

2021

DOKUMEN KURIKULUM

Program Studi

Tahun



Politeknik Negeri Batam

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1. Analisis Kebutuhan

Program Studi Teknik Robotika dibuka berdasarkan Surat Keputusan Menteri Riset, Teknologi, dan Pendidikan Tinggi Republik Indonesia Nomor 294/KPT/I/2016 Tentang Pembukaan Program Studi Teknik Robotika Program Diploma Empat pada Politeknik Negeri Batam tanggal 31 Agustus 2016. Mahasiswa angkatan pertama dimulai pada tahun ajaran Ganjil 2017-2018 dengan menggunakan kurikulum tahun 2017. Berdasarkan prosedur pengembangan kurikulum, maka pada tahun 2021 dilakukan tinjauan terhadap profil lulusan, capaian pembelajaran dan kurikulum sesuai dengan perkembangan dan tuntutan dari stakeholder. Beberapa kegiatan dilakukan untuk reposisi prodi Teknik Robotika yaitu:

A. Focus Group Discussion (FGD), dilakukan pada hari Jumát 11 Juni 2021 dengan mengundang sejumlah mitra industri antara lain:

- PT. CIBA Vision Batam
- PT. Schneider Electric Manufacturing Batam
- PT Epson Batam
- PT Philips Industrie Batam
- PT. Samudra Oceaneering
- PT. Shimano Batam (Division Bike)
- Feen Marine Inc
- PT Sago

Dari acara FGD tersebut diperoleh beberapa masukan terkait peningkatan di beberapa hal yaitu:

1. Technical Knowledge

- PLC
- Arm robot
- Vision system
- Teknologi Industry 4.0
- Open platform communication (OPC)
- Manufacturing management system
- Total productive maintenance (autonomous dan preventive maintenance)
- Data robot terkoneksi ke cloud
- Sensor industri
- Komunikasi antar device: serial, ethernet, dll antar device.
- Artificial Intelligence
- Aktuator
- Sensor-sensor radiasi.
- K3 dari radiasi.
- Teknologi 6-axis robot, SCARA system, AGV, Vision system (misal mengukur dimensi dengan cepat dan akurat).
- Labview untuk vision, product testing.
- web interface .

2. Personal & Professional Skills

- Kemampuan berfikir *out of the box*.
- Manfaat penerapan Project Based Learning (PBL) dan tim robot adalah mahasiswa sudah terbiasa problem solving.
- Ilmu yang dipelajari di kampus dengan di industri berbeda.
- Kemampuan inovasi sangat diperlukan.

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- Kemampuan improvisasi untuk mengubah sistem yang ada agar lebih baik.
- Kemampuan personal (personal skills: critical thinking, problem solving, dll).
- Skill x hardwork x attitude = succes. (attitude hanya punya nilai +1 atau -1).
- Karakter building mahasiswa perlu diperhatikan.
- Target to the problem, not the person. Sehingga tidak mudah untuk menyalahkan orang.

3. Interpersonal Skills

- Lebih bisa speak-up.
- Berani menunjukkan apa yang sudah dikerjakan.
- Lebih percaya diri dalam berkomunikasi, terlebih menggunakan bahasa Inggris.
- Etika komunikasi baik lisan dan tertulis masih lemah.
- Cara membuat CV yang bagus.
- Mahasiswa dibiasakan untuk menulis yang dikerjakan, dan mengerjakan apa yang ditulis.

4. Product/Process Development Skills

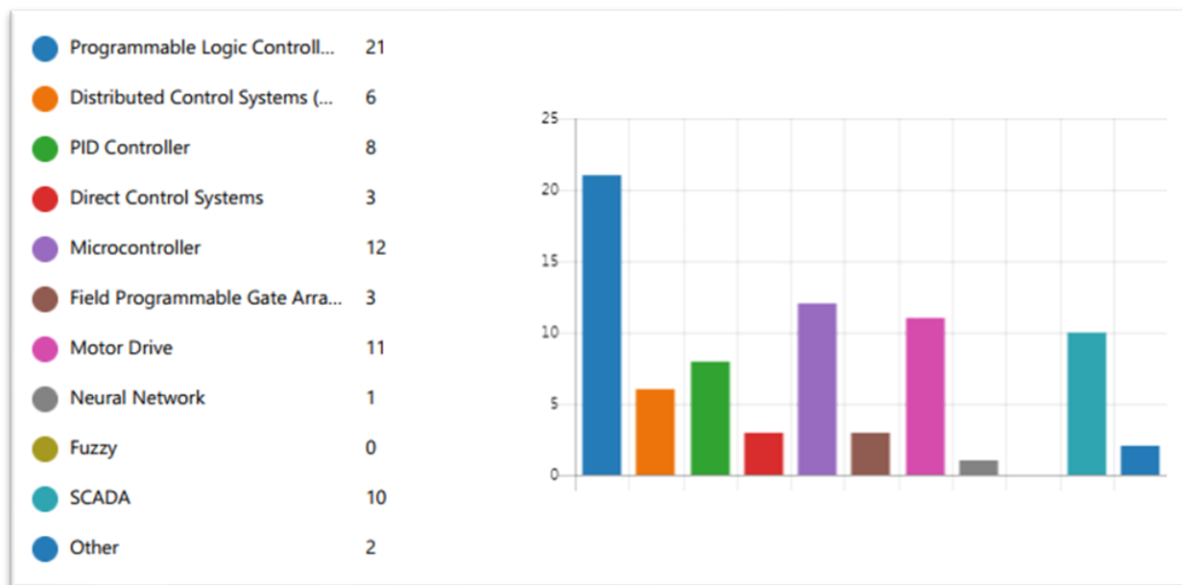
- Kemampuan Plan Do Check Action (PDCA).
- Membuat Work instruction, manual book.
- Reduce cost
- Manajemen proyek (menghitung biaya, sdm, dll), quality control, metode analisa untuk prediction (six sigma, FMEA, dll)
- Mulai memakai standar industri.
- Project kampus perlu dihadapkan dengan project riil, sehingga mengikuti standard, business flow.
- Perlu mendapatkan komentar dari orang luar mengenai produk yang dibuat.
- Standard IEC.

B. Survei Kebutuhan, dilaksanakan pada 19 Mei – 11 Juni 2021 dengan melibatkan sejumlah mitra industri yaitu:

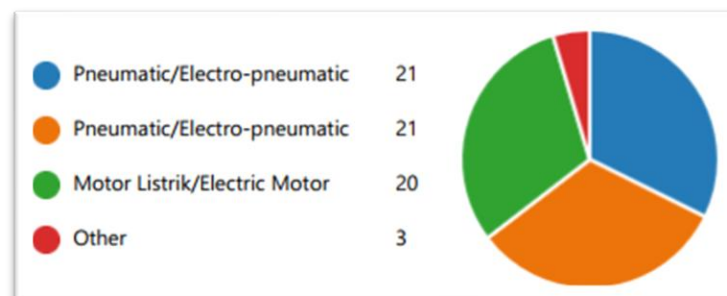
- PT. OSI Electronics
- LDR Automation
- PT. Sanindo Multi Tekno
- PT McDermott Indonesia
- PT Epson Batam
- PT. Scanjet Production Indah
- Feen Marine Inc
- PT Philips Industrie Batam
- PT Ecogreen Oleochemicals
- PT. Samudra Oceaneering
- PT. Shimano Batam (Division Bike)
- PT. PCI Elektronik Internasional
- PT. Arakanmarine Automation
- PT. Archasindo marine Automation
- PT. Infineon Technologies Batam
- PT. CIBA Vision Batam
- PT. Schneider Electric Manufacturing Batam

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Berdasarkan hasil survei tersebut diketahui jumlah perusahaan / industri yang menggunakan teknologi atau standar dalam proses produksinya yaitu:

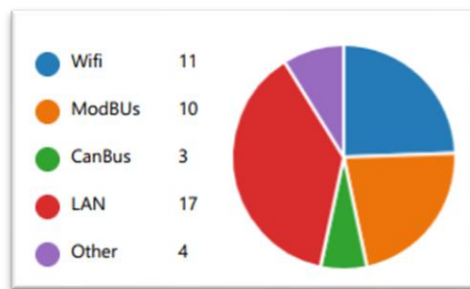


Gambar 1. Sistem kontrol

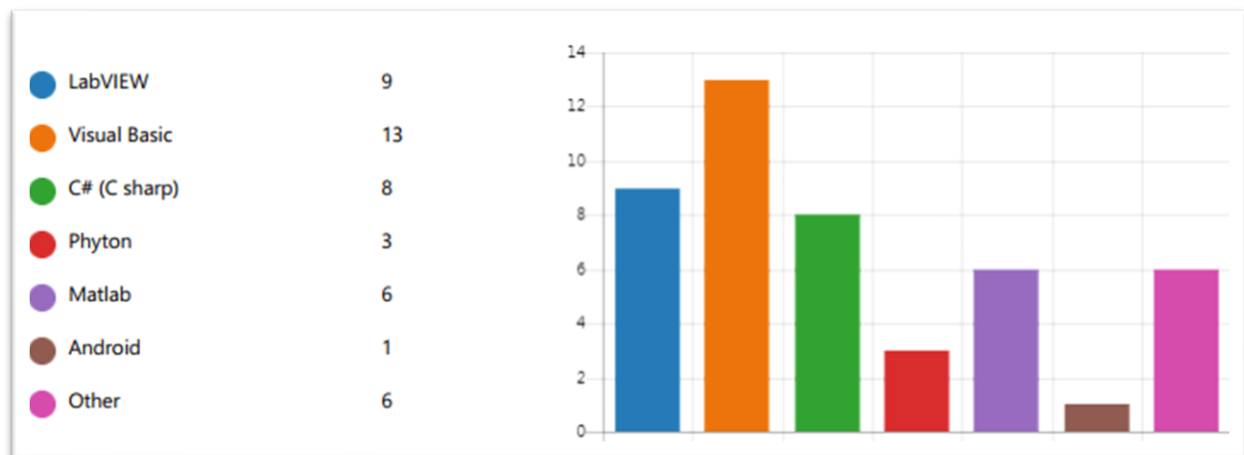


Gambar 2. Jenis aktuator

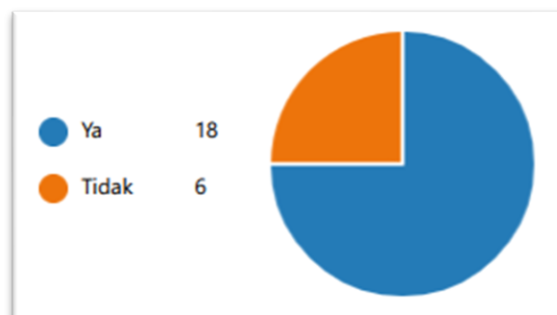
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Gambar 3. Jenis protokol komunikasi

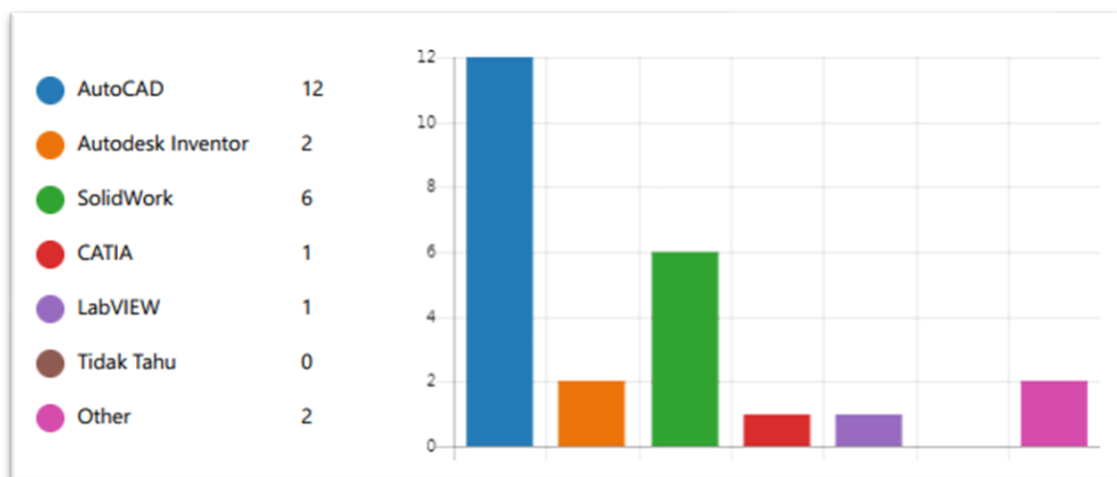


Gambar 4. Bahasa pemrograman yang digunakan

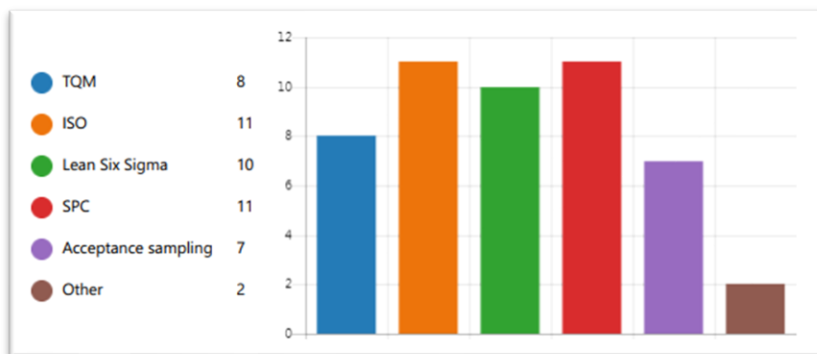


Gambar 5. Jumlah industri yang menerapkan teknologi industry 4.0

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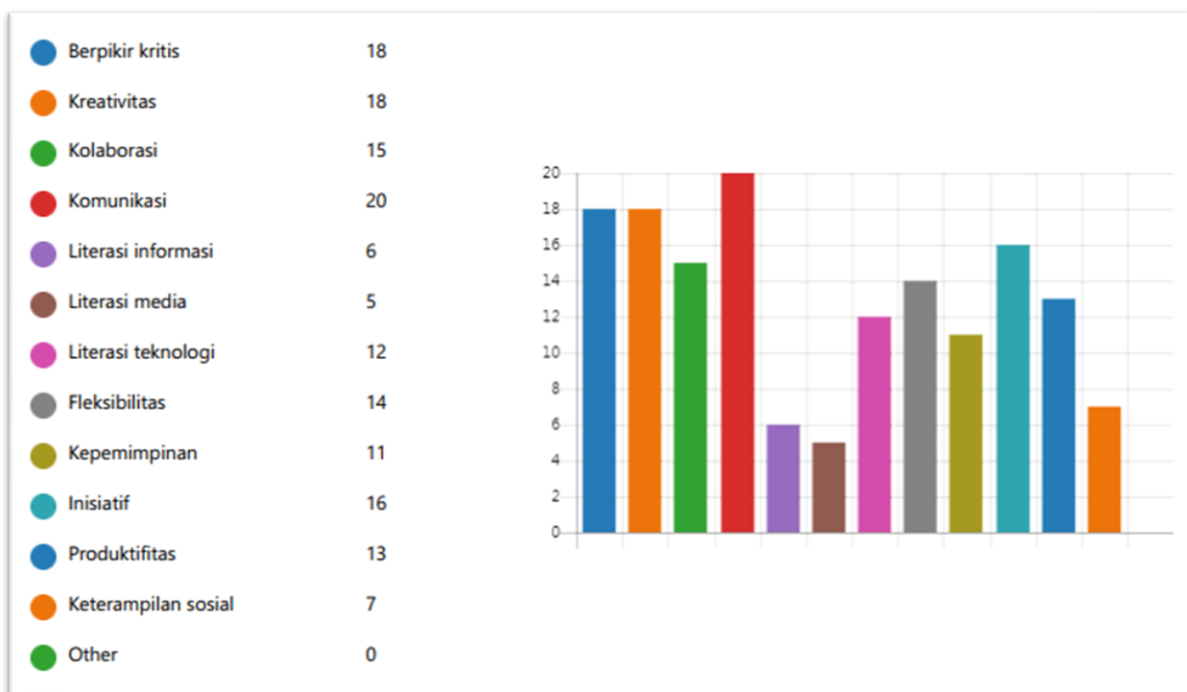
Gambar 6. Jenis software yang digunakan



