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|  | **UNIVERSITAS SUMATERA UTARA (USU)**  **FAKULTAS TEKNIK**  **DEPARTEMEN TEKNIK ELEKTRO** | | | | | | | | **Kode Dokumen** |
| **RENCANA PEMBELAJARAN SEMESTER** | | | | | | | | | |
| **MATA KULIAH (MK)** | | | **KODE** | **Rumpun MK** | **BOBOT (sks)** | | **SEMESTER** | **Tgl Penyusunan** | |
| **Pembangkit Tenaga Listrik** | | | TEE3212 |  | **2** |  |  | 7 AGUSTUS 2022 | |
| **OTORISASI / PENGESAHAN** | | | **Dosen Pengembang RPS** | | **Koordinator RMK** | | **Ka Prodi** | | |
| Ir. Hendra Zulkarnain, MT | | Ir. Hendra Zulkarnain, MT | | Suherman, ST., M.Comp., Ph.D | | |
| **Capaian Pembelajaran** | | **CPL-PRODI yang dibebankan pada MK** | | |  | | | | |
| CPL-1 | Mampu menerapkan pengetahuan matematika, ilmu pengetahuan alam/atau material, teknologi informasi dan kerekayasaan untuk mendapatkan pemahaman menyeluruh tentang prinsip-prinsip Teknik Elektro. | | | | | | |
| CPL-2 | Mampu mendesain komponen, sistem dan/atau proses untuk memenuhi kebutuhan yang diharapkan oleh masyarakat dengan dihadapkan pada batasan realistik yang meliputi aspek hukum, ekonomi, lingkungan, sosial, politik, kesehatan dan keselamatan, keberlanjutan. | | | | | | |
| CPL-3 | Mampu mendesain eksperimen laboratorium dan/atau lapangan serta menganalisis dan mengartikan data untuk memperkuat penilaian teknik khususnya dalam bidang Teknik Elektro. | | | | | | |
| CPL-4 | Mampu menyelesaikan permasalahan teknik khususnya dalam bidang Teknik Elektro secara bertanggungjawab dan memenuhi etika profesi. | | | | | | |
| CPL-5 | Mampu menerapkan metode, keterampilan dan perangkat teknik modern yang diperlukan untuk praktek profesi Teknik Elektro. | | | | | | |
| CPL-6 | Mampu berkomunikasi secara efektif, baik lisan maupun tulisan. | | | | | | |
| CPL-7 | Mampu mengevaluasi tugas-tugas dalam batasan yang ada secara disiplin dan menyeluruh. | | | | | | |
| CPL-8 | Mampu untuk bekerja dalam tim lintas disiplin dan multikultural serta global internasional. | | | | | | |
| CPL-9 | Mampu untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan Teknik Elektro. | | | | | | |
| CPL-10 | Memiliki kapasitas pembelajaran sepanjang hayat termasuk akses pengetahuan yang relevan tentang isu-isu terkini. | | | | | | |
| CPL-11 | Mampu mengidentifikasi potensi daerah di Sumatera Utara dan menerapkan inovasi, metode, keterampilan, dan perangkat teknik elektro yang relevan untuk mengembangkan potensi daerah tersebut. | | | | | | |
| CPL-12 | Mampu mendesain sistem dan/atau proses untuk memanfaatkan energi baru dan terbarukan sebagai sumber energi listrik alternatif dari potensi sumber daya lokal dan nasional dengan wawasan global. | | | | | | |
| **Capaian Pembelajaran Mata Kuliah (CPMK)** | | |  | | | | |
| CPMK 1 | Mampu mengidentifikasi jenis-jenis pembangkit tenaga listrik | | | | | | |
| CPMK 2 | Memahami klasifikasikan pembangkit tenaga listrik dan sumber energi pembangkit tenaga listrik | | | | | | |
| CPMK 3 | Memahami prinsip kerja dan diagram alir proses (process flow diagram) berbagai pembangkit tenaga listrik | | | | | | |
| CPMK 4 | Memahami prinsip kerja kompenen-komponen utama dari berbagai jenis pembangkit tenaga listrik | | | | | | |
| **Peta CPL – CPMK** | | |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | **CPL 01** | **CPL 02** | **CPL 03** | **CPL 04** | **CPL 05** | **CPL 06** | **CPL 07** | **CPL 08** | **CPL 09** | **CPL 10** | **CPL 11** | **CPL 12** | | CPMK 1 | **V** |  |  |  |  |  |  |  |  |  |  |  | | CPMK 2 |  | **V** |  |  |  |  |  |  |  |  |  |  | | CPMK 3 |  |  |  | **V** |  |  |  |  |  |  |  |  | | CPMK 4 |  |  |  |  | **V** |  |  |  |  |  |  |  | | | | | | | | |
