KEMENTERIAN PENDIDIKAN, KEBUDAYAAN,
RISET, DAN TEKNOLOGI
POLITEKNIK NEGERI BATAM
Jalan Ahmad Yani, Batam Centre, Kecamatan Batam Kota, Batam 29461
Telepon +62 778 469856 - 469860, Faksimile +62 778 463620
Laman: www.polibatam.ac.id, Surel: info@polibatam.ac.id
18477/A/0001/UK/En

KEPUTUSAN
DIREKTUR POLITEKNIK NEGERI BATAM
NOMOR 1234/K/PL29/IX/2021

TENTANG
PENETAPAN KURIKULUM TAHUN 2021 PROGRAM STUDI D-IV TEKNIK ROBOTIKA
JURUSAN TEKNIK ELEKTRO POLITEKNIK NEGERI BATAM

DIREKTUR POLITEKNIK NEGERI BATAM,

Menimbang :
a. bahwa kurikulum sebagai alat untuk melaksanakan dan mencapai tujuan pendidikan, harus memperhatikan perkembangan paradigma dan situasi eksternal serta internal perguruan tinggi;
b. bahwa telah dilakukan evaluasi kurikulum berjalan yang melibatkan pihak industri dan pemangku kepentingan Program Studi D-IV Teknik Robotika Jurusan Teknik Elektro Politeknik Negeri Batam;
c. bahwa untuk meningkatkan mutu pembelajaran Program Studi D-IV Teknik Robotika Jurusan Teknik Elektro, perlu ditetapkan kurikulum sesuai dengan hasil evaluasi yang telah dilakukan;
d. bahwa berdasarkan pertimbangan yang dimaksud pada huruf a, b, dan c di atas, perlu menetapkan keputusan tentang Penetapan Kurikulum Tahun 2021 Program Studi D-IV Teknik Robotika Jurusan Teknik Elektro Politeknik Negeri Batam;

Mengingat :
1. Undang-Undang Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional;
2. Undang-Undang Nomor 12 Tahun 2012 tentang Pendidikan Tinggi;
3. Peraturan Menteri Pendidikan dan Kebudayaan Nomor 3 Tahun 2020 tentang Standar Nasional Pendidikan Tinggi;
4. Peraturan Menteri Pendidikan dan Kebudayaan Nomor 5 Tahun 2020 Tentang Akreditasi Program Studi dan Perguruan Tinggi;
5. Peraturan Pemerintah Nomor 17 Tahun 2020 tentang Pengelolaan dan Penyelenggaraan Pendidikan;
6. Peraturan Menteri Pendidikan Nasional Nomor 26 Tahun 2010 tentang Pendirian, Organisasi, dan Tata Kerja Politeknik Negeri Batam;
7. Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi Nomor 41 Tahun 2016 tentang Statuta Politeknik Negeri Batam;
8. Keputusan Menteri Pendidikan dan Kebudayaan Nomor 62067/MPK/RHS/KP/2020 tentang Pengangkatan Direktur Politeknik Negeri Batam Periode Tahun 2020-2024;

MEMUTUSKAN:

Menetapkan : KEPUTUSAN DIREKTUR POLITEKNIK NEGERI BATAM TENTANG PENETAPAN KURIKULUM TAHUN 2021 PROGRAM STUDI D-IV TEKNIK ROBOTIKA JURUSAN TEKNIK ELEKTRO POLITEKNIK NEGERI BATAM.

KESATU : Menetapkan dan mengesahkan Kurikulum Tahun 2021 Program Studi D-IV Teknik Robotika Jurusan Teknik Elektro Politeknik Negeri Batam sebagaimana tercantum dalam lampiran keputusan ini.

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KEDUA : Keputusan ini mulai berlaku pada tanggal ditetapkan.

Ditetapkan di Batam
pada tanggal 14 September 2021
Direktur,

Dr. Uuf Brajawidagda
NIP 197608112015041001

DOKUMEN KURIKULUM

Program Studi

Teknik Robotika

Tahun

2021

Politeknik Negeri Batam

Daftar Isi

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 dibeberapa hal yaitu:

1. *Technical Knowledge*
   - PLC
   - Arm robot
   - Vision system
   - Teknology Industry 4.0
   - Open platform comunication (OPC)
   - Manufacturing management system
   - Total productive maintenance (autonomous dan preventive maintenace)
   - 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
   - Kemampian berfikir *out of the box*.
   - Manfaat penerapan Project Bsed Learning (PBL) dan tim robot adalah mahasiswa sudah terbiasa problem solving.
   - Ilmu yang dipelajari di kampus dengan di industri berbeda.
   - Kemampuan inovasi sangat diperlukan.

- 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.

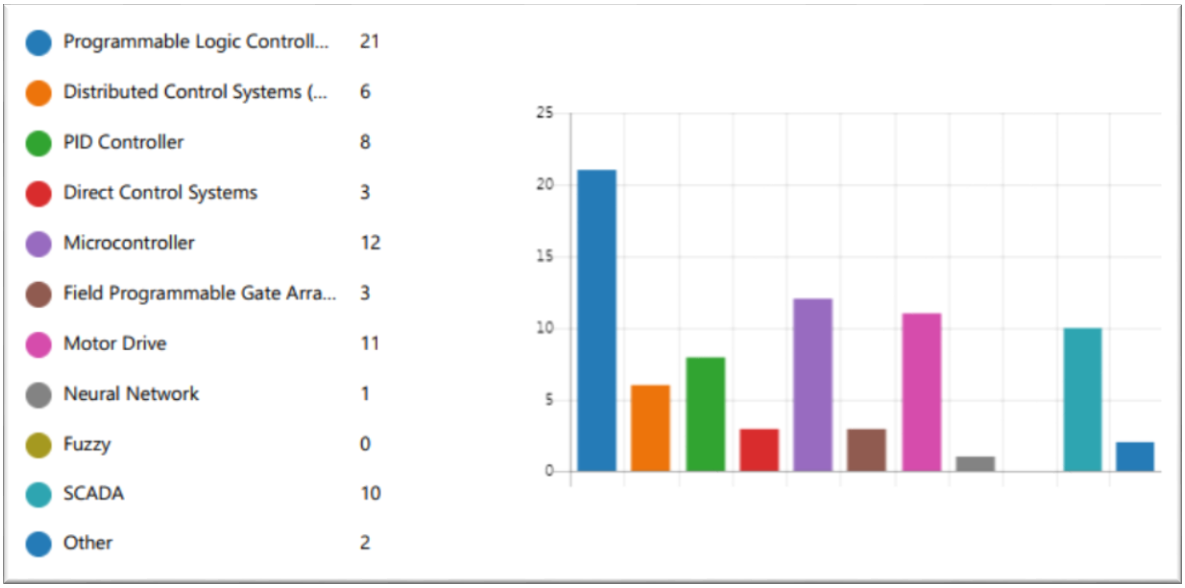
3. Interpersonal Skills
   - Lebih bisa speak-up.
   - Berani menunjukkan apa yang sudah dikerjakan.
   - Lebih percaya diri dalam berkomunikasi, terlebih menggunakan bahasa Inggris.
   - Etika komunikasi baik lisan dan tertulis masih lemah.
   - Cara membuat CV yang bagus.
   - Mahasiswa dibiasakan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

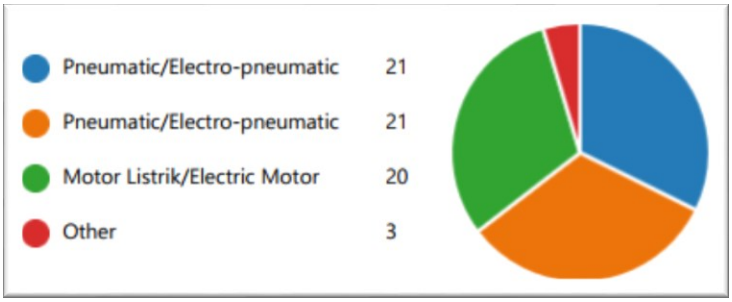
B. Survei Kebutuhan, dilaksanakan pada 19 Mei – 11 Juni 2021 dengan melibatkan sejumlah mitra industri yaitu:

- 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

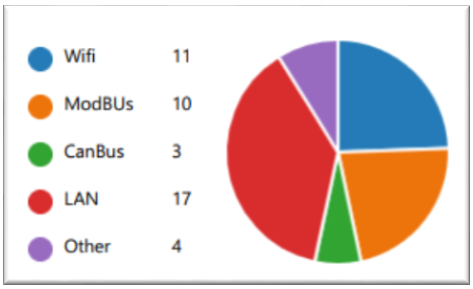
Berdasarkan hasil survei tersebut diketahui jumlah perusahaan / industri yang menggunakan teknologi atau standar dalam proses produksinya yaitu:



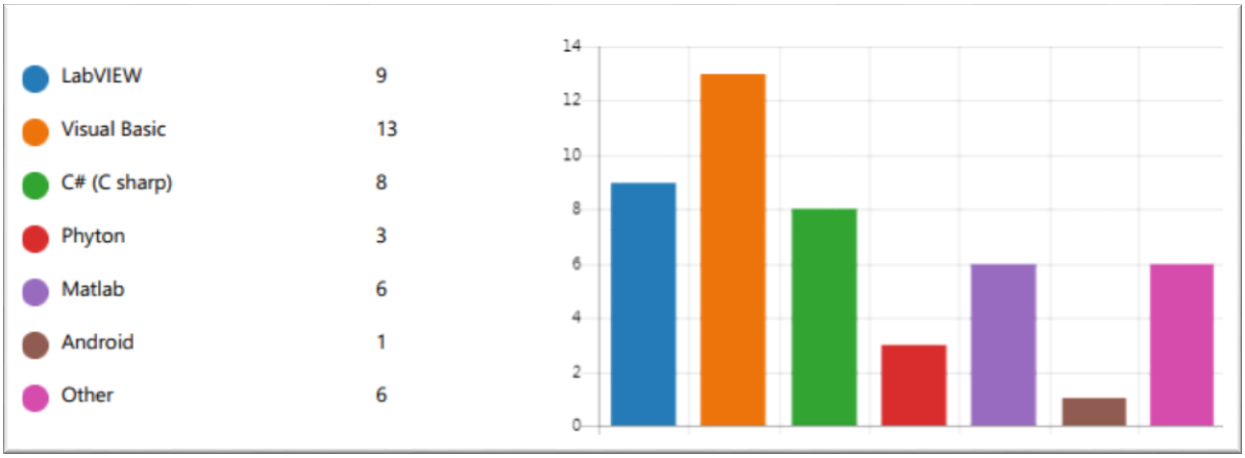
Gambar 1. Sistem kontrol



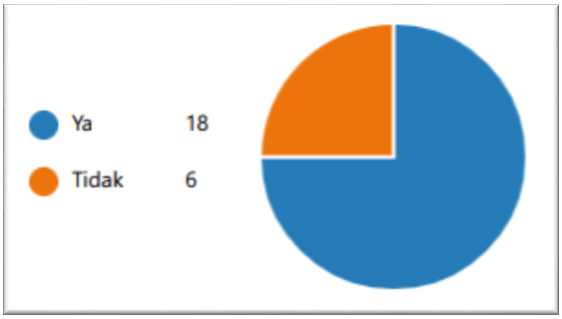
Gambar 2. Jenis aktuator



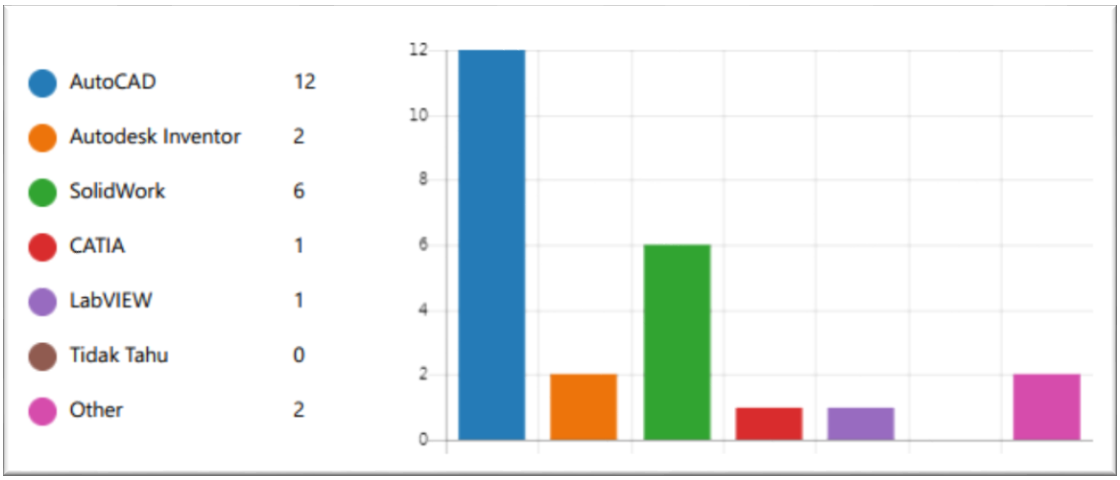
Gambar 3. Jenis protokol komunikasi



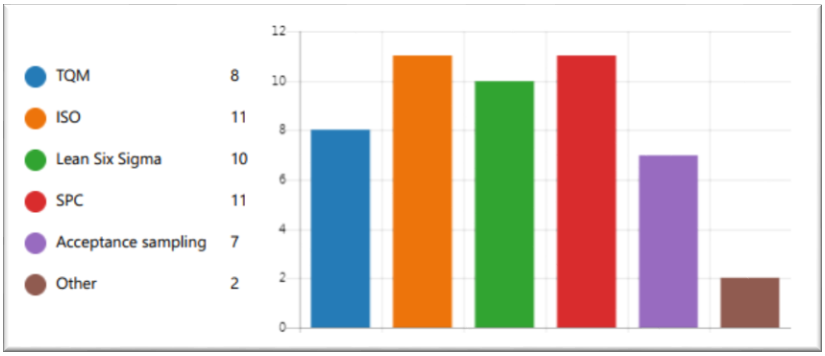
Gambar 4. Bahasa pemrograman yang digunakan