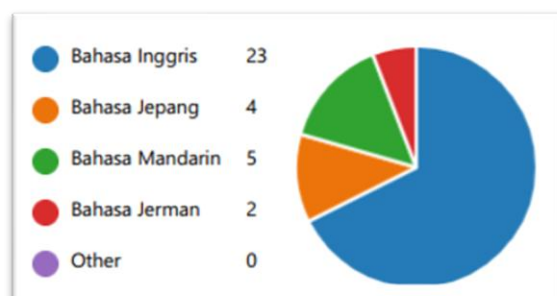
Gambar 7. Sistem yang digunakan

Selain itu juga ditanyakan terkait personal dan interpersonal skills yang dibutuhkan di industri, dengan hasil survei sebagai berikut:

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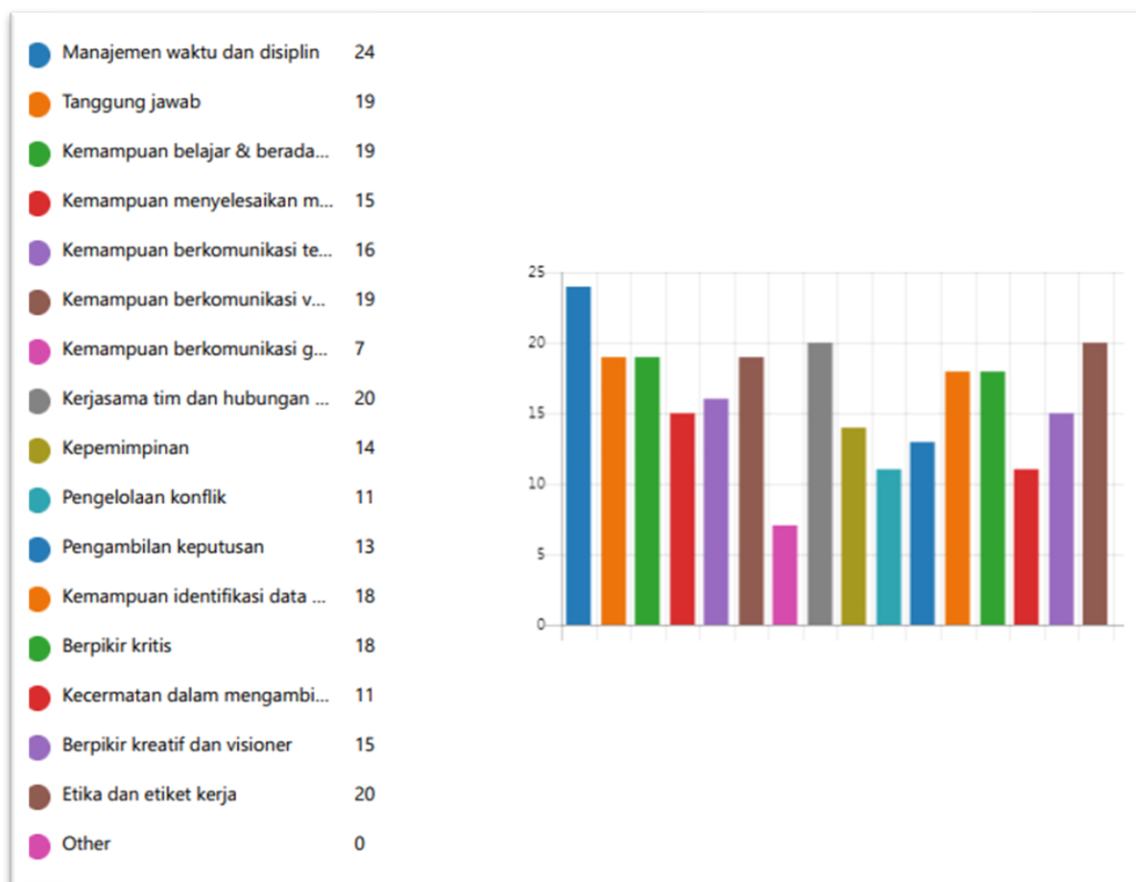


Gambar 8. 21st century skills



Gambar 9. Kemampuan komunikasi bahasa asing

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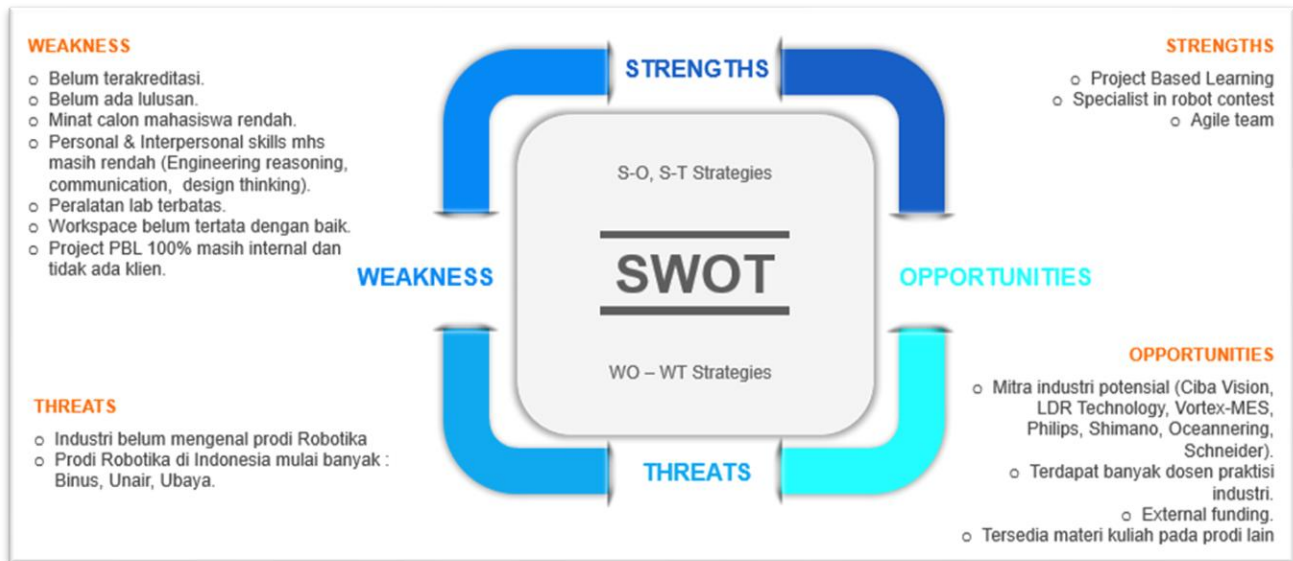


Gambar 10. Softskills yang diperlukan sebelum magang industry

C. Analisa SWOT dan Strategi

Berdasarkan hasil FGD, survei industri serta kondisi prodi Teknik Robotika saat ini, maka dapat digambarkan posisi prodi jika dilihat dari faktor internal (Strength dan Weakness) serta faktor eksternal (Opportunity dan Threats). Kemudian dilakukan analisa SWOT yang dapat digunakan untuk menentukan strategi yang diperlukan dalam meningkatkan mutu lulusan prodi.

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Gambar 11. Analisa SWOT posisi prodi Teknik Robotika

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Tabel 1. Strategi pengembangan prodi Teknik Robotika

		Internal	
		STRENGTHS (S)	WEAKNESS (W)
External	OPPORTUNITIES (O)	1. Menyusun design-implement experiences berjenjang pada setiap semester, dimana capstone project-nya kerjasama dengan mitra industri melalui industrial PBL. (Industri sebagai klien) 2. MoU dengan prodi lain untuk saling mengambil matakuliah pilihan (Merdeka Belajar). 3. Memanfaatkan hasil riset tim robot kontes menjadi produk/project (trainer kit, produk turunan). 4. Memaksimalkan external funding untuk membiayai project PBL.	1. Pengembangan integrated curriculum dimana matakuliah saling mendukung serta merencanakan pembentukan personal dan interpersonal skills serta product development skills. 2. Bekerjasama dengan mitra dalam penyediaan peralatan bersama (joint research, joint project, project di industri). 3. Membuat materi kuliah (video/ppt) berbahasa Inggris. 4. Menyusun buku ajar ber-ISBN.
	THREATS (T)	1. Melibatkan praktisi industri sebagai Advisory Board. 2. Program magang 6 bulan atau 1 tahun di industri (harus ada MoA dulu). 3. Melibatkan praktisi industri sebagai dosen pengajar untuk matakuliah Industrial Best Parctice (Project Management, Quality Engineering). 4. Melibatkan praktisi industri sebagai klien atau subject matter expert pada proyek PBL unggulan. 5. Menjalani komunikasi dengan prodi Robotika PT lain untuk membuat forum komunikasi Kaprodi Robotika.	1. Bekerjasama dengan industri membangun industrial showcase di kampus. 2. Akreditasi BAN-PT. 3. Akreditasi internasional. 4. Penataan lab menjadi workspace yang lebih kolaboratif. 5. Legalisasi Ikatan Alumni Barelang. 6. Menawarkan program pelatihan robot ke SMA/SMK, secara online.

Berkaitan dengan kurikulum, maka Prodi Teknik Robotika secara berkelanjutan wajib mengembangkan kurikulum dan metode pembelajaran sesuai dengan perkembangan teknologi dan kebutuhan stakeholder. Beberapa hal yang menjadi fokus perhatian adalah:

Pertanyaan Umum

1. Apa saja pengetahuan, keterampilan, dan sikap yang harus dimiliki lulusan prodi Teknik Robotika, dan pada tingkat kemahiran apa?
2. Bagaimana cara untuk memastikan mahasiswa menguasai keterampilan tersebut?

Tujuan Program

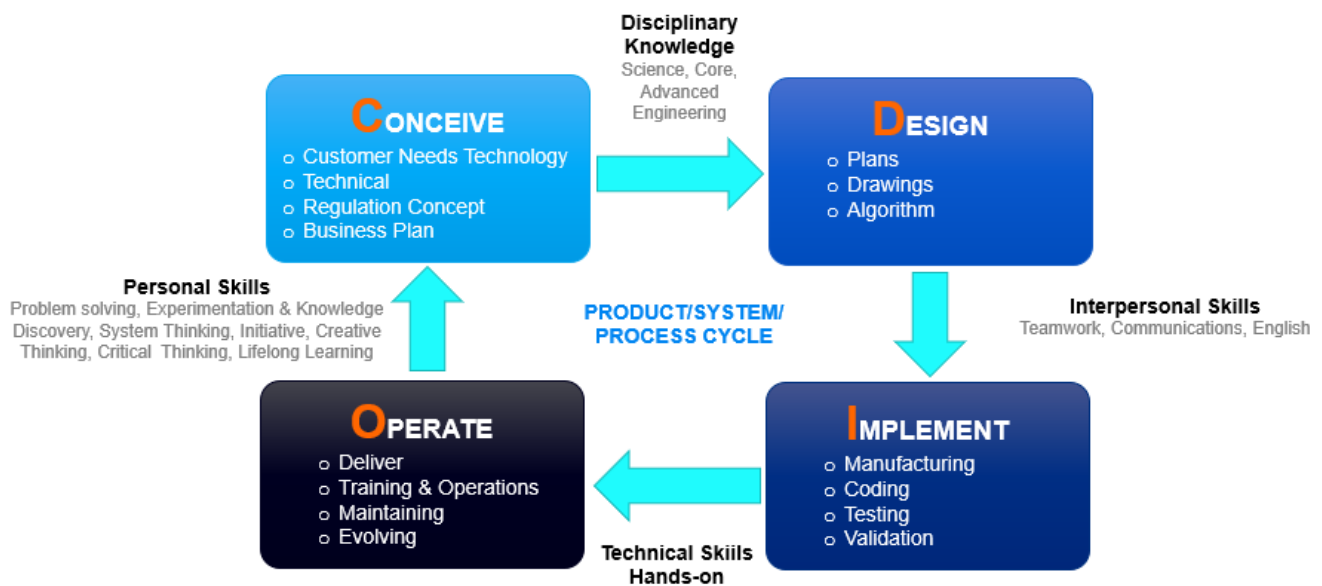
1. Menguasai dasar pengetahuan dan teknologi robotika secara mendalam.
2. Menjadi yang terdepan dalam penciptaan produk dan sistem baru.
3. Memahami nilai pentingnya penelitian dan pengembangan teknologi.