| **Diskripsi Singkat MK** | | Mata kuliah Pembangkit Tenaga Listrik membahas identifikasi jenis-jenis pembangkit tenaga listrik, sumber energi pembangkit tenaga listri, klasifikasikan pembangkit tenaga listrik, prinsip kerja dan diagram alir proses (process flow diagram) berbagai pembangkit tenaga listrik serta membahas prinsip kerja kompenen utama dari berbagai jenis pembangkit tenaga listrik. | | | | | | | |
| **Bahan Kajian:** Materi pembelajaran | | Prinsip Dasar Pembangkit Tenaga Listrik; Pltu: Pengertian Pltu, Konversi Energi Pltu, Rankine Cycle, Boiler, Water Tube dan Fire Tube Boiler, Steam Drum, Superheater, Reheater dan Economizer, Oil & Gas Burner, Chaingrate Coal Burner, Pulverized Coal Burner, Fluidized Bed Combustion Burner; Pltu (Lanjutan): Peralatan Pendukung (Accessories) Boiler, Steam Condenser, Cooling Tower , Turbin Uap , Impulse Turbine, Reaction Steam Turbine, Extraction Steam Turbine, Multi Stage Steam Turbine; Pltg dan Combine Cycle: Process Flow Diagram Pltg, Turbin Gas, Siklus Brayton, Efisiensi Turbin Gas, Open Cycle Gas Turbine, Closed Cycle Gas Turbine, Komponen Utama Pltg, Process Flow Diagram Combine Cycle, Konfigurasi Single dan Multi-Shaft; Plta: Plta Sebagai Energi Terbarukan, Prinsip Kerja Plta, Daya Turbin Air dan Efisiensi, Plta – Impoundment, Plta – Diversion, Plta - Pumped Storage, Kekebihan dan Kelemahan Plta; Plta (Lanjutan): Komponen Utama Plta (Reservoirs, Bendungan, Trash Rack, Fore Bay (danau Depan), Penstock (Pipa Pesat), Surge Tank ,Spillway), Turbin Air dan Generator, Draft Tube, Power House; Plta (Lanjutan): Impulse Turbine, Turbin Pelton, Turbin Turgo, Turbin Cross Flow, Reaction Turbine, Turbin Kaplan (Adjustable Blade Pitch), Turbin Francis Propeller (Fixed Vanes), Turbin Propeller (Fixed Blade Pitch), Beberapa Istilah Beban/Pembebanan, Or; Pltd: Gambaran Umum dan Fungsi Pltd, Process Flow Pltd, Keuntungan dan Kelemahan Pltd, Mesin Diesel (Diesel Cycle), Fuel Supply System, Strainer, Air Intake System, Exhaust System, Cooling System, Lubricating System, Engine Starting System, Governing Syst; Pltn: Pembangkit Listrik Tenaga Nuklir dan Proses Operasi Pltn, Reaksi Fisi dan Fusi, Reaktor Nuklir, Coolant, Heat Exchanger (Steam Generator), Steam Turbine dan Generator, Condenser dan Cooling Tower, Feed Water Pump, Fuel Handling, Safety Sistem, Contr; Pltn (Lanjutan): Water Cooled Reactor, Pressurized Water Reactor (Pwr) , Boiling Water Reactor (Bwr) , Pool-Type Reactor, Gas Coolant Reactor, Advanced Gas Cooled Reactor (Agcr) , Liquid Metal Cooled Reactor, Fast Breeder Reactor (Fbr), Keuntungan dan Ker; Plt Angin: Kerja Pembangkit Listrik Tenaga Angin, Anemometer, Blades (Bilah), Brake (Rem), Yaw Drive, Yaw Motor , Controller, Gearbox, Generator, High-Speed Shaft , Poros Untuk Generator (Putaran Tinggi)., Low-Speed Shaft, Poros Turbin Angin (Puatan Rendah), Pitch; Mahasiswa dapat mengerjakan latihan tentang plt angin (lanjutan): horizontal axis wind turbine (hawt), regular (ordinary) hawt, counter rotating wind turbine hawt, vertical axis wind turbine (vawt), savonius vawt, giromill/darrieus vawt, vortexis vawt, en; Mahasiswa memahami perkembangan teori plt panas bumi: energi panas bumi, susunan lapisan bumi, geothermal system , dry steam plants, dry steam non-condensing geothermal power plant, dry steam condensing geothermal power plant, flash power plants, single f; Mahasiswa memahami plt panas bumi (lanjutan) dan plt surya: binary geothermal plants., kalina binary cycle geothermal power plants, flash/binary combined cycle, brine bottoming binary (bbb) system, spent steam bottoming binary (ssbb) system, hybrid system | | | | | | | |