Gambar 5. Jumlah industri yang menerapkan teknologi industry 4.0

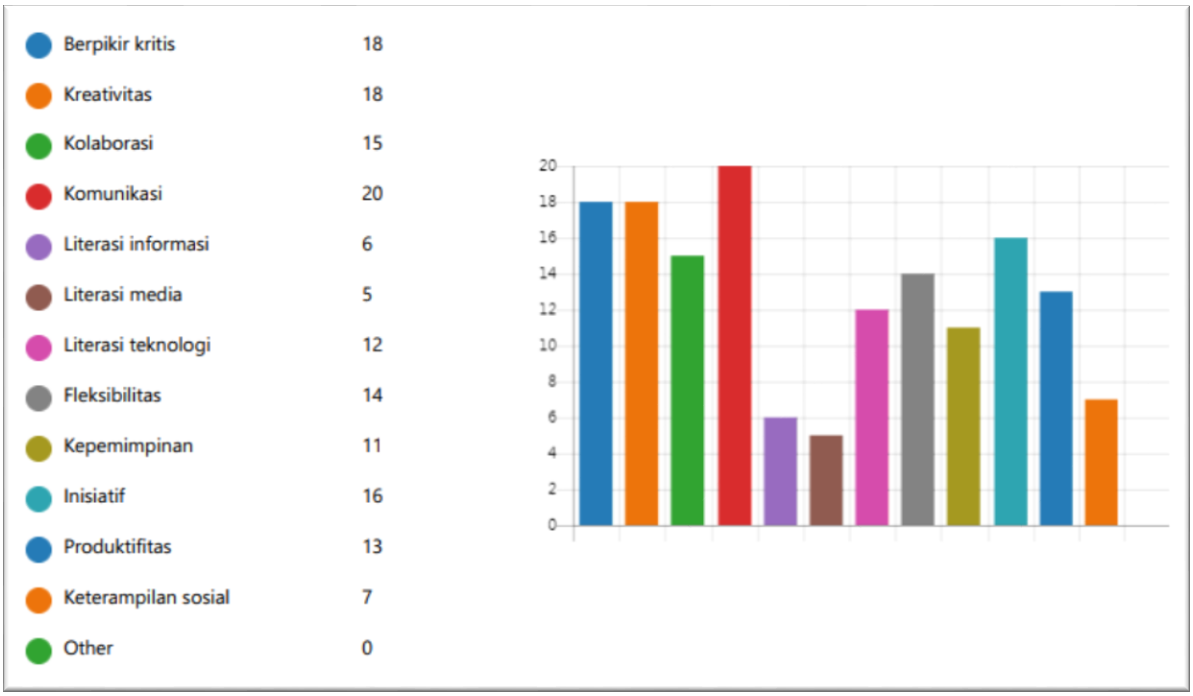


Gambar 6. Jenis software yang digunakan

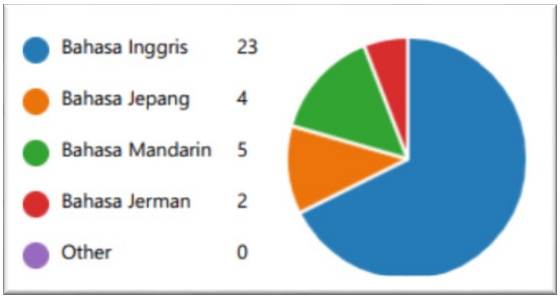


Gambar 7. Sistem yang digunakan

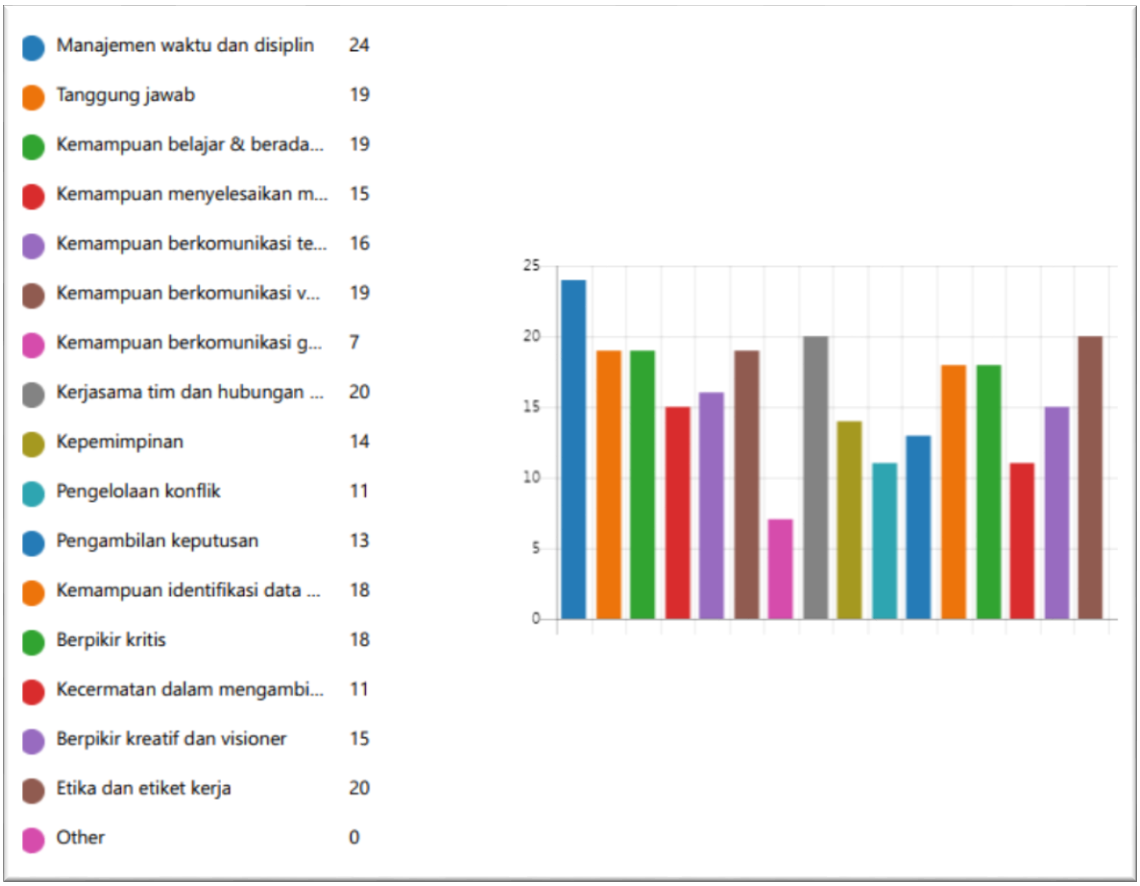
Selain itu juga ditanyakan terkait personal dan interpersonal skills yang dibutuhkan di indutri, dengan hasil survei sebagai berikut:



Gambar 8. 21st century skills



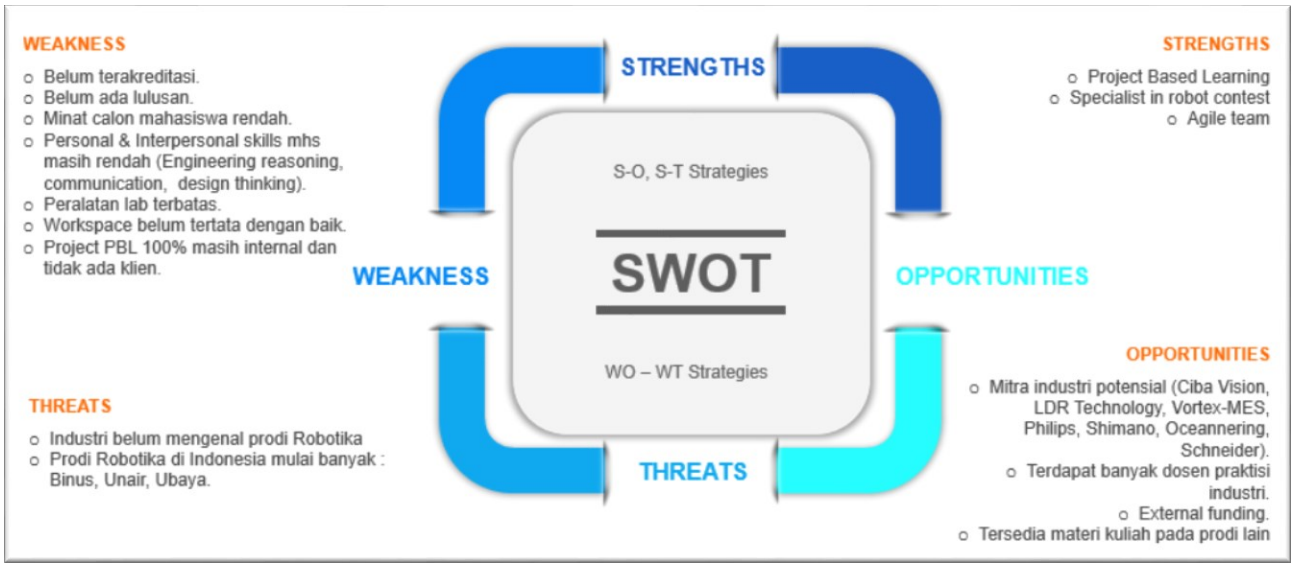
Gambar 9. Kemampuan komunikasi bahasa asing



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 (Oportunity dan Threats). Kemudian dilakukan analisa SWOT yang dapat digunakan untuk menentukan strategi yang diperlukan dalam meningkatkan mutu lulusan prodi.



Gambar 11. Analisa SWOT posisi prodi Teknik Robotika

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 penyedian 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. Menjalin 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?