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Skills Developments

1. Technical Knowledge
2. Personal & Professional Skills
3. Interpersonal Skills: Teamwork & Communication
4. Product/Process Development Skills

Salah satu pendekatan yang dipilih dalam mengembangkan kurikulum adalah dengan menerapkan siklus pengembangan produk, sistem atau proses yang terdiri dari 4 tahapan yaitu Conceive, Design, Implement, Operate (C-D-I-O) yang pada setiap tahapan memerlukan skills developments yang selaras dengan hasil FGD dan survei kebutuhan yang dijelaskan dibagian awal dari analisa kebutuhan ini. Siklus pengembangan produk ini kemudian digunakan oleh Massachusetts Institute of Technology (MIT) pada tahun 2000 menjadi sebuah kerangka pembentukan kurikulum yang dikenal dengan CDIO Approach. Pada kurikulum tahun 2021 ini, prodi Teknik Robotika juga menerapkan CDIO Approach dengan acuan CDIO standard dan CDIO syllabus.



Gambar 12. Siklus pengembangan produk, sistem atau proses

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2. Profil Lulusan

Kode PL	Profil Lulusan (PL)	Deskripsi Profil
PL-1	Robotics Engineer	• Merancang dan mengembangkan prototipe robot. • Membangun, mengonfigurasi, menguji, dan men-debug robot dan sistem robot. • Memasang, mengoperasikan, mengkalibrasi, dan memelihara robot. • Memastikan mesin robot beroperasi dengan aman, andal, dan presisi; mengidentifikasi dan mengimplementasikan modifikasi. • Memproses atau menginterpretasi sinyal atau data sensor. • Mengintegrasikan teknologi kecerdasan buatan ke dalam sistem robotika. • Mengintegrasikan robot dengan perangkat seperti pengelas, kontroler atau perlengkapan lainnya. • Mendokumentasikan pembuatan robot, perawatan atau perubahan. • Menyediakan dukungan teknis untuk sistem robot yang sudah dibuat. • Melakukan supervisi teknisi atau engineer lain.
PL-2	Robotics Designer	• Mendesain sistem robot otomatis yang digunakan untuk meningkatkan produksi dan level kepresisian pada industri yang spesifik. • Memilih teknologi dan komponen yang akan digunakan sesuai dengan desain sistem . • Mendesain perangkat lunak untuk mengendalikan sistem robot. • Melakukan kaji ulang desain dan menyetujui estimasi biaya. • Menganalisa dan mengevaluasi purwarupa dan sistem robot yang dibuat.

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3. Tujuan Program Pendidikan / *Program Educational Objectives (PEO)*

Kurikulum Program Studi Teknik Robotika yang dikembangkan pada tahun 2021 ini selain mengacu pada akreditasi BAN-PT juga mengacu pada akreditasi internasional yaitu *Accreditation Board for Engineering and Technology (ABET)*. Oleh karena itu disyaratkan untuk menentukan tujuan program pendidikan atau *Program Educational Objectives (PEO)* yang merupakan pernyataan umum yang menggambarkan karir dan pencapaian profesional ketika lulusan sudah bekerja 3-5 tahun. Program studi Teknik Robotika telah menetapkan PEO sebagai berikut:

- Our graduates are able to actively, creatively and innovatively identify and solve problems related to robotics technology through the application of engineering principles. (PEO-1)
- Our graduates possess superior personal and interpersonal skills for successful careers in industry, academia and business. (PEO-2)
- Our graduates are able to adapt to new technologies through quality, open and relevant applied research, and in close collaboration with society and industry. (PEO-3)

PEO diatas telah diselaraskan dengan Visi dan Misi Politeknik Negeri Batam dengan keterkaitan yang dapat dilihat pada matrik berikut:

PEO	Misi Politeknik Negeri Batam	
	Aktif dalam proses kreasi, penyebaran dan penerapan sains dan teknologi melalui layanan pendidikan tinggi vokasi dan penelitian terapan yang bermutu, terbuka, relevan, dan berkolaborasi erat dengan masyarakat dan industri	Menerapkan tata kelola institusi yang baik untuk kehidupan bangsa yang lebih baik
PEO-1	√	√
PEO-2	√	√
PEO-3	√	

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4. Capaian Pembelajaran

Kode CP	Capaian Pembelajaran (CP)	Sumber Acuan
	Aspek Sikap	[Sesuai Lampiran Permendikbud Nomor 3 Tahun 2020 tentang Standar Nasional Pendidikan Tinggi]
S-1	Bertakwa kepada Tuhan Yang Maha Esa dan mampu menunjukkan sikap religius;	
S-2	Menjunjung tinggi nilai kemanusiaan dalam menjalankan tugas berdasarkan agama, moral, dan etika;	
S-3	Berkontribusi dalam peningkatan mutu kehidupan bermasyarakat, berbangsa, bernegara, dan kemajuan peradaban berdasarkan Pancasila;	
S-4	Berperan sebagai warga negara yang bangga dan cinta tanah air, memiliki nasionalisme serta rasa tanggungjawab pada negara dan bangsa;	
S-5	Menghargai keanekaragaman budaya, pandangan, agama, dan kepercayaan, serta pendapat atau temuan orisinal orang lain;	
S-6	Bekerja sama dan memiliki kepekaan sosial serta kepedulian terhadap masyarakat dan lingkungan;	
S-7	Taat hukum dan disiplin dalam kehidupan bermasyarakat dan bernegara;	
S-8	Menginternalisasi nilai, norma, dan etika akademik;	
S-9	Menunjukkan sikap bertanggungjawab atas pekerjaan di bidang keahliannya secara mandiri; dan	
S-10	Menginternalisasi semangat kemandirian, kejuangan, dan kewirausahaan.	
	Aspek Pengetahuan	[Sesuai dengan Deskripsi KKNI Level 6]
P-1	Konsep teoritis sains alam, matematika terapan secara umum;	
P-2	Konsep teoritis sains rekayasa dan prinsip-prinsip rekayasa secara mendalam;	
P-3	Konsep, prinsip, metoda dan teknik perancangan dan analisa sistem rekayasa robotika menggunakan software simulasi dan teknologi mutakhir yang dapat diimplementasikan menjadi sistem yang siap digunakan;	
P-4	Pengetahuan operasional lengkap tentang fungsi, cara mengoperasikan dan analisis data atau informasi dari instrument yang umum digunakan untuk melakukan pekerjaan teknologi rekayasa robotika;	
P-5	Pengetahuan faktual dan metode aplikasi, referensi teknis (kode dan standar) nasional dan internasional serta peraturan yang berlaku di wilayah kerjanya untuk melakukan pekerjaan teknologi rekayasa robotika;	
P-6	Prinsip-prinsip penjaminan mutu;	
P-7	Konsep dan prinsip pelestarian lingkungan;	
P-8	Pengetahuan faktual dan isu terkini di bidang teknologi rekayasa robotika dalam kaitannya dengan masalah ekonomi, sosial dan ekologi secara umum;	



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Kode CP	Capaian Pembelajaran (CP)	Sumber Acuan
P-9	Prinsip dan tata cara kerja bengkel/studio dan kegiatan laboratorium, serta pelaksanaan keselamatan dan kesehatan kerja, dan lingkungan (K3L);	
P-10	Prinsip dan teknik berkomunikasi efektif secara lisan dan tulisan; dan	
P-11	Pengetahuan faktual tentang perkembangan teknologi mutakhir dalam bidang teknologi rekayasa robotika.	
	Aspek Keterampilan Umum	[Sesuai Lampiran Permendikbud Nomor 3 Tahun 2020 tentang Standar Nasional Pendidikan Tinggi disesuaikan dengan program studi yang diusulkan]
KU-1	Mampu menerapkan pemikiran logis, kritis, inovatif, bermutu, dan terukur dalam melakukan pekerjaan yang spesifik di bidang keahliannya serta sesuai dengan standar kompetensi kerja bidang robotika;	
KU-2	Mampu menunjukkan kinerja mandiri, bermutu dan terukur;	
KU-3	Mampu mengkaji kasus penerapan ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan bidang keahlian robotika dalam rangka menghasilkan prototype, prosedur baku, desain atau karya seni, menyusun hasil kajiannya dalam bentuk kertas kerja, spesifikasi desain, atau esai seni, dan mengunggahnya dalam laman perguruan tinggi;	
KU-4	Mampu menyusun hasil kajian tersebut di atas dalam bentuk kertas kerja, spesifikasi desain, atau esai seni, dan mengunggahnya dalam laman perguruan tinggi;	
KU-5	Mampu mengambil keputusan secara tepat berdasarkan prosedur baku, spesifikasi desain, persyaratan keselamatan dan keamanan kerja dalam melakukan supervisi dan evaluasi pada pekerjaannya;	
KU-6	Mampu memelihara dan mengembangkan jaringan kerja sama dan hasil kerja sama di dalam maupun di luar lembaganya;	
KU-7	Mampu bertanggungjawab atas pencapaian hasil kerja kelompok dan melakukan supervisi dan evaluasi terhadap penyelesaian pekerjaan yang ditugaskan kepada pekerja yang berada di bawah tanggungjawabnya;	
KU-8	Mampu melakukan proses evaluasi diri terhadap kelompok kerja yang berada dibawah tanggung jawabnya, dan mampu mengelola pembelajaran secara mandiri; dan	
KU-9	Mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data untuk menjamin kesahihan dan mencegah plagiasi.	
	Aspek Keterampilan Khusus	[Sesuai dengan Criteria for Accreditating Engineering]
KK-1	Mampu menerapkan pengetahuan, teknik, keterampilan dan peralatan modern matematika, sains, teknik, dan teknologi untuk memecahkan masalah teknik secara luas sesuai dengan disiplin ilmu robotika;	
KK-2	Mampu merancang sistem, komponen, atau proses yang memenuhi kebutuhan khusus untuk menyelesaikan masalah teknik secara luas sesuai dengan disiplin ilmu robotika;	

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Kode CP	Capaian Pembelajaran (CP)	Sumber Acuan
KK-3	Mampu menerapkan komunikasi tertulis, lisan, dan grafis dalam lingkungan teknis dan non-teknis secara luas serta mampu mengidentifikasi dan menggunakan literatur teknis yang sesuai;	Technology ABET – ETAC 2021-2022]
KK-4	Mampu melakukan tes standar, pengukuran, eksperimen, menganalisis dan menafsirkan hasil untuk meningkatkan proses; dan;	
KK-5	Mampu berfungsi secara efektif sebagai anggota atau sebagai pemimpin tim teknis.	

Pada akreditasi ABET, Capaian Pembelajaran seperti diatas dikenal dengan istilah **Student Outcome (SO)**. Program Studi Teknik Robotika menggunakan *Engineering Technology Accreditation Commission (ETAC) 21-22 Criteria 3 Student Outcome* yaitu:

- an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;
- an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
- an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;
- an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
- an ability to function effectively as a member as well as a leader on technical teams.

Kurikulum baru Program Studi Teknik Robotika ini dibangun menggunakan *Conceive Design Implement Operate (CDIO) Framework* yang dikembangkan oleh MIT pada tahun 2001. Pada CDIO framework, terdapat dua bagian penting yaitu CDIO Standard dan CDIO Syllabus seperti ditunjukkan pada Gambar 1. CDIO Standard mengatur hal-hal terkait cara mengajar (*How to Teach*) yaitu:

- Standard 1: The Context
- Standard 2: Learning Outcomes
- Standard 3: Integrated Curriculum
- Standard 4: Introduction to Engineering
- Standard 5: Design-Implement Experiences
- Standard 6: Engineering Learning Workspaces
- Standard 7: Integrated Learning Experiences
- Standard 8: Active Learning

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- Standard 9: Enhancement of Faculty Competence
- Standard 10: Enhancement of Faculty Teaching Competence
- Standard 11: Learning Assessment
- Standard 12: Program Evaluation

Sedangkan CDIO Syllabus berisi apa saja yang harus diajarkan (*What to Teach*) yaitu:

1 Technical Knowledge And Reasoning

- 1.1 Knowledge Of Underlying Science
- 1.2 Core Engineering Fundamental Knowledge
- 1.3 Advanced Engineering Fundamental Knowledge

2 Personal And Professional Skills And Attributes

- 2.1 Engineering Reasoning And Problem Solving
- 2.2 Experimentation And Knowledge Discovery
- 2.3 System Thinking
- 2.4 Personal Skills And Attitudes
- 2.5 Professional Skills And Attitudes

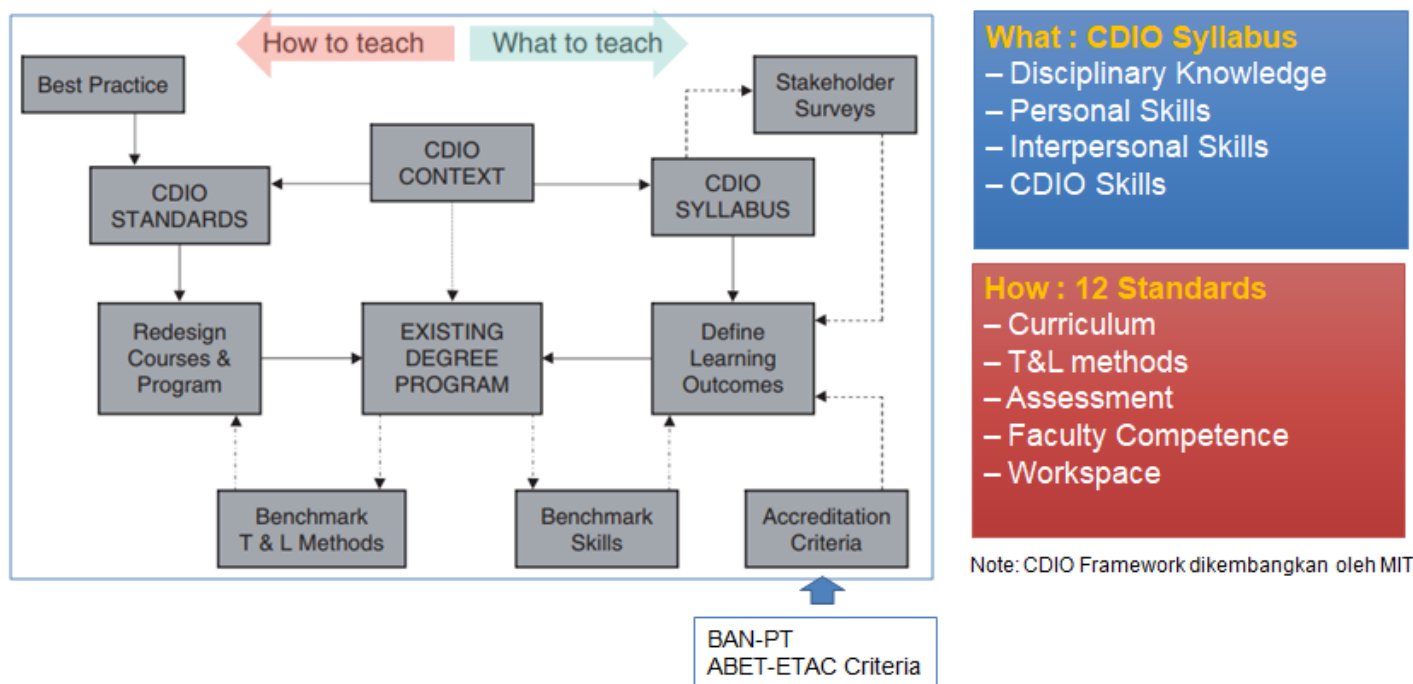
3 Interpersonal Skills: Teamwork And Communication