| **Pustaka** | | **Utama:** |  | | | | | | |
| 1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | | | | | | | |
| **Pendukung:** |  | | | | | | |
| 1. P, K, Nag, “Power Plant Engineering” Tata McGrawhill Publishing, 3rd Edition, 2007 2. Manoj Kumar Gupta, “Power Plant Engineering”, PHI Learning, Delhi, 2012 3. Farshid Zabihian, “ Power Plant Engineering”, CRC Press, 1st Edition, 2021 4. Muyiwa Adaramola. PhD, “Wind Turbine Technology”, Apple Academic Press – CRC Press, Toronto, 2014 | | | | | | | |
| **Dosen Pengampu** | | Ir. Hendra Zulkarnain, MT | | | | | | | |
| **Matakuliah syarat** | |  | | | | | | | |

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| **Mg Ke-** | **Kemampuan akhir tiap tahapan belajar (Sub-CPMK)** | **Penilaian** | | **Bantuk Pembelajaran;**  **Metode Pembelajaran;**  **Penugasan Mahasiswa;**  **[ Estimasi Waktu]** | | **Materi Pembelajaran**  **[Pustaka]** | **Bobot Penilaian (%)** |
| **Indikator** | **Kriteria & Teknik** |
| **(1)** | **(2)** | **(3)** | **(4)** | **Tatap Muka(5)** | **Daring (6)** | **(7)** | **(8)** |
| 1 | Mahasiswa memahami tentang sejarah pembangkit tenaga listrik, jenis-jenis pembangkit tenaga listrik dan penggerak mula, spesifikasi tegangan dan generator, faktor daya, pengaturan tegangan dan frekuensi generator serta kerja paralel beberapa generator. | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Sejarah pembangkittTenaga listrik, jenis-jenis pembangkit tenaga listrik, pembangkit tenaga listrik mekanis, penggerak mula, spesifikasi tegangan yang dibangkitkan dan generator listrik  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 2 | Mahasiswa memahami tentang sejarah pembangkit tenaga listrik, jenis-jenis pembangkit tenaga listrik dan penggerak mula, spesifikasi tegangan dan generator, faktor daya, pengaturan tegangan dan frekuensi generator serta kerja paralel beberapa generator. (lanjutan) | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Faktor Daya, pengaturan besar tegangan generator, pengaturan frekuensi tegangan dibangkitkan, kerja paralel generator, droop dan ischoronous.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 3 | Mahasiswa memahami tentang prinsip PLTU, process flow PLTU, Rankine Cycle, boiler dan burner, peralatan pendukung (Accessories) boiler, steam condenser, cooling tower dan berbagai jenis turbin Uap. | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Konversi Energi PLTU & Rankine Cycle, boiler, water tube boiler, fire tube boiler, steam drum.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 4 | Mahasiswa memahami tentang prinsip PLTU, process flow PLTU, Rankine Cycle, boiler dan burner, peralatan pendukung (Accessories) boiler, steam condenser, cooling tower dan berbagai jenis turbin Uap. (lanjutan) | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Superheater, reheater, economizer, oil & gas burner, chaingrate coal burner, fluidized bed combustion curner, pulverized coal burner, pressure indicator & control, water level control and indicators, peralatan accessories lain.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 5 | Mahasiswa memahami tentang prinsip PLTU, process flow PLTU, Rankine Cycle, boiler dan burner, peralatan pendukung (Accessories) boiler, steam condenser, cooling tower dan berbagai jenis turbin Uap. (lanjutan) | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Steam condenser, cooling Tower , turbin uap, impulse Turbine, reaction steam turbine, extraction steam turbine, multi stage steam turbine.