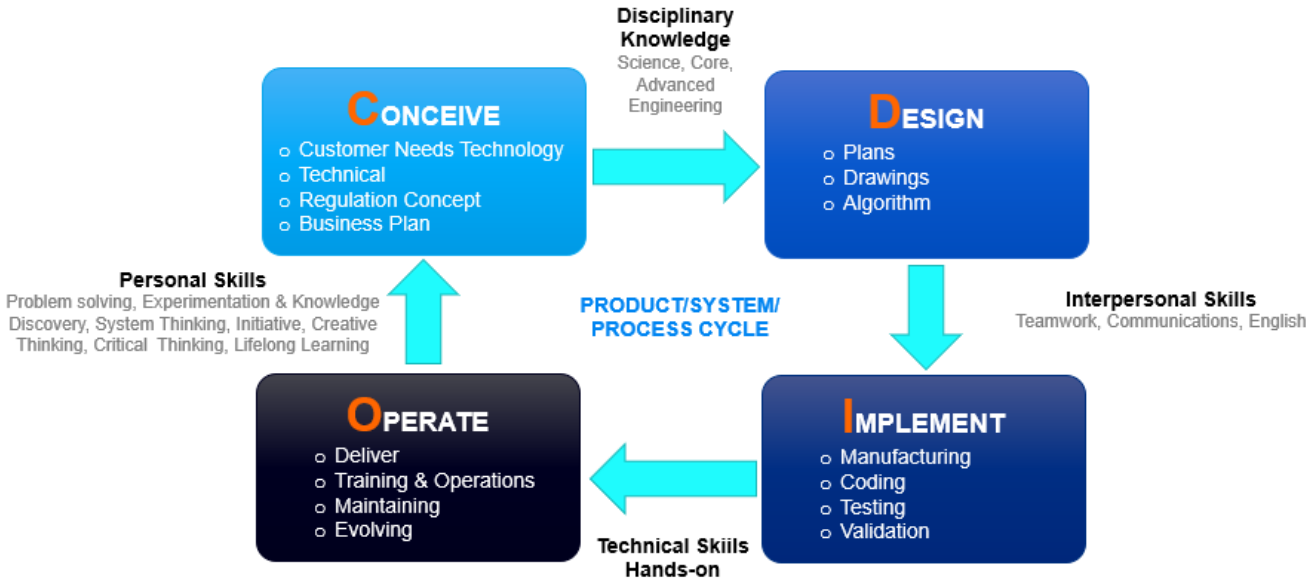
Tujuan Program

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.

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 yamg 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

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 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.
PL-3	Robotics Automation Software Engineer	• Merancang pergerakan robot. • Mengembangkan perangkat lunak untuk kontrol dan otomatisasi robot. • Menggunakan embedded system yang mengontrol peralatan otomatis. • Membangun perangkat lunak baru atau menguji, meningkatkan, atau men-debug perangkat lunak yang ada.
PL-4	Product Development Engineer	• Mengelola desain, membuat prototipe, dan menguji pengembangan produk. • Menghasilkan desain pembuatan produk dalam bentuk gambar CAD. • Berperan sebagai ahli teknis pada produk dan proses. • Melakukan analisis pasar terhadap produk pesaing untuk menentukan kebutuhan dan persyaratan pelanggan. • Menganalisis dan meningkatkan proses dan produk yang ada, termasuk memperbarui dokumentasi.

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	√	

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;	

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 pemikian 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;	

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:

a. 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;
b. an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
c. 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;
d. an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
e. an ability to function effectively as a member as well as a leader on technical teams.

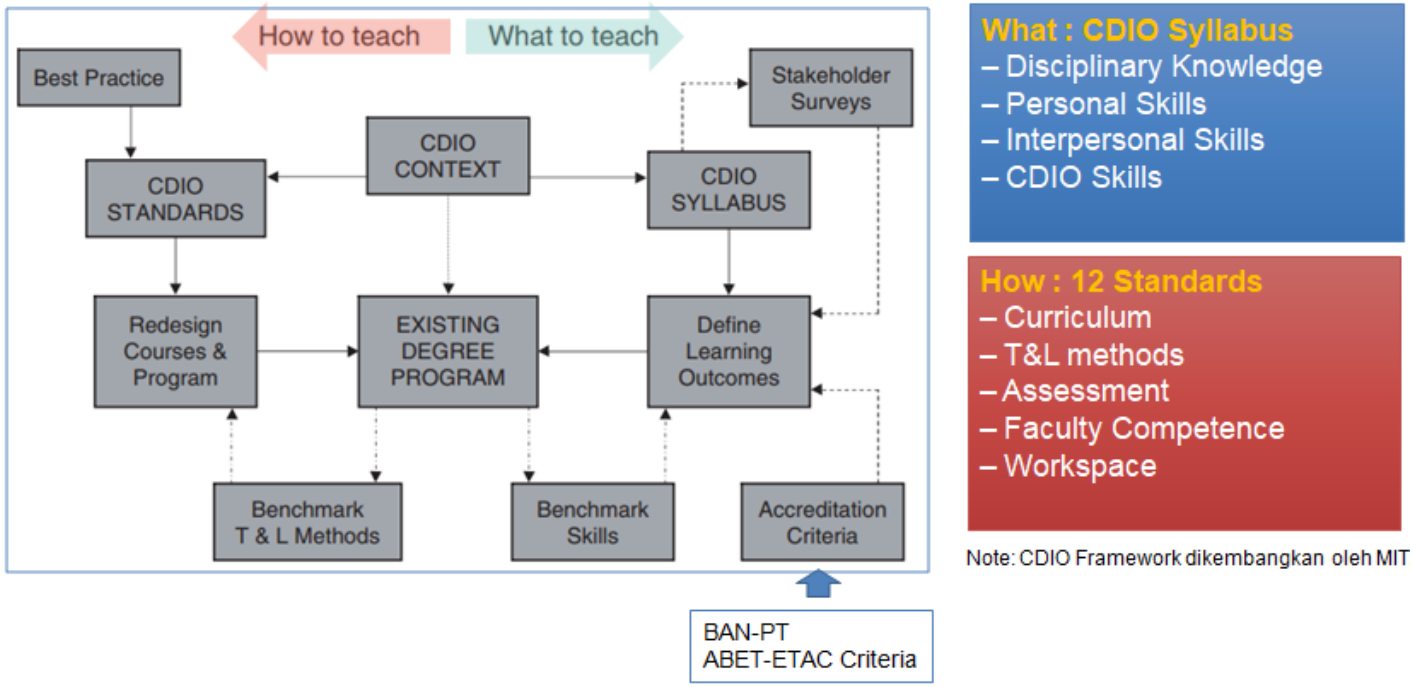
Kurikulum baru Program Studi Teknik Robotika ini dibangun menggunakan *Conceive Design Implement Operate (CDIO) Framework* yang dikembangkan oleh MIT pada tahun 2001. Pada CDIO framework, terdapat dua bagian penting yaitu CDIO Standard dan CDIO Syllabus seperti ditunjukkan pada Gambar 1. CDIO Standard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

- 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



Gambar 13. CDIO Framework

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

- 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

- Elective Course 2
- Entrepreneurship
- Industrial Attachment

ETAC-ABET Program Criteria: Electromechanical Engineering Technology

a. graphical representations of electromechanical systems;
b. 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;
c. 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;
d. appropriate computer programming languages for operating electromechanical systems;
e. electrical/electronic devices such as amplifiers, motors, relays, power systems, and computer and instrumentation systems for applied design, operation, or troubleshooting electromechanical systems;
f. advanced topics in engineering mechanics, engineering materials, and fluid mechanics for applied design, operation, or troubleshooting of electromechanical systems;
g. fundamentals of control systems for the applied design, operation, or troubleshooting of electromechanical systems;
h. utilization of differential and integral calculus, as a minimum, to characterize the
i. static and dynamic performance of electromechanical systems; and
j. application of project management techniques in the investigation, analysis, and
k. design of electromechanical systems.