- 3.1 Multi-disciplinary Teamwork
- 3.2 Communications
- 3.3 Communications In Foreign Languages

4 Conceiving, Designing, Implementing, And Operating Systems In The Enterprise And Societal Context

- 4.1 External And Societal Context
- 4.2 Enterprise And Business Context
- 4.3 Conceiving And Engineering Systems
- 4.4 Designing
- 4.5 Implementing
- 4.6 Operating

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Gambar 13. CDIO Framework

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5. Matriks Bahan Kajian

Berdasarkan hasil FGD, survei kebutuhan, CDIO syllabus proficiency levels, serta *Program Criteria: Electromechanical Engineering Technology* dari standar akreditasi internasional ETAC - ABET, maka untuk mencapai Capaian Pembelajaran (Student Outcome) maka ditetapkanlah sejumlah bahan kajian sebagai berikut:

1.1 KNOWLEDGE OF UNDERLYING SCIENCE

- Applied Calculus
- Engineering Math
- Statics and Dynamics

1.2 CORE ENGINEERING FUNDAMENTAL KNOWLEDGE

- Principles of Electrical and Electronic Engineering
- Electronic Systems
- Sensor and Data Acquisition
- Actuators and Drive Systems
- Computer Aided Design and Drafting (CADD)
- Machine Tools Lab
- Computer Aided Manufacturing
- Procedural Programming
- Object Oriented Programming
- Data Flow Programming
- Robot Operating System (ROS)

1.3 ADVANCED ENGINEERING FUNDAMENTAL KNOWLEDGE

- Introduction to Robotics
- Control System
- Design and Simulation
- Programmable Logic Controllers
- Manipulator Robots
- Industrial Data Communication

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- Computer Vision
- Motion Planning
- Cloud Robotics
- Robotics Control
- Machine Learning
- Localization and Mapping

2 PERSONAL AND PROFESSIONAL SKILLS

- Agama
- Pancasila
- Kewarganegaraan
- Design Thinking
- Professional Skills and Attitudes
- Work Health and Safety
- Quality Engineering Principles

3 INTERPERSONAL SKILLS: TEAMWORK AND COMMUNICATION

- Bahasa Indonesia
- English for Written Communication
- English for Presentation
- Technical Writing
- Engineering Project Management

4. PRODUCT DEVELOPMENT SKILLS

- Introduction to Robotics Engineering
- Rapid Prototyping Project
- Robotics Design and Fabrication
- Agile Innovation Project
- Application of Robotics
- Industrial Robotics Project
- Final Project: Advanced Robotics

5. MERDEKA BELAJAR

- Elective Course 1

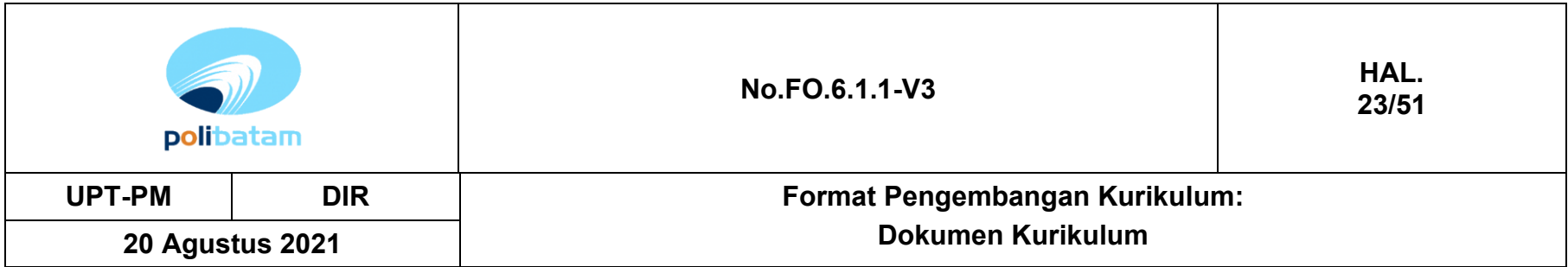
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- Elective Course 2
- Entrepreneurship
- Industrial Attachment

ETAC-ABET Program Criteria: Electromechanical Engineering Technology

- graphical representations of electromechanical systems;
- application of circuit analysis, analog and digital electronics, basic instrumentation, associated software and computers to aid in the characterization, analysis, and troubleshooting of electromechanical systems;
- application of statics, dynamics (or applied mechanics), strength of materials, engineering materials, engineering standards, and manufacturing processes to aid in the characterization, analysis, and troubleshooting of electromechanical systems;
- appropriate computer programming languages for operating electromechanical systems;
- electrical/electronic devices such as amplifiers, motors, relays, power systems, and computer and instrumentation systems for applied design, operation, or troubleshooting electromechanical systems;
- advanced topics in engineering mechanics, engineering materials, and fluid mechanics for applied design, operation, or troubleshooting of electromechanical systems;
- fundamentals of control systems for the applied design, operation, or troubleshooting of electromechanical systems;
- utilization of differential and integral calculus, as a minimum, to characterize the
- static and dynamic performance of electromechanical systems; and
- application of project management techniques in the investigation, analysis, and
- design of electromechanical systems.

Untuk melihat keterkaitan antara Capaian Pembelajaran terhadap CDIO Syllabus, maka dapat dilihat pada matriks berikut:

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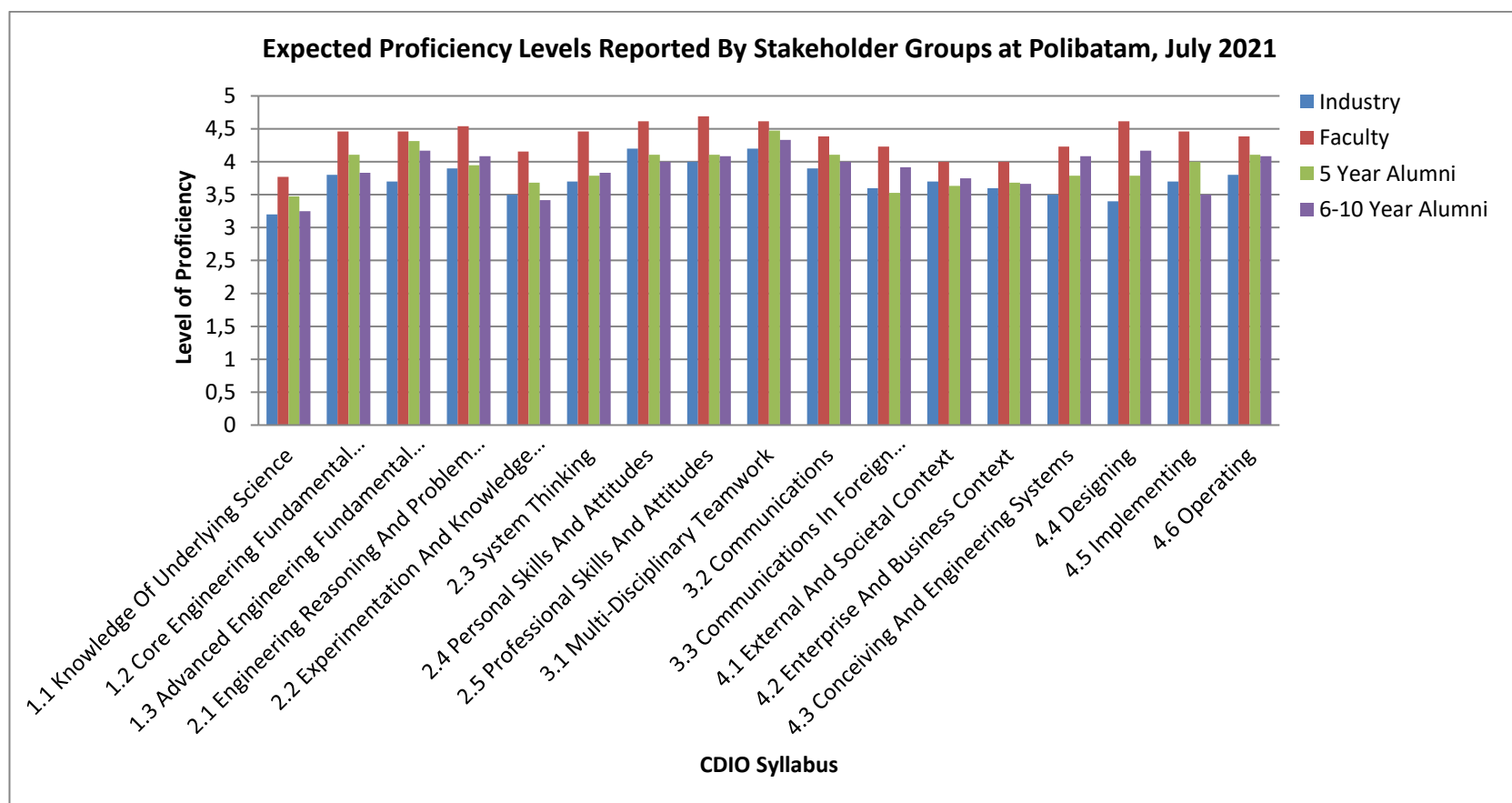
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Untuk melihat keterkaitan Student Outcome terhadap CDIO Syllabus, maka dapat dilihat dari matriks berikut:

	CDIO SYLLABUS	ABET ETAC 21-22 Criteria 3 Student Outcome				
		SO-1	SO-2	SO-3	SO-4	SO-5
Learning to Know	1 TECHNICAL KNOWLEDGE AND REASONING					
	1.1 KNOWLEDGE OF UNDERLYING SCIENCE					
	1.2 CORE ENGINEERING FUNDAMENTAL KNOWLEDGE					
	1.3 ADVANCED ENGINEERING FUNDAMENTAL KNOWLEDGE					
Learning to Be	2 PERSONAL AND PROFESSIONAL SKILLS AND ATTRIBUTES					
	2.1 ENGINEERING REASONING AND PROBLEM SOLVING					
	2.2 EXPERIMENTATION AND KNOWLEDGE DISCOVERY					
	2.3 SYSTEM THINKING					
	2.4 PERSONAL SKILLS AND ATTITUDES					
	2.5 PROFESSIONAL SKILLS AND ATTITUDES					
Learning to Live Together	3 INTERPERSONAL SKILLS: TEAMWORK AND COMMUNICATION					
	3.1 MULTI-DISCIPLINARY TEAMWORK					
	3.2 COMMUNICATIONS					
	3.3 COMMUNICATIONS IN FOREIGN LANGUAGES					
Learning to Do	4 CONCEIVING, DESIGNING, IMPLEMENTING, AND OPERATING SYSTEMS IN THE ENTERPRISE AND SOCIETAL CONTEXT					
	4.1 EXTERNAL AND SOCIETAL CONTEXT					
	4.2 ENTERPRISE AND BUSINESS CONTEXT					
	4.3 CONCEIVING AND ENGINEERING SYSTEMS					
	4.4 DESIGNING					
	4.5 IMPLEMENTING					
	4.6 OPERATING					

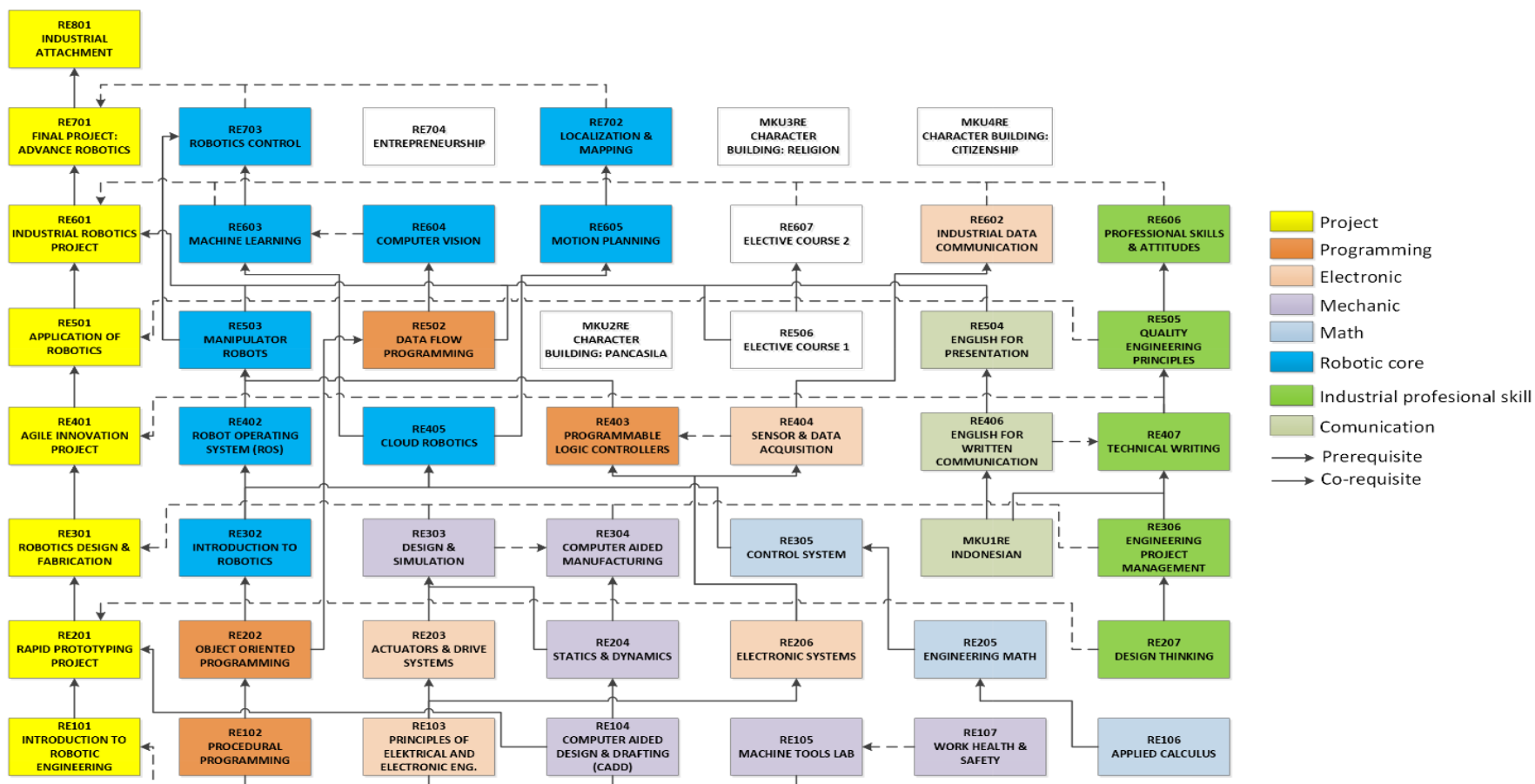
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Untuk mengetahui level kemahiran (proficiency levels) dari CDIO syllabus, yang diinginkan oleh stakeholder, maka pada bulan Juli 2021 telah dilakukan survei ke industri, dosen, dan alumni dengan hasil sebagai berikut:



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6. Peta Mata Kuliah



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7. Kurikulum, Capaian Pembelajaran, dan Rencana Pembelajaran

No.	Semester	Kode Mata Kuliah	Nama Mata Kuliah	Mata Kuliah Kompetensi ¹⁾	Bobot Kredit (sks)			Konversi Kredit ke Jam ²⁾	Capaian Pembelajaran ³⁾				RPS ⁴⁾	Metode Pembelajaran	Keterangan (Pelaksanaan Merdeka Belajar)	Keterlibatan IDUKA	Unit Penyelenggara (Prodi/MKU)
					Kuliah/ Penceramah	Seminar	Praktikum/ Praktikum/ Praktikum		Sikap	Pengetahuan	Keterampilan Umum	Keterampilan Khusus					
1	I	RE101	Introduction to Robotics Engineering	√	0	0	3	8,5	√	√	√	√	√	Praktikum, PBL	Tidak	Tidak	Prodi
2	I	RE102	Procedural Programming	√	2	0	1	6,2		√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
3	I	RE103	Principles of Electrical and Electronic Engineering	√	2	0	1	6,2		√		√	√	PBL/ Penelitian	Tidak	Tidak	Prodi
4	I	RE104	Computer Aided Design and Drafting	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
5	I	RE105	Machine Tools Lab	√	2	0	1	6,2		√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
6	I	RE106	Applied Calculus		2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
7	I	RE107	Work Health and Safety		2	0	0	3,3	√	√	√	√	√	Kuliah	Tidak	Tidak	Prodi
8	II	RE201	Rapid Prototyping Project	√	0	0	3	8,5	√	√	√	√	√	Praktikum, PBL	Tidak	Tidak	Prodi
9	II	RE202	Object Oriented Programming	√	2	0	1	6,2		√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
10	II	RE203	Actuators and Drive Sytems	√	2	0	1	6,2		√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi



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11	II	RE204	Statics and Dynamics	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
12	II	RE205	Engineering Math		2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
13	II	RE206	Electronic Systems	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
14	II	RE207	Design Thinking		2	0	0	3,3	√	√	√	√	√	Kuliah	Tidak	Tidak	Prodi
15	III	RE301	Robotics Design & Fabrication	√	0	0	3	8,5	√	√	√	√	√	Praktikum, PBL	Tidak	Tidak	Prodi
16	III	RE302	Introduction to Robotics	√	2	0	1	6,2	√	√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
17	III	RE303	Design and Simulation	√	2	0	1	6,2		√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
18	III	RE304	Computer Aided Manufacturing	√	2	0	1	6,2		√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
19	III	RE305	Control System	√	2	0	1	6,2		√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
20	III	RE306	Engineering Project Management		2	0	0	3,3		√		√	√	Kuliah	Tidak	Praktisi Industri	Prodi
21	III	PK4RE	Indonesian		2	0	0	3,3		√	√	√	√	Kuliah	Tidak	Tidak	MKU
22	IV	RE401	Agile Innovation Project	√	0	0	3	8,5	√	√	√	√	√	Praktikum, PBL	Tidak	Tidak	Prodi
23	IV	RE402	Robot Operating System (ROS)	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
24	IV	RE403	Programmable Logic Controllers	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
25	IV	RE404	Sensor and Data Acquisition	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
26	IV	RE405	Cloud Robotics	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
27	IV	RE406	English for Written Communication		2	0	0	3,3		√		√	√	Kuliah	Tidak	Tidak	Prodi
28	IV	RE407	Technical Writing		2	0	0	3,3	√	√	√	√	√	Kuliah	Tidak	Tidak	Prodi



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29	V	RE501	Application of Robotics	√	0	0	3	8,5		√	√	√	√	Praktikum, PBL	Tidak	Tidak	Prodi
30	V	RE502	Data Flow Programming	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
31	V	RE503	Manipulator Robots	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
32	V	RE504	English for Presentation		2	0	0	3,3		√		√	√	Kuliah	Tidak	Tidak	Prodi
33	V	RE505	Quality Engineering Principles		2	0	0	3,3		√	√	√	√	Kuliah	Tidak	Praktisi Industri	Prodi
34	V	RE506	Elective Course 1		2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
35	V	PK2RE	Character Building: Pancasila		2	0	0	3,3	√		√	√	√	Kuliah	Tidak	Tidak	MKU
36	VI	RE601	Industrial Robotics Project	√	0	0	3	8,5	√	√	√	√	√	Praktikum, PBL	Tidak	Tidak	Prodi
37	VI	RE602	Industrial Data Communication	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
38	VI	RE603	Machine Learning	√	2	0	1	6,2		√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
39	VI	RE604	Computer Vision	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
40	VI	RE605	Motion Planning	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
41	VI	RE606	Professional Skills and Attitudes		2	0	0	3,3	√		√	√	√	Kuliah	Tidak	Praktisi Industri	Prodi
42	VI	RE607	Elective Course 2		2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
43	VII	RE701	Final Project : Advanced Robotics	√	0	0	4	11,3	√	√	√	√	√	Praktikum, PBL	Tidak	Tidak	Prodi
44	VII	RE702	Localization and Mapping	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
45	VII	RE703	Robotics Control	√	2	0	1	6,2		√	√	√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
46	VII	RE704	Entrepreneurship		2	0	0	3,3	√	√	√	√	√	Kuliah	Tidak	Praktisi Industri	Prodi

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47	VII	PK1RE	Character Building: Religion		2	0	0	3,3	√	√	√	√	√	Kuliah	Tidak	Tidak	MKU
48	VII	PK3RE	Character Building: Citizenship		2	0	0	3,3	√		√	√	√	Kuliah	Tidak	Tidak	MKU
49	VIII	RE801	Industrial Attachment		0	0	20	56,7	√	√	√	√	√	Praktik Lapangan	Ya	Pembimbing Industri	Prodi
Jumlah					82		70	335									

Keterangan:

¹⁾ Diisi dengan tanda centang V jika mata kuliah termasuk dalam mata kuliah kompetensi program studi.

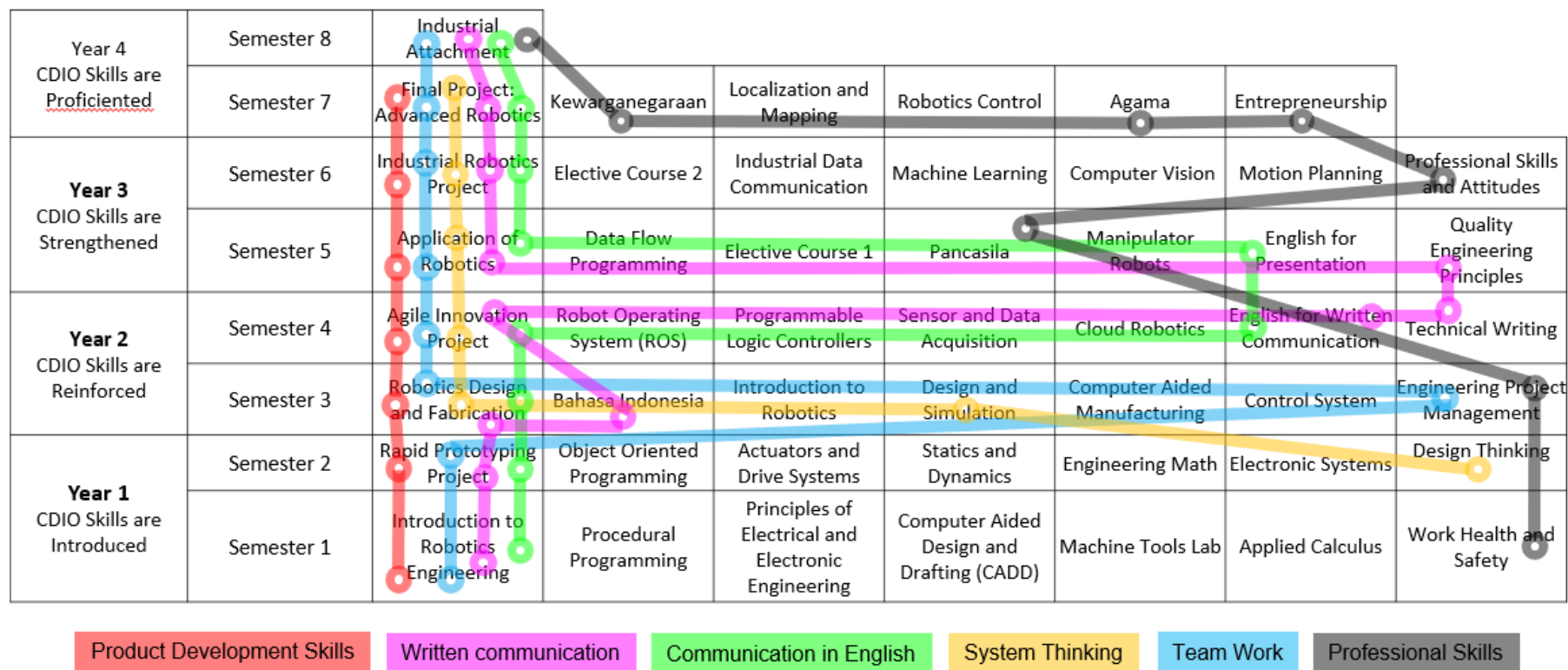
²⁾ Diisi dengan konversi bobot kredit ke jam pelaksanaan pembelajaran. Data ini diisi oleh pengusul dari program studi pada program Diploma Tiga/Sarjana/Sarjana Terapan.

³⁾ Beri tanda V pada kolom unsur pembentuk Capaian Pembelajaran (CP) sesuai dengan rencana pembelajaran.

⁴⁾ Diisi dengan nama dokumen rencana pembelajaran yang digunakan.

Sesuai dengan CDIO Standard 3 yaitu Integrated curriculum, maka matakuliah didesain saling mendukung serta merencanakan pembentukan personal dan interpersonal skills serta product development skills. Gambar

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Gambar Integrated Curriculum

Mahasiswa belajar personal dan interpersonal skills, kemampuan membangun produk sekaligus pengetahuan sesuai disiplin ilmu melalui praktek keteknikan secara profesional. Berbeda dengan Standar 3: Integrated Curriculum, yang menekankan pada rancangan sistematis dalam mengintegrasikan skills yang menjadi target luaran (outcome) ke dalam program kurikulum, Standar 7: Integrated Learning, fokus pada implementasi rancangan tersebut di dalam setiap matakuliah.

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No	Course Learning Outcomes (CLOs)	
1	Explain basic programming concepts	 Technical knowledge
2	Explain OOP paradigm concepts (Class, Objects and Constructor)	
3	Explain the elements that make up an object (class, instance, method, class variable)	
4	Explain the three main principles of object-oriented programming: encapsulation, polymorphism, and inheritance.	
5	Explain the benefits of object oriented design and understand when it is an appropriate methodology to use.	 Conceive  Personal & professional skills
6	Design object oriented solutions for small systems involving multiple objects.	 Design
7	Implement, test and debug solutions in C++ or python	 Implement, Operate
8	Independently find and interpret discipline related documentation.	 Interpersonal skills
9	Write clear and effective documentation	



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Distribution of Robotics Engineering Course Credit Hours among the Student Outcomes