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 6 | Mahasiswa memahami process flow diagram PLTG dan combine cycle, Turbin Gas, Siklus Brayton, Efisiensi Turbin Gas, Open cycle gas turbine, Closed cycle gas turbine, komponen utama PLTG, process flow diagram combine cycle, konfigurasi single dan multi-shaft | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Turbin Gas, siklus Brayton, efisiensi turbin gas, open cycle gas turbine, closed cycle gas turbine, komponen Penunjang PLTG, combine cycle power plant, konfigurasi single dan multi-shaft.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 8% |
| 7 | Mahasiswa memahami gambaran umum dan fungsi PLTD, process flow PLTD, keuntungan dan kelemahan PLTD, mesin miesel (Diesel Cycle), fuel supply system, strainer, air intake system, exhaust system, cooling system, lubricating system, engine starting system, governing system (governor). | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Gambaran umum dan fungsi PLTD, keuntungan dan kelemahan PLTD, mesin Diesel (Diesel Cycle), fuel supply system, strainer, air intake system, exhaust system, cooling system, lubricating system, engine starting system, governing system (governor).  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 8 | UJIAN TENGAH SEMESTER |  |  |  |  |  |  |
| 9 | Mahasiswa memahami PLTA sebagai energi terbarukan, prinsip kerja PLTA, daya dan efisiensi Turbin Air, jenis-jenis PLTA, kelebihan dan kelemahan PLTA, prinsip kerja PLTA, komponen utama PLTA, Impulse Turbine, Turbin Pelton, Turbin Turgo, Turbin Cross flow, Reaction Turbine, Turbin Kaplan (adjustable blade pitch), Turbin Francis propeller (fixed vanes), Turbin Propeller (fixed blade pitch), beberapa istilah beban/pembebanan, orientasi susunan Turbin-Generator. | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  PLTA sebagai energi terbarukan, PLTA – Impoundment, PLTA – Diversion, PLTA - Pumped storage, prinsip kerja PLTA, daya turbin air dan efisiensi, kekebihan dan kelemahan PLTA, komponen utana PLTA  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 8% |
| 10 | Mahasiswa memahami PLTA sebagai energi terbarukan, prinsip kerja PLTA, daya dan efisiensi Turbin Air, jenis-jenis PLTA, kelebihan dan kelemahan PLTA, prinsip kerja PLTA, komponen utama PLTA, Impulse Turbine, Turbin Pelton, Turbin Turgo, Turbin Cross flow, Reaction Turbine, Turbin Kaplan (adjustable blade pitch), Turbin Francis propeller (fixed vanes), Turbin Propeller (fixed blade pitch), beberapa istilah beban/pembebanan, orientasi susunan Turbin-Generator. (lanjutan) | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Turbin air, draft Tube, power house, turbin Impuls, turbin Pelton, turbin Turgo , turbin Cross flow, turbin Reaksi, turbin Kaplan (adjustable blade pitch), turbin Francis propeller (fixed vanes) , turbin Propeller (fixed blade pitch), pump turbine, beberapa Istilah beban/pembebanan, orientasi Susunan Turbin-Generator.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 11 | Mahasiswa memahami konsep Pembangkit Listrik Tenaga Nuklir dan proses operasi PLTN, uranium, reaksi fisi dan fusi, komponen utama PLTN, konponen utama raktor nuklir, reactor assembly, jenis-jenis reaktor nuklir pada PLTN, kontrol reaktor nuklir, keuntungan dan kerugian PLTN. | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Pembangkit Listrik Tenaga Nuklir dan proses operasi PLTN, uranium, reaksi fisi dan fusi, komponen utama PLTN, konponen utama raktor nuklir.