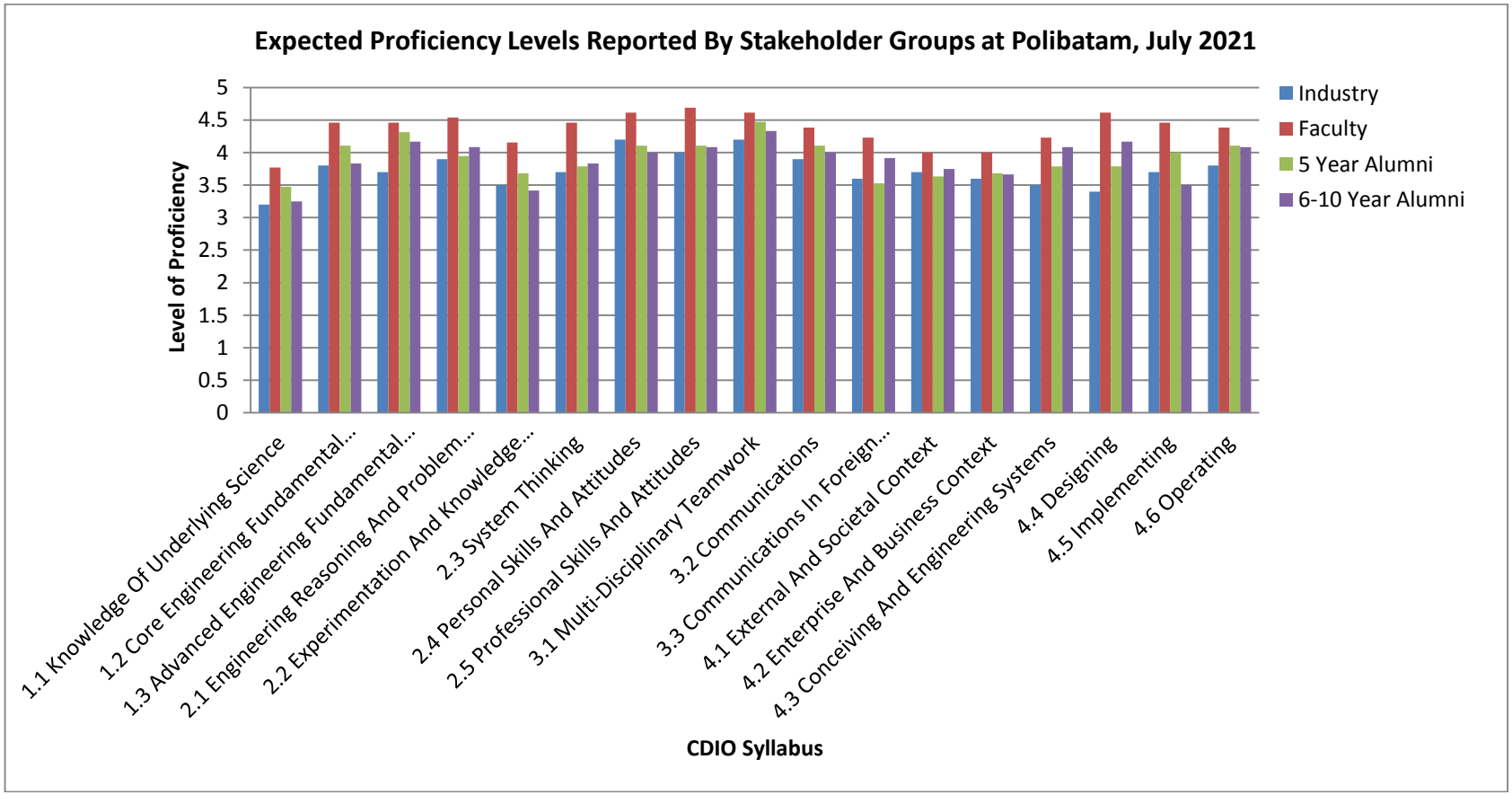
Untuk melihat keterkaitan antara Capaian Pembelajaran terhadap CDIO Syllabus, maka dapat dilihat pada matriks berikut:

CDIO SYLLABUS	SIKAP										PENGETAHUAN											KETERAMPILAN UMUM									KETERAMPILAN KHUSUS				
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	KU1	KU2	KU3	KU4	KU5	KU6	KU7	KU8	KU9	KK1	KK2	KK3	KK4	KK5
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																	■															■			

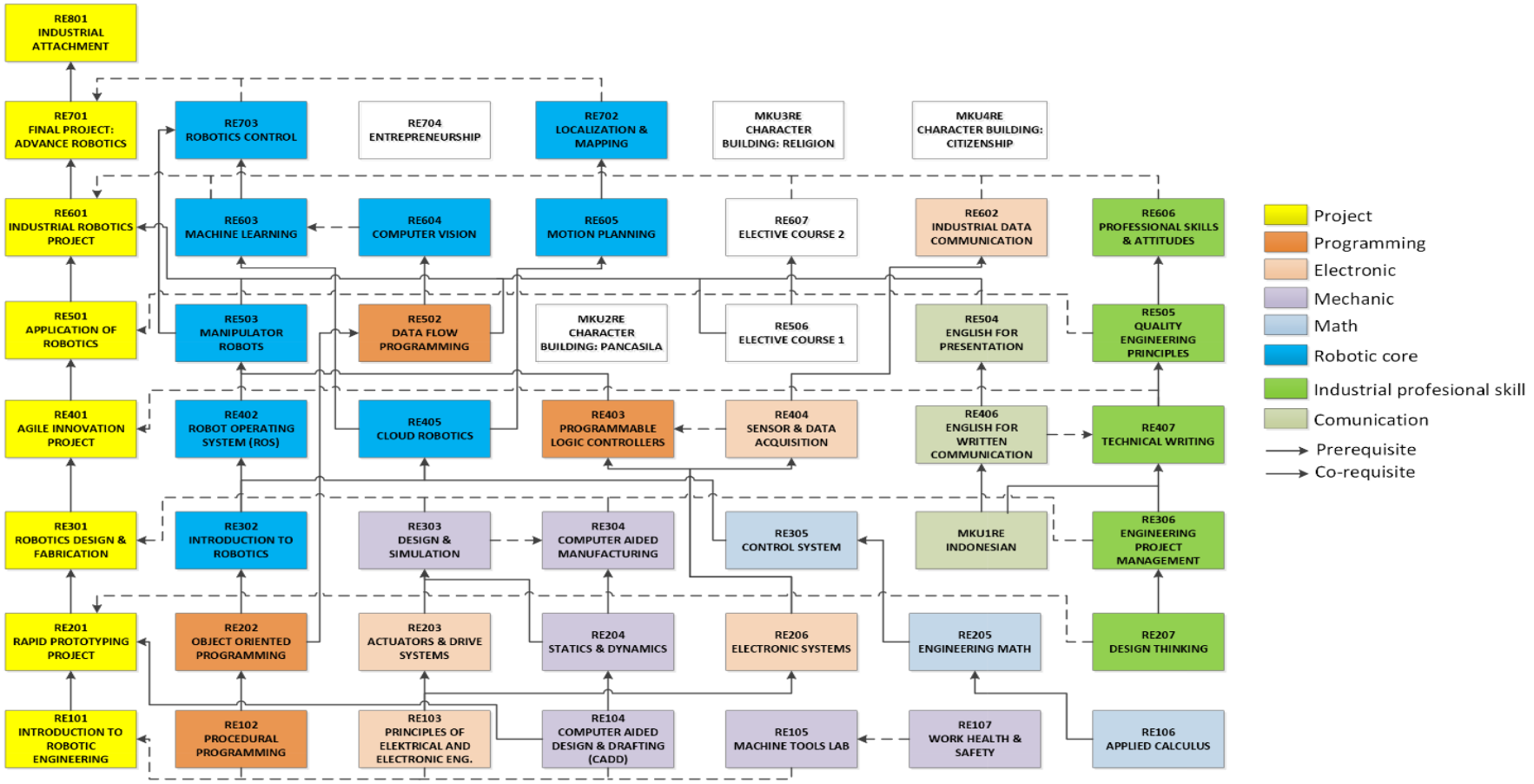
Untuk melihat keterkaitan Student Outcome terhadap CDIO Syllabus, maka dapat dilihat dari matriks berikut:

	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		■			

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:



6. Peta Mata Kuliah



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/ Responsi/	Seminar	Praktikum/ Praktik/		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
11	II	RE204	Statics and Dynamics	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi

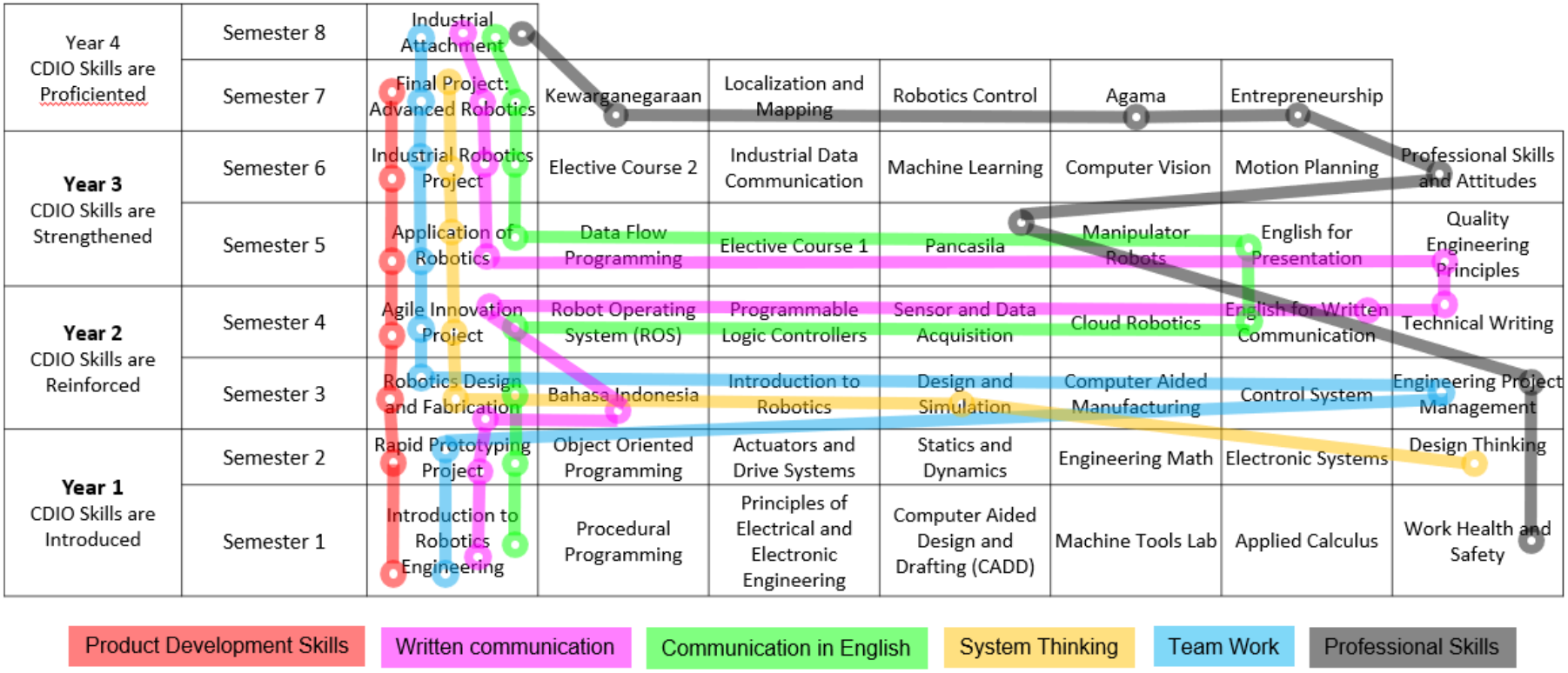
12	II	RE205	Engineering Math		2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
13	II	RE206	Electronic Systems	√	2	0	1	6,2		√		√	√	Kuliah, Praktikum, PBL	Tidak	Tidak	Prodi
14	II	RE207	Design Thinking		2	0	0	3,3	√	√	√	√	√	Kuliah	Tidak	Tidak	Prodi
15	III	RE301	Robotics Design & Fabrication	√	0	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
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
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



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.

No	Course Learning Outcomes (CLOs)
1	Explain basic programming concepts
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.
6	Design object oriented solutions for small systems involving multiple objects.
7	Implement, test and debug solutions in C++ or python
8	Independently find and interpret discipline related documentation.
9	Write clear and efective documentation

Technical knowledge

Conceive → Personal & professional skills

Design

Implement, Operate

Interpersonal skills

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	0,2	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	0,4	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	0,8	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	0,3	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
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
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
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	0,3	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
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
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
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
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
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
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
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
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
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
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
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

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	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	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	3	0	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
Expected CDIO Levels							3	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

Catatan: Secara lengkap dapat dilihat pada lampiran

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.

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 proffession. 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; analyse and synthesise 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, materilas 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
	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 braindstorming 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 Sytems
	Kode	:	RE203
	SKS	:	3
	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
	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, ergonomis,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.
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) 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 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, datalogging, 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 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 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 lavel students in robotic engineering. In this project student teams will design, build and test solutions to real-wold problem. Students will work with advanced topics in robotics ie.: motion planning, positioning, teleoperation, control, navigation, human-robot interaction.
44	Mata Kuliah	:	Localization and Mapping
	Kode	:	RE702
	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 Behaviour Tree, Finite State Machine (FSM), LQR, Linier System robotic controller system. Student also equiped a

			proper choosen 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
	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.

[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 proffession. 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-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	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
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
		SO-1	SO-2	SO-3	SO-4	SO-5												
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

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.

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

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

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

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		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	0,4	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	I	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	0,6	0,0	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		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	0,3	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 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
4	II	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		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	0,2	0,0	0,0	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	III	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		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	IV	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		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	V	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		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	VI	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	0,0	0,8	0,0
1		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	VII	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
1	VIII	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												

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20 Agustus 2021		

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		RE101	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		RE102	Procedural Programming	3	2	1	0	3	0	0	3	0	0	0	0	3	0	0	0	0	3	2	0
3		RE103	Principles of Electrical and Electronic Engineering	3	2	1	0	3	0	0	4	0	0	0	0	0	0	0	0	0	3	3	0
4	I	RE104	Computer Aided Design and Drafting (CADD)	3	2	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
5		RE105	Machine Tools Lab	3	2	1	0	3	0	0	3	0	0	0	0	3	0	0	0	0	0	0	3
6		RE106	Applied Calculus	3	2	1	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
7		RE107	Work Health and Safety	2	2	0	0	3	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0
1		RE201	Rapid Prototyping Project	3	0	3	0	3	0	0	3	0	3	0	3	3	3	0	0	0	3	0	0
2		RE202	Object Oriented Programming	3	2	1	0	3	0	0	3	0	0	0	0	3	0	0	0	0	3	0	0
3		RE203	Actuators and Drive Sytems	3	2	1	0	3	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0
4	II	RE204	Statics and Dynamics	3	2	1	0	3	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
6		RE206	Electronic Systems	3	2	1	0	4	0	0	4	0	0	0	0	0	0	0	0	0	3	3	0
7		RE207	Design Thinking	2	2	0	0	3	0	3	0	3	3	0	0	3	0	3	3	3	3	0	0
1		RE301	Robotics Design & Fabrication	3	0	3	0	4	0	4	4	4	0	0	4	4	3	0	0	4	4	4	0
2		RE302	Introduction to Robotics	3	2	1	3	0	3	0	4	0	0	0	4	0	0	0	0	4	4	4	0
3		RE303	Design and Simulation	3	2	1	0	0	4	0	4	4	0	0	0	4	0	0	0	4	4	0	0
4	III	RE304	Computer Aided Manufacturing	3	2	1	0	4	0	0	4	0	0	0	0	4	0	0	0	0	0	4	0
5		RE305	Control System	3	2	1	4	3	0	0	4	0	0	0	0	4	0	0	0	0	4	4	0
6		RE306	Engineering Project Management	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7		PK4RE	Indonesian	2	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
1		RE401	Agile Innovation Project	3	0	3	4	4	4	0	4	4	0	0	4	4	3	0	4	3	4	4	3
2		RE402	Robot Operating System (ROS)	3	2	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3		RE403	Programmable Logic Controllers	3	2	1	0	4	0	0	4	0	0	0	0	0	0	0	0	0	4	4	0
4	IV	RE404	Sensor and Data Acquisition	3	2	1	0	4	0	0	4	0	0	0	0	0	0	0	0	0	4	0	0
5		RE405	Cloud Robotics	3	2	1	0	0	4	0	4	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	4	0	0	0	0	0	0
7		RE407	Technical Writing	2	2	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0
1		RE501	Application of Robotics	3	0	3	0	0	4	4	4	4	0	0	0	4	4	0	3	4	4	4	0
2		RE502	Data Flow Programming	3	2	1	0	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
3		RE503	Manipulator Robots	3	2	1	4	3	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0
4	V	RE504	English for Presentation	2	2	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
5		RE505	Quality Engineering Principles	2	2	0	0	0	0	0	0	0	0	0	0	4	0	0	3	0	4	4	0
6		RE506	Elective Course 1	3	2	1	0	0	3	0	4	0	0	0	0	0	0	0	0	0	4	4	0
7		PK2RE	Character Building: Pancasila	2	2	0	0	0	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0
1		RE601	Industrial Robotics Project	3	0	3	0	0	0	4	4	4	0	0	0	4	4	4	4	4	4	4	0
2		RE602	Industrial Data Communication	3	2	1	0	4	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0
3		RE603	Machine Learning	3	2	1	0	0	4	0	4	0	0	0	0	4	0	0	0	0	0	0	0
4	VI	RE604	Computer Vision	3	2	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5		RE605	Motion Planning	3	2	1	0	0	4	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	4	0	0	0	0	0	0	0	0	0
7		RE607	Elective Course 2	3	2	1	0	0	4	0	4	0	0	0	0	0	0	0	0	0	4	4	0
1		RE701	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		RE702	Localization and Mapping	3	2	1	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0
3	VII	RE703	Robotics Control	3	2	1	0	0	4	0	0	0	0	0	0	4	0	0	0	0	4	4	0
4		RE704	Entrepreneurship	2	2	0	0	0	0	0	0	0	4	0	4	4	0	0	4	0	0	0	0
5		PK1RE	Character Building: Religion	2	2	0	0	0	0	0	0	0	4	0	4	4	0	0	0	0	0	0	0
6		PK3RE	Character Building: Citizenship	2	2	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0
1	VIII	RE801	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
Expected CDIO Levels							3	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