Course Information							Student Outcomes (SOs) - CDIO Syllabus																				
							SO-1			SO-2	SO-4	SO-2	SO-5			SO-3			SO-2								
NO	SEM	CODE	COURSE	Credits	Theory	Practical	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	4.1	4.2	4.3	4.4	4.5	4.6				
1	I		Introduction to Robotics Engineering	3	0	3	0,0	0,4	0,0	0,4	0,4	0,0	0,0	0,4	0,5	0,3	0,3	0,0	0,0	0,0	0,4	0,0	0,0				
2			Procedural Programming	3	2	1	0,0	1,3	0,0	0,0	1,2	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,0	0,2	0,2	0,0			
3			Principles of Electrical and Electronic Engineering	3	2	1	0,0	2,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,2	0,0			
4			Computer Aided Design and Drafting	3	2	1	0,0	2,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,8	0,0	0,0			
1	II		Rapid Prototyping Project	3	0	3	0,0	0,8	0,0	0,0	0,3	0,0	0,5	0,0	0,3	0,3	0,3	0,0	0,0	0,0	0,5	0,0	0,0				
2			Object Oriented Programming	3	2	1	0,0	1,8	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0			
3			Actuators and Drive Sytems	3	2	1	0,0	2,4	0,0	0,0	0,4	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
4			Statics and Dynamics	3	2	1	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
1	III		Robotics Design & Fabrication	3	0	3	0,0	0,2	0,0	0,2	0,4	0,2	0,0	0,0	0,2	0,2	0,2	0,0	0,0	0,2	0,7	0,2	0,0	0,0			
2			Introduction to Robotics	3	2	1	0,2	0,0	0,6	0,0	0,8	0,0	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,3	0,7	0,3	0,0			
1	IV		Agile Innovation Project	3	0	3	0,2	0,2	0,2	0,0	0,3	0,2	0,0	0,0	0,2	0,5	0,1	0,0	0,2	0,3	0,2	0,3	0,3	0,3			
2			Robot Operating System (ROS)	3	2	1	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
1	V		Application of Robotics	3	0	3	0,0	0,3	0,2	0,2	0,2	0,2	0,0	0,0	0,0	0,2	0,2	0,0	0,1	0,5	0,3	0,7	0,0	0,0			
2			Data Flow Programming	3	2	1	0,0	2,7	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
1	VI		Industrial Robotics Project	3	0	3	0,0	0,0	0,0	0,3	0,2	0,2	0,0	0,0	0,0	0,2	0,2	0,2	0,5	0,4	0,2	0,6	0,0	0,0			
2			Industrial Data Communication	3	2	1	0,0	0,5	2,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
1	VII		Final Project : Advanced Robotics	4	0	4	0,0	0,0	0,4	0,3	0,4	0,1	0,0	0,1	0,1	0,6	0,1	0,1	0,1	0,1	0,6	0,4	0,1	0,0			
2			Localization and Mapping	3	2	1	0,0	0,0	2,3	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
3			Robotics Control	3	2	1	0,0	0,0	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0	0,0	0,4	0,9	0,0	0,0			
4			Entrepreneurship	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,3	0,3	0,0	0,0	1,1	0,0	0,0	0,0	0,0	0,0			
1	VIII		Industrial Attachment	20	0	20	2,2	2,2	2,2	0,0	0,0	0,0	2,2	6,7	0,0	2,2	2,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0			
Total credit hours				152	82	70																					
Credit hours distribution per each CDIO Syllabus							9,2	30,1	23,0	1,7	15,5	1,3	7,3	10,9	3,2	14,4	7,6	0,5	2,4	2,9	10,9	10,0	1,1				
Percentage of credit hours per each CDIO Syllabus (%)							6,1	19,8	15,1	1,1	10,2	0,9	4,8	7,2	2,1	9,5	5,0	0,3	1,6	1,9	7,2	6,6	0,7				
							SO-1	SO-2	SO-3	SO-4	SO-5																
Credit hours distribution per each Student Outcome							62,3	30,8	21,9	15,5	21,4																
Percentage of credit hours per each Student Outcome (%)							41,0	20,3	14,4	10,2	14,1																

Catatan: Secara lengkap dapat dilihat pada lampiran

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Progression of CDIO Skills Levels on Robotics Engineering Courses

Course Information							Student Outcomes (SOs) - CDIO Syllabus																	
							SO-1			SO-2	SO-4	SO-2			SO-5			SO-3			SO-2			
NO	SEM	CODE	COURSE	Credits	Theory	Practical	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	4.1	4.2	4.3	4.4	4.5	4.6	
1	I		Introduction to Robotics Engineering	3	0	3	0	3	0	3	3	0	0	3	2	2	2	0	0	0	3	0	0	
2			Procedural Programming	3	2	1	0	3	0	0	3	0	0	0	0	3	0	0	0	0	3	2	0	
3			Principles of Electrical and Electronic Engineering	3	2	1	0	3	0	0	4	0	0	0	0	0	0	0	0	0	0	3	3	0
4			Computer Aided Design and Drafting (CADD)	3	2	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
1	II		Rapid Prototyping Project	3	0	3	0	3	0	0	3	0	3	0	3	3	3	0	0	0	3	0	0	
2			Object Oriented Programming	3	2	1	0	3	0	0	3	0	0	0	0	0	3	0	0	0	3	0	0	
1	III		Robotics Design & Fabrication	3	0	3	0	4	0	4	4	4	0	0	4	4	3	0	0	4	4	4	0	
2			Introduction to Robotics	3	2	1	3	0	3	0	4	0	0	0	4	0	0	0	0	4	4	4	0	
1	IV		Agile Innovation Project	3	0	3	4	4	4	0	4	4	0	0	4	4	3	0	4	3	4	4	3	
2			Robot Operating System (ROS)	3	2	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	V		Application of Robotics	3	0	3	0	3	4	4	4	4	0	0	0	4	4	0	3	4	4	4	0	
2			Data Flow Programming	3	2	1	0	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	
1	VI		Industrial Robotics Project	3	0	3	0	0	0	4	4	4	0	0	0	4	4	4	4	4	4	4	0	
2			Industrial Data Communication	3	2	1	0	4	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	
1	VII		Final Project : Advanced Robotics	4	0	4	0	0	4	4	4	4	0	4	4	4	4	4	4	4	4	4	4	
2			Localization and Mapping	3	2	1	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	
1	VIII		Industrial Attachment	20	0	20	4	4	4	0	0	0	4	4	0	4	4	0	0	0	0	0	0	
Total credit hours				152	82	70																		
Final CDIO Levels							4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Expected CDIO Levels							3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Gap (Final Levels - Expected Levels)							1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Catatan: Secara lengkap dapat dilihat pada lampiran

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8. Integrasi Kegiatan Penelitian/PkM dalam Pembelajaran

No.	Judul Penelitian/PkM ¹⁾	Nama Dosen	Mata Kuliah	Bentuk Integrasi ²⁾
1	2	3	4	5
1	Lower Limb Exoskeleton	Daniel Sutopo, Susanto, Riska Analia, Hendawan Soebhakti, Abdullah Sani	- RE301 Robotics Design & Fabrication - RE401 Agile Innovation Project - RE501 Application of Robotics - RE601 Industrial Robotics Project - RE701 Final Project : Advanced Robotics	Project-Based Learning
2	Robot Hockey	Adlian Jefiza, Susanto	RE101 Introduction to Robotics Engineering	Project-Based Learning
3	Workshop Robotika		- RE201 Rapid Prototyping Project - RE301 Robotics Design & Fabrication	Project-Based Learning

Keterangan:

¹⁾ Judul penelitian dan PkM tercatat di unit/lembaga yang mengelola kegiatan penelitian/PkM di tingkat Perguruan Tinggi/UPPS.

²⁾ Bentuk integrasi dapat berupa tambahan materi perkuliahan, studi kasus, Bab/ Subbab dalam buku ajar, atau bentuk lain yang relevan.

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9. Silabus Mata Kuliah

[Urutkan berdasarkan kode mata kuliah].

No	Komponen Silabus	Deskripsi
1.	Mata Kuliah :	Introduction to Robotics Engineering
	Kode :	RE101
	SKS :	3
	Deskripsi Mata Kuliah :	As a student of Robotics Engineering, you are part of the engineering profession. In this course, you will develop your identity as a modern engineer who will collaboratively contribute to the society. This course will provide the framework for engineering practice in product, process, and system building, and introduces essential personal and interpersonal skills. Students engage in the practice of engineering through a simple robotics project as a team. Utilization of C programming language, computer-aided design (CAD) software, and the microcontroller-based robotic control system into the project will help students to build prototypes. Students will asked to demonstrate critical thinking, creativity, and problem-solving skills in hands-on lab experiences.
2.	Mata Kuliah :	Procedural Programming
	Kode :	RE102
	SKS :	3
	Deskripsi Mata Kuliah :	Students will learn the fundamentals of programming in the C programming language, including iteration, decision branching, data types and expression. Students will use a microcontroller platform to implement C programming code.
3.	Mata Kuliah :	Principles of Electrical and Electronic Engineering
	Kode :	RE103
	SKS :	3
	Deskripsi Mata Kuliah :	Students learn electrical and electronics principles and instrument to measure the parameters. DC fundamentals include sources, resistance, Ohm's and Kirchhoff's Laws with simple circuits, diode, transistor and FET. AC systems include transformers and reactive elements, power production and distribution, filtering, motors and relays. Digital Electronics: Perform basic binary arithmetic calculations; analyze and synthesize combinatorial logic circuits;
4	Mata Kuliah :	Computer Aided Design and Drafting
	Kode :	RE104
	SKS :	3
	Deskripsi Mata Kuliah :	Introduces the use of computer-aided design & drafting (CADD) software to create 3D models complete with detailed documentation such as dimensions, materials used and even details the design process. Topics include blue print reading, orthographic projection, sectioning, assembly drawing and basic solid modelling.
5	Mata Kuliah :	Machine Tools Lab
	Kode :	RE105
	SKS :	3

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	Deskripsi Mata Kuliah	:	Students will demonstrate their abilities to interpret drawings and select the appropriate equipment needed to produce each part. Parts built will be inspected by the student to verify the meeting of part requirements. Students will repair/replace any parts that are found to be out of specifications. Inspection tools will be utilized in the product validation requirement of the course. Topics will be experimentally validated through the creation of mechanical parts that will be assembled into a final product.
6	Mata Kuliah	:	Applied Calculus
	Kode	:	RE106
	SKS	:	3
	Deskripsi Mata Kuliah	:	Utilization of differential and integral calculus, as a minimum, to characterize the static and dynamic performance of robotics systems. Course topics including determinant, matrices, vectors, trigonometry, complex numbers, limits, derivative, integrals, differential equation, and Laplace transformations.
7	Mata Kuliah	:	Work Health and Safety
	Kode	:	RE107
	SKS	:	2
	Deskripsi Mata Kuliah	:	This course has been developed to provide an understanding of health and safety responsibilities in the workplace, how risk is managed in the workplace using the risk management process, and what you should expect to find in the workplace to help you work safely.
8	Mata Kuliah	:	Rapid Prototyping Project
	Kode	:	RE201
	SKS	:	3
	Deskripsi Mata Kuliah	:	Equip students with a deep design thinking skills of ideation, prototyping, and iteration. Consistently generate more and better ideas by using CDIO approach to brainstorming and ideation. Lowering a risk by running small experiments to learn from failure in a controlled environment. Create a culture of experimentation on a team and expand students capacity for innovation.
9	Mata Kuliah	:	Object Oriented Programming
	Kode	:	RE202
	SKS	:	3
	Deskripsi Mata Kuliah	:	This course introduces the concepts of object-oriented programming to students with a background in the procedural programming paradigm. The course begins with a brief review of control structures, data types and array processing. It then moves on to introduce the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design. Other topics include an overview of programming language principles, simple analysis of algorithms, basic searching and sorting techniques, memory management, an introduction to software engineering issues, and ethics in software development.
10	Mata Kuliah	:	Actuators and Drive Systems
	Kode	:	RE203
	SKS	:	3

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	Deskripsi Mata Kuliah	:	This course introduces actuators and drive system for both of pneumatics & hydraulic actuators and electric actuators. Course topics including a study of fluid power technology using fluids or compressed air as the transfer media. Complete hydraulic and pneumatic systems are studied, including power sources, reservoirs, pumps, compressors, lines, valves and actuators. Troubleshooting strategies to identify, localize and correct malfunctions. Preventative maintenance and safety issues will also be discussed. Introduction of power electronic drives with motors includes electromagnetic and energy conversion, amplifiers, motors, relays, power systems, application specific selection of machinery and drive systems.
11	Mata Kuliah	:	Statics and Dynamics
	Kode	:	RE204
	SKS	:	3
	Deskripsi Mata Kuliah	:	This course studies how to perform static calculations on objects and what physical factors affect these objects as well as the concept of rigid body motion analysis and dynamic systems and modeling of robotic systems.
12	Mata Kuliah	:	Engineering Math
	Kode	:	RE205
	SKS	:	3
	Deskripsi Mata Kuliah	:	This course discusses how to solve mathematical problems such as systems of linear, nonlinear, derivative, integral, differential and interpolation equations using a numerical method approach. In addition, it also discusses basic statistics and Bayesian probabilities.
13	Mata Kuliah	:	Electronic Systems
	Kode	:	RE206
	SKS	:	3
	Deskripsi Mata Kuliah	:	Students learn electronics systems, their basic performance and applications. Computer systems are presented with a microcontroller and provide the ability to write and read both digital and analog data. Analog systems include diodes, transistors, IC amplifiers, and analog-digital and digital to analog conversions. The semester closes by combining all of the topics presented in the control of motor speed.
14	Mata Kuliah	:	Design Thinking
	Kode	:	RE207
	SKS	:	2
	Deskripsi Mata Kuliah	:	Student will engage in critical analysis of real-world problems and global challenges. They will demonstrate the ability to recognize opportunity and to take initiative in developing solutions applying the principles of human centered design, local and global impact of engineering solutions on individuals, organizations and society. Students will be able to communicate effectively and to work well on teams. Problems and solutions will be examined from societal, cultural, and ethical perspectives.
15	Mata Kuliah	:	Robotics Design & Fabrication
	Kode	:	RE301
	SKS	:	3

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	Deskripsi Mata Kuliah	:	Design and construct a simple robotics system that integrates the mechanical, electrical, electronics and programming into a working product. In the process of designing, building and fabricating the product, students will integrate knowledge of mechanical system design, computer aided design (CAD), basic electrical and electronics learnt in other modules. Various aspects of personal and interpersonal skills such as teamwork, communications, as well as managing learning are systematically infused in carrying out the design-fabricate project.
16	Mata Kuliah	:	Introduction to Robotics
	Kode	:	RE302
	SKS	:	3
	Deskripsi Mata Kuliah	:	This course introduces the fundamental concepts of robotics with emphasis on hands-on experience in programming and application of various robots. Topics covered include introduction of robotics, robot classifications, robot programming, safety considerations, sensors, motors, robot and system integration, and fundamentals of kinematics. Students will get hands-on experience with building robots, integrating sensors and actuators, and developing algorithms for robot control. It is an explicit goal of this course to advance students' critical thinking and communication skills. This is achieved through laboratories, group work, and discussions.
17	Mata Kuliah	:	Design and Simulation
	Kode	:	RE303
	SKS	:	3
	Deskripsi Mata Kuliah	:	This course introduces standard part, robot mechanism, ergonomic, product design, dynamic simulation in CAD software.
18	Mata Kuliah	:	Computer Aided Manufacturing
	Kode	:	RE304
	SKS	:	3
	Deskripsi Mata Kuliah	:	The course focuses on CNC milling as a manufacturing automation process applied to a project. Course provides knowledge of computer-aided machining in milling and turning, including process planning techniques, machine coding and operational instructions to produce precision components. Manufacturing management and system skills, such as product planning, manufacturing sequence, time and cost are also discussed. Student also learn how to effectively present the ideas and outcomes using oral and report based methods.
19	Mata Kuliah	:	Control System
	Kode	:	RE305
	SKS	:	3
	Deskripsi Mata Kuliah	:	An introduction to the analysis and design of linear feedback control systems. The course will include a study of introduction to control system, mathematical model of system, state variable model, root locus, design of feedback control system, steady-state analysis, time response analysis, digital control system. Laboratory exercises will develop a student's ability to design feedback systems and quantify system performance.

