Closed water cooling system</li> </ul> <p><i>[1]: Chapter 4 and BW training module Handouts in myITS Classroom</i></p>	
<b>11</b>	<p>Mahasiswa mampu menganalisa proses pembakaran coal, ultimate dan proximate analysis, AFR, Air to Coal Ratio, Primary dan Secondary Air</p> <p><i>Students are able to analyze the coal combustion process, ultimate and proximate analysis, AFR, Air to Coal Ratio, Primary and Secondary Air</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan proses pembakaran coal, ultimate dan proximate analysis, AFR, Air to Coal Ratio, Primary dan Secondary Air</p> <p><i>Completeness, clarity, accuracy (material &amp; time), and originality in</i></p>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> <p><i>Criteria:</i></p> <ul style="list-style-type: none"> <li>- <b>Rubric</b></li> <li>- <b>Marking Scheme</b></li> </ul> <p>Bentuk: non-test (tugas) <i>Form: non-test (assignment)</i></p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming</p> <p><i>Lecture &amp; Discussion, Brainstroming</i></p> <p>Metode: Ekspositori dan <i>discovery learning</i></p> <p><i>Expository and discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<ul style="list-style-type: none"> <li>- Latihan soal &amp; Homework di MyITS Classroom</li> </ul> <p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <ul style="list-style-type: none"> <li>- <b>Practice questions &amp; Homework in MyITS Classroom</b></li> </ul> <p>Review &amp; Summary of PPT lectures in MyITS Classroom</p>	<ul style="list-style-type: none"> <li>- Proses pembakaran, ultimate dan proximate analysis, AFR, Excess air, Air to Coal Ratio, Primary dan Secondary Air</li> <li>- Perhitungan residen time, AFR, dan Mill outlet Temperatur</li> </ul> <p>[1]: Bab 3 Handout di myITS Classroom</p> <ul style="list-style-type: none"> <li>- <i>Combustion process, ultimate and proximate analysis, AFR, Excess air, Air to Coal Ratio, Primary and Secondary Air</i></li> </ul>	3



		<i>solving coal combustion process problems, ultimate and proximate analysis, AFR, Air to Coal Ratio, Primary and Secondary Air</i>				<p>- Calculation of resident time, AFR, and Mill outlet Temperature</p> <p>[1]: Chapter 3 Handouts in myITS Classroom</p>	
12	<p>Mahasiswa mampu menganalisa proses kerja CFB beserta komponen-komponen dalam CFB</p> <p><i>Students are able to analyze the CFB work process and the components in the CFB</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan proses kerja CFB beserta komponen-komponen dalam CFB</p> <p><i>Completeness, clarity, accuracy (material &amp; time), and originality in resolving CFB work process</i></p>	<p>Kriteria:</p> <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> <p>Criteria:</p> <ul style="list-style-type: none"> <li>- Rubric</li> <li>- Marking Scheme</li> </ul> <p>Bentuk: test (dokumen tes, Kuis 2)</p> <p>Form: test (document test, quiz 2)</p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming</p> <p><i>Lecture &amp; Discussion, Brainstroming</i></p> <p>Metode: Ekspositori dan discovery learning</p> <p><i>Expository and discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>		<ul style="list-style-type: none"> <li>- Proses pembakaran CFB PA, SA dan Pasir</li> <li>- Cyclone, Heating part, wingwall, tubewall, superheater</li> <li>- Biomass + coal u CFB</li> </ul> <p>[1]: Bab 5 dan buku 3 Handout di myITS Classroom</p> <ul style="list-style-type: none"> <li>- CFB PA, SA and Sand burning process</li> <li>- Cyclone, Heating part, wingwall, tubewall, superheater</li> <li>- Biomass + coal u CFB</li> </ul>	10



		<i>problems and the components in CFB</i>				<i>[1]: Chapter 5 and book 3 Handouts in myITS Classroom</i>	
<b>13</b>	Mahasiswa mampu memahami dan menerapkan Siklus Bryton, Intercooler, Siklus kombinasi, HRSG <i>Students are able to understand and apply the Bryton Cycle, Intercooler, Combination Cycle, HRSG</i>	Kelengkapan, kejelasan, ketepatan (materi & waktu), dan originalitas dalam menyelesaikan permasalahan Siklus Bryton, Intercooler, Siklus kombinasi, HRSG <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving Bryton Cycle, Intercooler, Combination Cycle, HRSG problems</i>	Kriteria: - Rubrik - Marking Scheme  <i>Criteria:</i> - <b>Rubric</b> - <b>Marking Scheme</b>  Bentuk: non-test (tugas) <i>Form: non-test (assignment)</i>	Bentuk: kuliah & Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i>  Metode: Ekspositori dan <i>discovery learning</i> <i>Expository and discovery learning</i>  (TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")	- Latihan soal & Homework di MyITS Classroom  Review & Summary PPT perkuliahan di MyITS Classroom  - <b>Practice questions &amp; Homework in MyITS Classroom</b>  <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i>	- Prinsip dasar Siklus Bryton, Intercooler, Siklus kombinasi, HRSG - Dengan software: membangun heat and mass balance dari gas power plant serta kombinasi - Cara kerja dan performac HRSG beserta komponennya  [1]: Bab 7 <i>Handout</i> di myITS Classroom  - <i>Basic principles of Bryton Cycle, Intercooler, Combination cycle, HRSG</i> - <i>With software: build heat and mass balance of gas power plants and combinations</i>	3