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	RE101	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		RE102	Procedural Programming	3	2	1	0	3	0	0	3	0	0	0	0	3	0	0	0	0	3	2	0
3		RE103	Principles of Electrical and Electronic Engineering	3	2	1	0	3	0	0	4	0	0	0	0	0	0	0	0	0	3	3	0
4		RE104	Computer Aided Design and Drafting (CADD)	3	2	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
5		RE105	Machine Tools Lab	3	2	1	0	3	0	0	3	0	0	0	0	3	0	0	0	0	0	0	3
6		RE106	Applied Calculus	3	2	1	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
7		RE107	Work Health and Safety	2	2	0	0	3	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0
1	II	RE201	Rapid Prototyping Project	3	0	3	0	3	0	0	3	0	3	0	3	3	3	0	0	0	3	0	0
2		RE202	Object Oriented Programming	3	2	1	0	3	0	0	3	0	0	0	0	3	0	0	0	0	3	0	0
3		RE203	Actuators and Drive Sytems	3	2	1	0	3	0	0	3	0	0	0	0	3	0	0	0	0	0	0	0
4		RE204	Statics and Dynamics	3	2	1	0	3	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
6		RE206	Electronic Systems	3	2	1	0	4	0	0	4	0	0	0	0	0	0	0	0	0	3	3	0
7		RE207	Design Thinking	2	2	0	0	3	0	3	0	3	3	0	0	3	0	3	3	3	3	0	0
1	III	RE301	Robotics Design & Fabrication	3	0	3	0	4	0	4	4	4	0	0	4	4	3	0	0	4	4	4	0
2		RE302	Introduction to Robotics	3	2	1	3	0	3	0	4	0	0	0	4	0	0	0	0	4	4	4	0
3		RE303	Design and Simulation	3	2	1	0	0	4	0	4	4	0	0	0	4	0	0	0	4	4	0	0
4		RE304	Computer Aided Manufacturing	3	2	1	0	4	0	0	4	0	0	0	0	4	0	0	0	0	0	4	0
5		RE305	Control System	3	2	1	4	3	0	0	4	0	0	0	0	4	0	0	0	0	4	4	0
6		RE306	Engineering Project Management	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7		PK4RE	Indonesian	2	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
1	IV	RE401	Agile Innovation Project	3	0	3	4	4	4	0	4	4	0	0	4	4	3	0	4	3	4	4	3
2		RE402	Robot Operating System (ROS)	3	2	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3		RE403	Programmable Logic Controllers	3	2	1	0	4	0	0	4	0	0	0	0	0	0	0	0	0	4	4	0
4		RE404	Sensor and Data Acquisition	3	2	1	0	4	0	0	4	0	0	0	0	0	0	0	0	0	4	0	0
5		RE405	Cloud Robotics	3	2	1	0	0	4	0	4	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	4	0	0	0	0	0	0
7		RE407	Technical Writing	2	2	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0
1	V	RE501	Application of Robotics	3	0	3	0	0	4	4	4	4	0	0	0	4	4	0	3	4	4	4	0
2		RE502	Data Flow Programming	3	2	1	0	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
3		RE503	Manipulator Robots	3	2	1	4	3	4	0	4	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	4	0	0	0	0	0	0
5		RE505	Quality Engineering Principles	2	2	0	0	0	0	0	0	0	0	0	0	4	0	0	3	0	4	4	0
6		RE506	Elective Course 1	3	2	1	0	0	3	0	4	0	0	0	0	0	0	0	0	0	4	4	0
7		PK2RE	Character Building: Pancasila	2	2	0	0	0	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0
1		RE601	Industrial Robotics Project	3	0	3	0	0	0	4	4	4	0	0	0	4	4	4	4	4	4	4	0
2		RE602	Industrial Data Communication	3	2	1	0	4	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0
3		RE603	Machine Learning	3	2	1	0	0	4	0	4	0	0	0	0	4	0	0	0	0	0	0	0

4	VI	RE604	Computer Vision	3	2	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5		RE605	Motion Planning	3	2	1	0	0	4	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	4	0	0	0	0	0	0	0	0	0
7		RE607	Elective Course 2	3	2	1	0	0	4	0	4	0	0	0	0	0	0	0	0	0	4	4	0
1	VII	RE701	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		RE702	Localization and Mapping	3	2	1	0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0
3		RE703	Robotics Control	3	2	1	0	0	4	0	0	0	0	0	0	4	0	0	0	0	4	4	0
4		RE704	Entrepreneurship	2	2	0	0	0	0	0	0	0	4	0	4	4	0	0	4	0	0	0	0
5		PK1RE	Character Building: Religion	2	2	0	0	0	0	0	0	0	4	0	4	4	0	0	0	0	0	0	0
6		PK3RE	Character Building: Citizenship	2	2	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0
1	VIII	RE801	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
Expected CDIO Levels							3	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

CDIO SYLLABUS
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

Student Outcomes (SOs)
SO-1: an ability to apply knowledge, techniques, skills and modern tools of mathematics, science,
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined
SO3: an ability to apply written, oral, and graphical communication in broadly-defined technical and non-
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE102	Procedural Programming

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain different programming paradigms.		3																
2	Explain microcontroller hardware and IDE software.		3																
3	Conduct experiment using microcontroller and simple input output devices.		3			3													
4	Explain C data types.		3			3													
5	Using decision making in C.		3			3													
6	Using program loops in C.		3			3													
7	Using functions in C.		3			3													
8	Using storage classes and scope.		3			3													
9	Using pointers effectively.		3			3													
10	Using structures, union and data storage.		3			3													
11	Using C preprocessor and bitwise operations.		3			3													
12	Design and write their own library.		3			3										3	2		
13	Design and write C code for specific task.		3			3										3	2		
14	Test and debug C code.					3											2		
15	Write program documentation to describe the code to its users.										3								
Summary		**0**	**39**	**0**	**0**	**36**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**6**	**6**	**0**	
Sum of levels		**90**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**1,30**	**0,00**	**0,00**	**1,20**	**0,00**	**0,00**	**0,00**	**0,00**	**0,10**	**0,00**	**0,00**	**0,00**	**0,00**	**0,20**	**0,20**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**1,30**	**0,40**	**0,10**	**1,20**	**0,00**													
Maximum CDIO skills level		**0**	**3**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**2**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE101	Introduction to Robotics Engineering

Course Description

As a student of Robotics Engineering, you are part of the engineering proffession. 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																	Assessment Method
		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	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**	
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**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
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**	

Notes:

1) CDIO Syllabus

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
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SO-5: an ability to function effectively as a member as well as a leader on technical teams.