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20	Mata Kuliah	:	Engineering Project Management
	Kode	:	RE306
	SKS	:	2
	Deskripsi Mata Kuliah	:	This course provides students with the skills necessary for successful completion of their design project. Topics include group dynamics, ethics, timelines, resource allocation, project management and performance evaluations. Skills in oral and written communications, problem conceptualization, creative problem solving and technical presentations are developed.
21	Mata Kuliah	:	Indonesian
	Kode	:	PK4RE
	SKS	:	2
	Deskripsi Mata Kuliah	:	In this course Students will explore lecture materials including: (a) academic ethics and differences proper type and systematics of scientific writing; (b) the Indonesian formulation used in the scientific writings with due observance of grammatical principles, PUEBI, and KBBI; (c) reference related to scientific writing; (d) the accuracy of the Indonesian language formulation in writing scientific papers; (e) accuracy the use of the Indonesian language formulation properly and correctly in the preparation of scientific papers; (f) skilled in conveying the results of ideas / ideas orally including presentation techniques. (g) able to write e-mails effectively, technical reports, and instruction manuals.
22	Mata Kuliah	:	Agile Innovation Project
	Kode	:	RE401
	SKS	:	3
	Deskripsi Mata Kuliah	:	Equip students with agile methodology to create innovative products or solutions. Students collaborate in multi-disciplinary groups to define, design, build, test and release products.
23	Mata Kuliah	:	Robot Operating System (ROS)
	Kode	:	RE402
	SKS	:	3
	Deskripsi Mata Kuliah	:	The course provides an application-specific introduction to the robotics operating system (ROS) to provide practicing engineers in developing a robotic application. Topics include what ROS is, basic concepts of ROS, nodes, topics, services, actions, and parameters. Use ROS to inspect and debug a robotics system, prototype simple command and control applications for a simulated mobile robot, integrate a new sensor into the robot's ROS ecosystem and make use of sensor data to inform a robot's mission in real-time. In addition, this course will discuss about robot modeling using ROS and Gazebo.
24	Mata Kuliah	:	Programmable Logic Controllers
	Kode	:	RE403
	SKS	:	3
	Deskripsi Mata Kuliah	:	This course examines the concepts, devices, and common practices associated with modern industrial control systems. Common industrial control devices are studied. Students learn how to wire, program, and troubleshoot programmable logic controller (PLC)

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		based control systems. PLC applications focus on interfacing and controlling a variety of electromechanical devices such as motors and pneumatic actuators. Industrial safety practices and procedures are emphasized throughout the course.
25	Mata Kuliah :	Sensor and Data Acquisition
	Kode :	RE404
	SKS :	3
	Deskripsi Mata Kuliah :	This course introduce a microprocessor-based techniques for data acquisition and processing, including sensors, sensor fusion, interfacing, sampling, reconstruction, and computer communications. Signal processing based on error analysis and statistics.
26	Mata Kuliah :	Cloud Robotics
	Kode :	RE405
	SKS :	3
	Deskripsi Mata Kuliah :	This course explains cloud technology and its application in the field of robotics. Materials that will be discussed in this course include machine to machine and machine to cloud communication. The cloud robotic architecture leverages the combination of an ad-hoc cloud formed by machine-to-machine (M2M) communications among participating robots, and an infrastructure cloud enabled by machine-to-cloud (M2C) communications.
27	Mata Kuliah :	English for Written Communication
	Kode :	RE406
	SKS :	2
	Deskripsi Mata Kuliah :	This course introduce to students to write clear and positive messages and to understand basic writing strategies. The subject matter of this course includes some of the typical techniques for effective writing and will give students practice in writing a wide variety of email messages, memos, letters, scientific papers and workplace reports.
28	Mata Kuliah :	Technical Writing
	Kode :	RE407
	SKS :	2
	Deskripsi Mata Kuliah :	Provides knowledge of and practice in technical writing. Key topics include audience analysis; organizing, preparing and revising short and long technical documents; designing documents using effective design features and principles, and formatting elements using tables and graphs; conducting research; writing technical definitions, and physical and process descriptions; writing instructions; and individual and group peer editing.
29	Mata Kuliah :	Application of Robotics
	Kode :	RE501
	SKS :	3
	Deskripsi Mata Kuliah :	This project equip student with knowledge of commonly used robots, their applications, robot safety, and basic robot programming methods. The objective of the course is to equip students with fundamental knowledge on robots. Students will be aware of benefits of using robots, able to perform basic robot programming, and able to

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		select suitable robots and associated components for different applications.
30	Mata Kuliah	: Data Flow Programming
	Kode	: RE502
	SKS	: 3
	Deskripsi Mata Kuliah	: This course students will learn concept of data flow programming using LabVIEW. Course topics including programming concepts, techniques, features, VIs, and functions you can use to create test and measurement, data acquisition, instrument control, data logging, measurement analysis, and report generation applications. This course designed to build students proficiency with LabVIEW and help them to prepare for the NI Certified LabVIEW Associate Developer exam.
31	Mata Kuliah	: Manipulator Robots
	Kode	: RE503
	SKS	: 3
	Deskripsi Mata Kuliah	: This course discusses manipulator robots and related applications in industrial environments. This course will cover material related to homogeneous transformation, manipulator kinematics, and manipulator dynamics. Robot manipulator applications that will be discussed in this course include pick and place and packaging.
32	Mata Kuliah	: English for Presentation
	Kode	: RE504
	SKS	: 2
	Deskripsi Mata Kuliah	: The aim of the course is to prepare students to present in English and deal with questions from the audience at international conferences and other events. The students will study and practice various aspects of giving academic presentations. They will learn the key strategies necessary to improve their communicativeness and fluency.
33	Mata Kuliah	: Quality Engineering Principles
	Kode	: RE505
	SKS	: 2
	Deskripsi Mata Kuliah	: This course is designed to introduce the student to techniques required to maintain and improve quality within manufacturing organizations. The course covers concepts of quality, quality managements and assurance, product quality, design of quality control chart, statistical process control, and quality improvement through design by considering concept development and implementation. Student also introduced with Industry and engineering standards and codes, i.e IEC, FMEA, Six Sigma.
34	Mata Kuliah	: Elective Course 1
	Kode	: RE506
	SKS	: 3
	Deskripsi Mata Kuliah	: This course provide elective topics i.e: mobile technology, augmented reality and/or virtual reality, or special topics related to robotics. Augmented reality and virtual reality: This course presents an introduction to augmented and virtual reality technologies, with an emphasis on designing and developing interactive virtual and

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		augmented reality experiences. The course will cover the history of the area, fundamental theory, interaction techniques, and specific application areas. Concepts from the contributing fields of computer vision, computer graphics and human computer interaction will be introduced in the context of virtual and augmented reality. Students will be tasked with creating their own virtual or augmented reality application as a course project.
35	Mata Kuliah :	Character Building: Pancasila
	Kode :	PK2RE
	SKS :	2
	Deskripsi Mata Kuliah :	Students gain knowledge and learning experience to improve understanding and awareness about: a sense of nationality and love for the homeland through insights about Pancasila so that they become citizens who have competitiveness, and are highly disciplined and actively participate in building a peaceful life based on a value system Pancasila. After this lecture, it is hoped that students will be able to manifest themselves as citizens a good country that is able to support the nation and state. Smart citizen, civilized and responsible for the survival of the Indonesian state in practicing their knowledge, technology and art abilities.
36	Mata Kuliah :	Industrial Robotics Project
	Kode :	RE601
	SKS :	3
	Deskripsi Mata Kuliah :	This project focuses on the role of robots in increasing safety, productivity and profit for specific industries: manufacturing, medical, services, entertainment & military. A cost analysis of industry robot integration is provided supporting a positive increase in tasks performance and reduction of operational costs.
37	Mata Kuliah :	Industrial Data Communication
	Kode :	RE602
	SKS :	3
	Deskripsi Mata Kuliah :	This course will expose the students to many of the different Industrial Networks that will be encountered in a manufacturing setting. Students will gain an understanding of the network infrastructure utilized by industrial machinery and the communication profiles used. The communication profiles will include but not be limited to: Serial Communication, RS-232, Ethernet, Modbus, Profibus, DevicNet, Foundational Fieldbus and AS-I Bus.
38	Mata Kuliah :	Machine Learning
	Kode :	RE603
	SKS :	3
	Deskripsi Mata Kuliah :	Machine learning (ML) algorithms are used to extract and analyze large amounts of manufacturing data. Fundamental ML analytic techniques and commonly used ML algorithms for manufacturing applications will be introduced. Students will create, train, and deploy ML models on a cloud platform to create enterprise-ready smart manufacturing artificial intelligence (AI) solutions. In this course we will learn about the basics of deep neural networks, and their

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		applications to various AI tasks. By the end of the course, it is expected that students will have significant familiarity with the subject, and be able to apply Deep Learning to a variety of tasks. They will also be positioned to understand much of the current literature on the topic and extend their knowledge through further study.
39	Mata Kuliah	: Computer Vision
	Kode	: RE604
	SKS	: 3
	Deskripsi Mata Kuliah	: This course provides fundamental knowledge of integrated computer imaging or vision systems for sensing, quality control and robotics applications. Fundamental basis of optics, illumination, camera types with associated technologies, and image acquisition to develop a customized computer imaging or vision systems will be covered. Algorithms for image processing, image analysis and pattern recognition will also be covered.
40	Mata Kuliah	: Motion Planning
	Kode	: RE605
	SKS	: 3
	Deskripsi Mata Kuliah	: This course discusses various algorithms regarding robot movement planning, such as the A*, djikstra, RRT algorithm and also discusses optimization methods, which are methods to find the most optimal value of a problem. Optimization methods that will be discussed include genetic algorithms, particle swarm optimization, prohibition search and the Monte Carlo method.
41	Mata Kuliah	: Professional Skills and Attitudes
	Kode	: RE606
	SKS	: 2
	Deskripsi Mata Kuliah	: This course introduce professional ethics, integrity, responsibility and accountability, professional behavior, proactively planning for one's career, and stay current on world of engineer.
42	Mata Kuliah	: Elective Course 2
	Kode	: RE607
	SKS	: 3
	Deskripsi Mata Kuliah	: This elective course gives students the opportunity to choose courses on specific topics: Mobile Robots, Legged Robots, Medical Robots, Flying Robots and other topics.
43	Mata Kuliah	: Final Project : Advanced Robotics
	Kode	: RE701
	SKS	: 4
	Deskripsi Mata Kuliah	: This is the capstone project, a design experience for senior level students in robotic engineering. In this project student teams will design, build and test solutions to real-world problem. Students will work with advanced topics in robotics i.e.: motion planning, positioning, teleoperation, control, navigation, human-robot interaction.
44	Mata Kuliah	: Localization and Mapping
	Kode	: RE702

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	SKS	:	3
	Deskripsi Mata Kuliah	:	This course discusses the technique for creating an environment map and determining the robot pose relative to a given map of the environment. The localization algorithms that will be discussed are Extended Kalman Filter (EKF), Unscented Kalman Filter (UKF), and Monte Carlo Localization (MCL). Moreover, the occupancy grid mapping algorithm will be explained for map creation.
45	Mata Kuliah	:	Robotics Control
	Kode	:	RE703
	SKS	:	3
	Deskripsi Mata Kuliah	:	This course introduces a Behavior Tree, Finite State Machine (FSM), LQR, Linier System robotic controller system. Student also equipped a proper chosen of robotic controller system which is suitable with the project related to robotics in real application.
46	Mata Kuliah	:	Entrepreneurship
	Kode	:	RE704
	SKS	:	2
	Deskripsi Mata Kuliah	:	This course introduces engineering students to the concepts and practices of technology entrepreneurial thinking and entrepreneurship. Using lectures, case studies, business plans, and student presentations, the course teaches life skills in entrepreneurial thought and action that students can utilize in starting technology companies or executing R&D projects.
47	Mata Kuliah	:	Character Building: Religion
	Kode	:	PK1RE
	SKS	:	2
	Deskripsi Mata Kuliah	:	This Islamic Religious Education course discusses and explores materials with the substance of human relations with God to create a pious generation with the Qur'anic paradigm; human relations with fellow human beings in order to integrate Faith, Islam and Ihsan; and the relationship between humans and their environment in the context of grounding Islam to realize prosperity. Thus, a religious, humanist, broad-minded and caring generation was born.
48	Mata Kuliah	:	Character Building: Citizenship
	Kode	:	PK3RE
	SKS	:	2
	Deskripsi Mata Kuliah	:	The Citizenship course discusses and explores knowledge and skills learning experiences to increase understanding and awareness of: a sense of nationality and love for the homeland, civilized democracy, become a citizen with personality Indonesia is competitive, disciplined and actively participates in building peaceful life based on the Pancasila value system. Able to manifest yourself into good citizens who are able to support the nation and state, citizens who democratic, namely citizens who are intelligent, civilized and responsible for survival of the Indonesian state in practicing the ability of science, technology and art.
49	Mata Kuliah	:	Industrial Attachment
	Kode	:	RE801
	SKS	:	20

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Deskripsi Mata Kuliah :	Giving students valuable industry experience. Introduce students to industry culture and train the future workforce and industry leadership, enhance their studies, and gain from unique professional development opportunities.
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[Lengkapi tabel silabus dengan data seluruh mata kuliah, dan silabus ini menjadi data yang dipublikasi pada website masing-masing Program Studi].