						<p>- <i>How the HRSG and its components work and performance</i></p> <p>[1]: Chapter 7 Handouts in myITS Classroom</p>	
14	<p>Mahasiswa mampu memahami dan menerapkan Siklus Bryton, Intercooler, Siklus kombinasi, HRSG <i>Students are able to understand and apply the Bryton Cycle, Intercooler, Combination Cycle, HRSG</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan Siklus Bryton, Intercooler, Siklus kombinasi, HRSG <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving Bryton Cycle, Intercooler, Combination Cycle, HRSG problems</i></p>	<p>Kriteria: - Rubrik - Marking Scheme</p> <p>Criteria: - <b>Rubric</b> - <b>Marking Scheme</b></p> <p>Bentuk: non-test (tugas) Form: non-test (assignment)</p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i></p> <p>Metode: Ekspositori dan discovery learning <i>Expository and discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<p>- Latihan soal &amp; Homework di MyITS Classroom Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <p>- <b>Practice questions &amp; Homework in MyITS Classroom</b> <i>Review &amp; Summary of PPT lectures in MyITS Classroom</i></p>	<p>- Prinsip dasar Siklus Bryton, Intercooler, Siklus kombinasi, HRSG - Dengan software: membangun heat and mass balance dari gas power plant serta kombinasi - Cara kerja dan performac HRSG beserta komponennya</p> <p>[1]: Bab 7 <i>Handout</i> di myITS Classroom</p> <p>- <i>Basic principles of Bryton Cycle, Intercooler, Combination cycle, HRSG</i></p>	



						<ul style="list-style-type: none"> <li>- <i>With software: build heat and mass balance of gas power plants and combinations</i></li> <li>- <i>How the HRSG and its components work and performance</i></li> </ul> <p>[1]: Chapter 7 Handouts in myITS Classroom</p>	
15	<p>Mahasiswa mampu memahami dan menerapkan Siklus Bryton, Intercooler, Siklus kombinasi, HRSG <i>Students are able to understand and apply the Bryton Cycle, Intercooler, Combination Cycle, HRSG</i></p>	<p>Kelengkapan, kejelasan, ketepatan (materi &amp; waktu), dan originalitas dalam menyelesaikan permasalahan Siklus Bryton, Intercooler, Siklus kombinasi, HRSG <i>Completeness, clarity, accuracy (material &amp; time), and originality in solving Bryton Cycle,</i></p>	<p>Kriteria:  <ul style="list-style-type: none"> <li>- Rubrik</li> <li>- Marking Scheme</li> </ul> <p>Criteria:  <ul style="list-style-type: none"> <li>- Rubric</li> <li>- Marking Scheme</li> </ul> <p>Bentuk: non-test (tugas) Form: non-test (assignment)</p> </p></p>	<p>Bentuk: kuliah &amp; Diskusi, brainstorming <i>Lecture &amp; Discussion, Brainstroming</i></p> <p>Metode: Ekspositori dan discovery learning <i>Expository and discovery learning</i></p> <p>(TM: 3 x 50") (PT: 3 x 60") (BM: 3 x 60")</p>	<ul style="list-style-type: none"> <li>- Latihan soal &amp; Homework di MyITS Classroom</li> </ul> <p>Review &amp; Summary PPT perkuliahan di MyITS Classroom</p> <ul style="list-style-type: none"> <li>- Practice questions &amp; Homework in MyITS Classroom</li> </ul> <p>Review &amp; Summary of PPT lectures in MyITS Classroom</p>	<ul style="list-style-type: none"> <li>- Prinsip dasar Siklus Bryton, Intercooler, Siklus kombinasi, HRSG</li> <li>- Dengan software: membangun heat and mass balance dari gas power plant serta kombinasi</li> <li>- Cara kerja dan performac HRSG beserta komponennya</li> </ul> <p>[1]: Bab 7 Handout di myITS Classroom</p> <ul style="list-style-type: none"> <li>- Basic principles of Bryton Cycle,</li> </ul>	