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 12 | Mahasiswa memahami konsep Pembangkit Listrik Tenaga Nuklir dan proses operasi PLTN, uranium, reaksi fisi dan fusi, komponen utama PLTN, konponen utama raktor nuklir, reactor assembly, jenis-jenis reaktor nuklir pada PLTN, kontrol reaktor nuklir, keuntungan dan kerugian PLTN. (lanjutan) | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Reactor assembly, Pressurized Water Reactor (PWR), Boiling Water Reactor (BWR), Pool-type reactor, Advanced Gas Cooled Reactor (AGCR), Liquid Metal Cooled Reactor/Fast Breeder Reactor (FBR), kontrol reaktor nuklir, keuntungan dan kerugian PLTN.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 13 | Mahasiswa memahami kerja Pembangkit Listrik Tenaga Angin, komponen utama PLT Angin, jenis-jenis turbin angin, energi/daya turbin angin, Control and Monitoring, keuntungan dan kekurangan PLT Angin. | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Kerja Pembangkit Listrik Tenaga Angin, komponen utama PLT Angin, jenis-jenis turbin angin, energi/daya turbin angin, Control and Monitoring, keuntungan dan kekurangan PLT Angin.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 14 | Mahasiswa memahami energi panas bumi, susunan lapisan bumi, geothermal system, jenis-jenis PLTPB, keuntungan dan kerugian PLTPB. | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Energi panas bumi, susunan lapisan bumi, geothermal system, dry steam plants  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 15 | Mahasiswa memahami energi panas bumi, susunan lapisan bumi, geothermal system, jenis-jenis PLTPB, keuntungan dan kerugian PLTPB. (lanjutan) | 1. *The accuracy in providing the information required* 2. *The student’s fluency in reading the memo (spelling, intonation, and speed)* 3. *The correctness of the student’s answers* | **Kriteria:**  *Marking Scheme*  **Bentuk:**  *Worksheet* (Non-Tes)   1. *Reading the memo provided.* 2. *Responding to the opening questions given.* 3. *Completing the table (problem-solution) according to the information in the memo.* 4. *Finding the word or phrase with similar meaning (synonym) according to the information in the memo.*   *Classifying the words or phrases with the correct headings.* | BM [(1x(2x60”)]  **Kegiatan:**   1. *Reviewing the previous lessons.* 2. *Reading the added learning materials.* 3. *Recording the presence.* 4. *Responding to opening questions in the ‘Discussion Forum’ section.* 5. *Submitting the assigned tasks.*   PT [(1x(2x60”)]  **Task 3:**  *Restating the information obtained in the form of an a-150-words paragraph.*  **Moda (*Learning Management System*):**  [elearning@usu.ac.id](mailto:elearning@usu.ac.id) | TM [(1x(2x50”)]  **Kegiatan:**   1. *Making notes of the learning materials explained.* 2. *Responding to the questions or instructions given.* 3. *Completing all the provided exercises individually.* 4. *Discussing the exercises completed.*   **Media:**  *Power Point Presentation (PPT)*  *Zoom Meeting*  *Audio Recording*  *English Handout*  **Metode Pembelajaran:**   1. *Online Lecture* 2. *Discussion* 3. *Self-Paced*   *Learning* | **Pokok Bahasan:**  Jenis-jenis dry steam non-condensing geothermal power plant, flash power plants, binary geothermal plants, combined cycle Geothermal Power plants, hybrid system, keuntungan dan kerugian PLTPB.  **Referensi:**   1. R. K. Rajput, "Power System Engineering", Laxmi Publication (P) Ltd, New Delhi, 2006 2. Leonard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, Third Edition, CRC Press, 2012 3. Bella H. Chudnovsky, Transmission, Distribution and Renewable Energy Generation Power Equipment, Second Edition, CRC Press, 2017 | 7% |
| 16 | UJIAN AKHIR SEMESTER |  |  |  |  |  |  |
|  | Total | | | | | | **100** |