10. Matriks Hubungan Capaian Pembelajaran Mata Kuliah (Indikator Kinerja) dan Capaian Pembelajaran

RE101 Introduction to Robotics Engineering		Course Description																	
		As a student of Robotics Engineering, you are part of the engineering profession. In this course, you will develop your identity as a modern engineer who will collaboratively contribute to the society. This course will provide the framework for engineering practice in product, process, and system building, and introduces essential personal and interpersonal skills. Students engage in the practice of engineering through a simple robotics project as a team. Utilization of C programming language, computer-aided design (CAD) software, and the microcontroller-based robotic control system into the project will help students to build prototypes. Students will asked to demonstrate critical thinking, creativity, and problem-solving skills in hands-on lab experiences.																	
No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	
		SO-1			SO-2			SO-3			SO-4			SO-5			SO-6		
		1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	4.1	4.2	4.3	4.4	4.5	4.6	4.7
1	Explain the role of engineers in society and classify the different engineering branches, the functions of an engineer, and industries in which they work.									3									
2	Formulate and justify a solution to an engineering problem within a team structure.					3					2								
3	Design a simple robotics system based on formulated solution.																3		
4	Build hardware and software of a microcontroller-based robotics system.		3																
5	Test hardware and software performance.					3													
6	Demonstrate knowledge of effective practices for writing technical engineering documents.										2								
7	Demonstrate teamwork skills in working on an engineering team.									2									
8	Present the results of project orally in English.											2							
Summary		0	3	0	3	3	0	0	3	4	2	2	0	0	0	3	0	0	0
Sum of levels		23																	
Course Credits Hours		3																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,39	0,00	0,39	0,39	0,00	0,00	0,39	0,52	0,26	0,26	0,00	0,00	0,00	0,39	0,00	0,00	0,00
Credit hours distribution per each Student Outcome		0,39	0,78	0,52	0,39	0,91													
Maximum CDIO skills level		0	3	0	3	3	0	0	3	2	2	2	0	0	0	3	0	0	0

Secara lengkap untuk seluruh matakuliah dapat dilihat pada lampiran "Skills Progression Matrix"

11. Dokumen RPS (terlampir)

Format merujuk ke Format Rencana Pembelajaran Semester (RPS) yang berlaku saat ini.

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12. Peninjauan kurikulum

[Evaluasi konten kurikulum dilakukan per semester sesuai dengan perkembangan keilmuan dan kebutuhan pemangku kepentingan. Sedangkan peninjauan kurikulum dilakukan per 1 kali siklus kurikulum (maksimum 4 tahun untuk D-III dan 5 tahun untuk D-IV) juga disesuaikan dengan perkembangan keilmuan dan kebutuhan pemangku kepentingan].

No.	Kode Mata Kuliah	Nama Mata Kuliah	Mata Kuliah Baru/ Lama/Hapus	Perubahan pada		Alasan Peninjauan	Atas usulan/ masukan dari	Berlaku mulai Sem./Th.
				Silabus/RPS	Buku Ajar			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

Batam, 26 Juni 2021
Ketua Program Studi Teknik Robotika



(Senanjung Prayoga)
NIK : 115149

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LAMPIRAN

CDIO Syllabus 3rd Level

1 TECHNICAL KNOWLEDGE AND REASONING

1.1 KNOWLEDGE OF UNDERLYING SCIENCE

1.2 CORE ENGINEERING FUNDAMENTAL KNOWLEDGE

1.3 ADVANCED ENGINEERING FUNDAMENTAL KNOWLEDGE

2 PERSONAL AND PROFESSIONAL SKILLS AND ATTRIBUTES

2.1 ENGINEERING REASONING AND PROBLEM SOLVING

2.1.1 Problem Identification and Formulation

2.1.2 Modeling Employ assumptions to simplify complex systems and environment

2.1.3 Estimation and Qualitative Analysis

2.1.4 Analysis With Uncertainty

2.1.5 Solution and Recommendation

2.2 EXPERIMENTATION AND KNOWLEDGE DISCOVERY

2.2.1 Hypothesis Formulation

2.2.2 Survey of Print and Electronic Literature

2.2.3 Experimental Inquiry

2.2.4 Hypothesis Test, and Defense

2.3 SYSTEM THINKING

2.3.1 Thinking Holistically

2.3.2 Emergence and Interactions in Systems

2.3.3 Prioritization and Focus

2.3.4 Trade-offs, Judgment and Balance in Resolution

2.4 PERSONAL SKILLS AND ATTITUDES

2.4.1 Initiative and Willingness to Take Risks

2.4.2 Perseverance and Flexibility

2.4.3 Creative Thinking

2.4.4 Critical Thinking

2.4.5 Awareness of One's Personal Knowledge, Skills and Attitudes

2.4.6 Curiosity and Lifelong Learning

2.4.7 Time and Resource Management

2.5 PROFESSIONAL SKILLS AND ATTITUDES

2.5.1 Professional Ethics, Integrity, Responsibility & Accountability

2.5.2 Professional Behavior

2.5.3 Proactively Planning for One's Career

2.5.4 Staying Current on World of Engineer

3 INTERPERSONAL SKILLS: TEAMWORK AND COMMUNICATION

3.1 TEAMWORK

3.1.1 Forming Effective Teams

3.1.2 Team Operation

3.1.3 Team Growth and Evolution

3.1.4 Leadership

3.1.5 Technical Teaming

3.2 COMMUNICATIONS

3.2.1 Communications Strategy

3.2.2 Communications Structure

3.2.3 Written Communication

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3.2.4 Electronic/Multimedia Communication

3.2.5 Graphical Communication

3.2.6 Oral Presentation and Inter-Personal Communications

3.3 COMMUNICATIONS IN FOREIGN LANGUAGES

3.3.1 English

3.3.2 Languages of regional industrial nations

3.3.3 Other languages

4 CONCEIVING, DESIGNING, IMPLEMENTING, AND OPERATING SYSTEMS IN THE ENTERPRISE AND SOCIETAL CONTEXT

4.1 EXTERNAL AND SOCIETAL CONTEXT

4.1.1 Roles and Responsibility of Engineers

4.1.2 The Impact of Engineering on Society

4.1.3 Society's Regulation of Engineering

4.1.4 The Historical and Cultural Context

4.1.5 Contemporary Issues and Values

4.1.6 Developing a Global Perspective

4.2 ENTERPRISE AND BUSINESS CONTEXT

4.2.1 Appreciating Different Enterprise Cultures

4.2.2 Enterprise Strategy, Goals, and Planning

4.2.3 Technical Entrepreneurship

4.2.4 Working Successfully in Organizations

4.3 CONCEIVING AND ENGINEERING SYSTEMS

4.3.1 Setting System Goals and Requirements

4.3.2 Defining Function, Concept and Architecture

4.3.3 Modeling of System and Ensuring Goals Can Be Met

4.3.4 Development Project Management

4.4 DESIGNING

4.4.1 The Design Process

4.4.2 The Design Process Phasing and Approaches

4.4.3 Utilization of Knowledge in Design

4.4.4 Disciplinary Design

4.4.5 Multidisciplinary Design

4.4.6 Multi-Objective Design (DFX)

4.5 IMPLEMENTING

4.5.1 Designing the Implementation Process

4.5.2 Hardware Manufacturing Process

4.5.3 Software Implementing Process

4.5.4 Hardware Software Integration

4.5.5 Test, Verification, Validation, and Certification

4.5.6 Implementation Management

4.6 OPERATING

4.6.1 Designing and Optimizing Operations

4.6.2 Training and Operations

4.6.3 Supporting the System Lifecycle

4.6.4 System Improvement and Evolution

4.6.5 Disposal and Life-End Issues

4.6.6 Operations Management

Format Pengembangan Kurikulum: Dokumen Kurikulum

Course Information							Student Outcomes (SOs) - CDIO Syllabus																					
NO	SEM	CODE	COURSE	Credits	Theory	Practical	SO-1			SO-2	SO-4	SO-2	SO-5			SO-3			SO-2									
							1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	4.1	4.2	4.3	4.4	4.5	4.6					
1	I	RE101	Introduction to Robotics Engineering	3	0	3	0,0	0,4	0,0	0,4	0,4	0,0	0,0	0,4	0,5	0,3	0,3	0,0	0,0	0,0	0,0	0,0	0,0					
2		RE102	Procedural Programming	3	2	1	0,0	1,3	0,0	0,0	1,2	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,2	0,2	0,0					
3		RE103	Principles of Electrical and Electronic Engineering	3	2	1	0,0	2,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,2	0,0					
4		RE104	Computer Aided Design and Drafting	3	2	1	0,0	2,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,8	0,0	0,0					
5		RE105	Machine Tools Lab	3	2	1	0,0	0,6	0,0	0,0	1,2	0,0	0,0	0,0	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,6					
6		RE106	Applied Calculus	3	2	1	2,7	0,0	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
7		RE107	Work Health and Safety	2	2	0	0,0	0,4	0,0	0,0	0,0	0,0	0,0	1,2	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
1	II	RE201	Rapid Prototyping Project	3	0	3	0,0	0,8	0,0	0,0	0,3	0,0	0,5	0,0	0,3	0,3	0,0	0,0	0,0	0,0	0,5	0,0	0,0					
2		RE202	Object Oriented Programming	3	2	1	0,0	1,8	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,6	0,0	0,0	0,0	0,0	0,3	0,0	0,0					
3		RE203	Actuators and Drive Systems	3	2	1	0,0	2,4	0,0	0,0	0,4	0,0	0,0	0,0	0,0	0,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
4		RE204	Statics and Dynamics	3	2	1	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
5		RE205	Engineering Math	3	2	1	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
6		RE206	Electronic Systems	3	2	1	0,0	1,4	0,0	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,2	0,0					
7		RE207	Design Thinking	2	2	0	0,0	0,1	0,0	0,1	0,0	0,1	0,1	0,0	0,0	0,3	0,0	0,1	0,1	0,4	0,4	0,0	0,0					
1	III	RE301	Robotics Design & Fabrication	3	0	3	0,0	0,2	0,0	0,2	0,4	0,2	0,0	0,0	0,2	0,2	0,0	0,0	0,2	0,2	0,7	0,2	0,0					
2		RE302	Introduction to Robotics	3	2	1	0,2	0,0	0,6	0,0	0,8	0,0	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,3	0,7	0,3	0,0					
3		RE303	Design and Simulation	3	2	1	0,0	0,0	0,7	0,0	0,3	0,3	0,0	0,0	0,0	0,3	0,0	0,0	0,0	0,3	1,3	0,0	0,0					
4		RE304	Computer Aided Manufacturing	3	2	1	0,0	0,8	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	1,4	0,0					
5		RE305	Control System	3	2	1	0,5	0,4	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,5	0,5	0,0					
6		RE306	Engineering Project Management	2	2	0	0,0	0,0	0,0	0,1	0,0	0,0	0,1	0,0	0,2	0,5	0,0	0,0	0,0	0,4	0,1	0,6	0,1					
7		PK4RE	Indonesian	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
1	IV	RE401	Agile Innovation Project	3	0	3	0,2	0,2	0,2	0,0	0,3	0,2	0,0	0,0	0,2	0,5	0,1	0,0	0,2	0,3	0,2	0,3	0,3					
2		RE402	Robot Operating System (ROS)	3	2	1	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
3		RE403	Programmable Logic Controllers	3	2	1	0,0	1,6	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,5	0,0					
4		RE404	Sensor and Data Acquisition	3	2	1	0,0	1,6	0,0	0,0	1,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0					
5		RE405	Cloud Robotics	3	2	1	0,0	0,0	2,1	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
6		RE406	English for Written Communication	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0					
7		RE407	Technical Writing	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	1,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
1	V	RE501	Application of Robotics	3	0	3	0,0	0,0	0,4	0,2	0,2	0,2	0,0	0,0	0,0	0,2	0,2	0,0	0,1	0,5	0,3	0,7	0,0					
2		RE502	Data Flow Programming	3	2	1	0,0	2,7	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
3		RE503	Manipulator Robots	3	2	1	0,4	0,2	1,5	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
4		RE504	English for Presentation	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0					
5		RE505	Quality Engineering Principles	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,0	0,2	0,0	0,3	1,3	0,0					
6		RE506	Elective Course 1	3	2	1	0,0	0,0	1,1	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,5	1,0	0,0					
7		PK2RE	Character Building: Pancasila	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	1,6	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
1	VI	RE601	Industrial Robotics Project	3	0	3	0,0	0,0	0,0	0,3	0,2	0,2	0,0	0,0	0,0	0,2	0,2	0,2	0,5	0,4	0,2	0,6	0,0					
2		RE602	Industrial Data Communication	3	2	1	0,0	0,5	2,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
3		RE603	Machine Learning	3	2	1	0,0	0,0	2,0	0,0	0,5	0,0	0,0	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
4		RE604	Computer Vision	3	2	1	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
5		RE605	Motion Planning	3	2	1	0,0	0,0	3,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
6		RE606	Professional Skills and Attitudes	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
7		RE607	Elective Course 2	3	2	1	0,0	0,0	0,7	0,0	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,8	0,8	0,0					
1	VII	RE701	Final Project : Advanced Robotics	4	0	4	0,0	0,0	0,4	0,3	0,4	0,1	0,0	0,1	0,1	0,6	0,1	0,1	0,1	0,1	0,6	0,4	0,1					
2		RE702	Localization and Mapping	3	2	1	0,0	0,0	2,3	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
3		RE703	Robotics Control	3	2	1	0,0	0,0	1,2	0,0	0,0	0,0	0,0	0,0	0,0	0,4	0,0	0,0	0,0	0,0	0,4	0,9	0,0					
4		RE704	Entrepreneurship	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0	0,3	0,3	0,0	0,0	1,1	0,0	0,0	0,0	0,0					
5		PK1RE	Character Building: Religion	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	1,0	0,0	0,3	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
6		PK3RE	Character Building: Citizenship	2	2	0	0,0	0,0	0,0	0,0	0,0	0,0	1,5	0,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0					
7		RE801	Industrial Attachment	20	0	20	2,2	2,2	2,2	0,0	0,0	0,0	2,2	6,7	0,0	2,2	2,2	0,0	0,0	0,0	0,0	0,0	0,0					
Total credit hours							152	82	70																			
Credit hours distribution per each CDIO Syllabus							9,2	29,8	23,3	1,7	15,5	1,3	7,3	10,9	3,2	14,4	7,6	0,5	2,4	2,9	10,9	10,0	1,1					
Percentage of credit hours per each CDIO Syllabus (%)							6,1	19,6	15,3	1,1	10,2	0,9	4,8	7,2	2,1	9,5	5,0	0,3	1,6	1,9	7,2	6,6	0,7					
							SO-1	SO-2	SO-3	SO-4	SO-5																	
Credit hours distribution per each Student Outcome							62,3	30,8	21,9	15,5	21,4																	
Percentage of credit hours per each Student Outcome (%)							41,0	20,3	14,4	10,2	14,1																	