		<i>Intercooler, Combination Cycle, HRSG problems</i>				<i>Intercooler, Combination cycle, HRSG - With software: build heat and mass balance of gas power plants and combinations - How the HRSG and its components work and performance  [1]: Chapter 7 Handouts in myITS Classroom</i>	
16	Evaluasi Akhir Semester / Ujian Akhir Semester <i>FINAL EXAM</i>						30

**Catatan :**

1. **Capaian Pembelajaran Lulusan PRODI (CPL-PRODI)** adalah kemampuan yang dimiliki oleh setiap lulusan PRODI yang merupakan internalisasi dari sikap, penguasaan pengetahuan dan ketrampilan sesuai dengan jenjang prodinya yang diperoleh melalui proses pembelajaran.
2. **CPL yang dibebankan pada mata kuliah** adalah beberapa capaian pembelajaran lulusan program studi (CPL-PRODI) yang digunakan untuk pembentukan/pengembangan sebuah mata kuliah yang terdiri dari aspek sikap, keterampilan umum, keterampilan khusus dan pengetahuan.
3. **CP Mata kuliah (CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPL yang dibebankan pada mata kuliah, dan bersifat spesifik terhadap bahan kajian atau materi pembelajaran mata kuliah tersebut.
4. **Sub-CP Mata kuliah (Sub-CPMK)** adalah kemampuan yang dijabarkan secara spesifik dari CPMK yang dapat diukur atau diamati dan merupakan kemampuan akhir yang direncanakan pada tiap tahap pembelajaran, dan bersifat spesifik terhadap materi pembelajaran mata kuliah tersebut.



5. **Indikator penilaian** kemampuan dalam proses maupun hasil belajar mahasiswa adalah pernyataan spesifik dan terukur yang mengidentifikasi kemampuan atau kinerja hasil belajar mahasiswa yang disertai bukti-bukti.
6. **Kriteria Penilaian** adalah patokan yang digunakan sebagai ukuran atau tolok ukur ketercapaian pembelajaran dalam penilaian berdasarkan indikator-indikator yang telah ditetapkan. Kriteria penilaian merupakan pedoman bagi penilai agar penilaian konsisten dan tidak bias. Kriteria dapat berupa kuantitatif ataupun kualitatif.
7. **Bentuk penilaian:** tes dan non-tes.
8. **Bentuk pembelajaran:** Kuliah, Responsi, Tutorial, Seminar atau yang setara, Praktikum, Praktik Studio, Praktik Bengkel, Praktik Lapangan, Penelitian, Pengabdian Kepada Masyarakat dan/atau bentuk pembelajaran lain yang setara.
9. **Metode Pembelajaran:** *Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning*, dan metode lainnya yg setara.
10. **Materi Pembelajaran** adalah rincian atau uraian dari bahan kajian yg dapat disajikan dalam bentuk beberapa pokok dan sub-pokok bahasan.
11. **Bobot penilaian** adalah prosentasi penilaian terhadap setiap pencapaian sub-CPMK yang besarnya proposional dengan tingkat kesulitan pencapaian sub-CPMK tsb., dan totalnya 100%.
12. TM=Tatap Muka, PT=Penugasan terstruktur, BM=Belajar mandiri.

# *Pengelolaan Pembelajaran*

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INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA

## **BAB 11**





## 11. Pengelolaan Pembelajaran

### *Management of Learning*

No	Aktifitas <i>Activity</i>	Pejabat <i>Functionary</i>
1	Penanggung jawab dalam penyusunan kurikulum <i>Person in charge of curriculum development</i>	Kepala Departemen <i>Head of Department</i>
2	PIC Perangkat pembelajaran (RPS, RAE dan RT) MK pada Kurikulum <i>Person in charge of learning tools (Semester Learning Plan, Assessment and Evaluation Plan, and Assignment Plan) for courses in the curriculum</i>	Kepala Laboratorium <i>Head of Laboratory</i>
3	PIC monitoring dan evaluasi pelaksanaan kurikulum (mengacu pada perangkat pembelajaran) <i>Person in charge of monitoring and evaluating curriculum implementation (referring to learning tools)</i> <ul style="list-style-type: none"><li>• Pemeriksaan kesesuaian soal dengan CPMK dan / CPL <i>Checking the compatibility of questions with CLO and/ PLO</i></li><li>• Pemeriksaan lama waktu asesmen dengan bobot sks MK <i>Checking the assessment duration against the credit weight of the course</i></li></ul>	Kepala Program Studi Pascasarjana <i>Head of Postgraduate Program</i>
4	PIC monitoring dan evaluasi ketercapaian CPL, serta pelaporan ketercapaian CPL <i>Person in charge of monitoring and evaluating PLO achievement as well as reporting PLO achievement</i>	Kepala Departemen dan Kepala Program Studi Pascasarjana <i>Head of Department and Head of Postgraduate Program</i>