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	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	0,4	0,0	0,0	3,0
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	3,0
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	3,0
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	3,0
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	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,6	3,0
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	3,0
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	2,0
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	0,3	0,0	0,0	0,0	0,5	0,0	0,0	3,0
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	3,0
3		RE203	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	3,0
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	3,0
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	3,0
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	3,0
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	2,0
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	0,2	0,0	0,0	0,2	0,7	0,2	0,0	3,0
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	3,0
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	3,0
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	3,0
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	3,0
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	2,0
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	2,0
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	3,0
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	3,0
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	3,0
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	3,0
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	3,0
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	2,0
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	2,0
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	3,0
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	3,0
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	3,0
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	2,0
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	2,0
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	3,0
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	2,0
1		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	3,0
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	3,0
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	3,0

4	VI	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	3,0
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	3,0
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	2,0
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	0,0	0,8	0,8	0,0	3,0
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	4,0
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	3,0
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	3,0
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	2,0
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	2,0
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	2,0
1	VIII	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	20,0
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	152,0
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	100,0
							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													152,0
Percentage of credit hours per each Student Outcome (%)							41,0	20,3	14,4	10,2	14,1													100,0

CDIO SYLLABUS
1 TECHNICAL KNOWLEDGE AND REASONING
1.1 KNOWLEDGE OF UNDERLYING SCIENCE
1.2 CORE ENGINEERING FUNDAMENTAL KNOWLEDGE
1.3 ADVANCED ENGINEERING FUNDAMENTAL KNOWLEDGE
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2.1 ENGINEERING REASONING AND PROBLEM SOLVING
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3.2 COMMUNICATIONS
3.3 COMMUNICATIONS IN FOREIGN LANGUAGES
4 CONCEIVING, DESIGNING, IMPLEMENTING, AND OPERATING SYSTEMS IN THE ENTERPRISE AND SOCIETAL CONTEXT
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Student Outcomes (SOs)
SO-1: an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and
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SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

PK1RE	Character Building: Religion

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the essence of human relations with Allah, with fellow humans and with the natural environment in the Qur'anic paradigm;							3											
2	Present the results of conceptual and/or empirical studies related to the essence and urgency of Islamic spirituality values as one of the determinants in nation building character;										4								
3	Able to behave consistently towards the coherence of the main points of Islamic teachings as the implementation of Faith, Islam, and Ihsan;							4											
4	Present the results of individual and group studies regarding a case (case study) related to the contribution of Islam in the development of world civilization;									4	4								
5	Analyze the problem of optimizing the role of the mosque as a center for the development of Islamic culture, and a forum for the realization of the welfare of the people.							4											
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**4**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**23**																	
Course Credits Hours		**2**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,96**	**0,00**	**0,35**	**0,70**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,00**	**0,00**	**0,70**	**0,00**	**1,30**													
Maximum CDIO skills level		**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE301	Robotics Design & Fabrication

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Design a simple robot or re-design a prototype by considering the tools or equipment needed for fabrication, use of standard parts and ergonomics						4									4			
2	Simulate design before entering the fabrication process.					3										4			
3	Implement the insight of mechanical system design such as CAD, basic electronic and electrical, and programing for robot development.		4													4	4		
4	Conduct experiments and tests for the functionality of the robot.					4													
5	Solve problems that arise during the development of the robot.				4														
6	Apply project management within the team regarding scheduling, resource allocation, activity implementation management, performance evaluation.									4					4				
7	Demonstrate knowledge of effective practices for writing technical engineering documents.										4								
8	Present the results of project orally in English.											3							
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**4**	**0**	**4**	**7**	**4**	**0**	**0**	**4**	**4**	**3**	**0**	**0**	**4**	**12**	**4**	**0**	
Sum of levels		**50**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,24**	**0,00**	**0,24**	**0,42**	**0,24**	**0,00**	**0,00**	**0,24**	**0,24**	**0,18**	**0,00**	**0,00**	**0,24**	**0,72**	**0,24**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,24**	**1,68**	**0,42**	**0,42**	**0,24**													
Maximum CDIO skills level		**0**	**4**	**0**	**4**	**4**	**4**	**0**	**0**	**4**	**4**	**3**	**0**	**0**	**4**	**4**	**4**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE103	Principles of Electrical and Electronic Engineering

Course Description

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; analyse and synthesise combinatorial logic circuits;

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Use SI units, prefixes and symbols for electrical quantities.		3																
2	Use apropriate instrument to measure elecrical quantities.					4													
3	Apply Ohm's Law to solve circuits problems.		3																
4	Apply Kirchoff's Current Law to solve circuits problems.		3																
5	Apply Kirchoff's Voltage Law to solve circuits problems.		3																
6	Determine electrical power sources and sinks in a circuit.		3																
7	Analyse simple steady-state DC circuits of resistors, current and voltage sources, capacitors and inductors.		3																
8	Explain diode and transistor works.		3																
9	Design simple DC power supplies for battery charging.															3			
10	Use the principles of electrical energy conversion to analyse DC and AC system including transformers and reactive elements, power production and distribution, filtering, motors and relays.		3																
11	Explain the basic principles of rotating electric machines.		3																
12	Perform basic binary arithmetic calculations.		3																
13	Analyse and synthesise combinatorial logic circuits.		3																
14	Have experience in the practical design, construction and testing of electronic circuits for simple robot.					4										3	3		
15																			
Summary		**0**	**33**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**3**	**0**	
Sum of levels		**50**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**1,98**	**0,00**	**0,00**	**0,48**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,36**	**0,18**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**1,98**	**0,54**	**0,00**	**0,48**	**0,00**													
Maximum CDIO skills level		**0**	**3**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

PK2RE	Character Building: Pancasila

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Fear of God Almighty and able to demonstrate a religious attitude.							4											
2	Upholding human values in carrying out tasks based on religion, morals, and ethics.							4											
3	Contribute to improving the quality of life in society, nation, state, and progress of civilization based on Pancasila.							4											
4	Cooperate and have social sensitivity and concern for the community and environment.							4		4									
5	Work together to be able to make the most of its potential.							4		4									
6	Apply logical, critical, systematic, and thinking innovative in the context of the development or implementation of science and technology who pay attention to and apply humanities values that according to their field of expertise.							4											
7	Implement the principle of sustainability (sustainability) in developing knowledge.							4											
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	0	0	0	0	28	0	8	0	0	0	0	0	0	0	0	
Sum of levels		36																	
Course Credits Hours		2																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	0,00	0,00	0,00	0,00	1,56	0,00	0,44	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		0,00	0,00	0,00	0,00	2,00													
Maximum CDIO skills level		0	0	0	0	0	0	4	0	4	0	0	0	0	0	0	0	0	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE602	Industrial Data Communication

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain communication systems emerged in the field of industrial robotics and automation.			3															
2	Demonstrate RS-232 devices and programming.		4	4															
3	Demonstrate IEEE-488 devices and programming.		4	4															
4	Explain the functionality of Ethernet.			3															
5	Utilize a Modbus protocol.			4															
6	Utilize a Profibus protocol.			4															
7	Utilize a DeviceNet protocol.			4															
8	Utilize a Fieldbus protocol.			4															
9	Perform the ID and IO check of an ASI Bus.					4													
10	Test, build, wire and troubleshoot the different types of industrial data communication circuits.					4													
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**8**	**30**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**46**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,52**	**1,96**	**0,00**	**0,52**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**2,48**	**0,00**	**0,00**	**0,52**	**0,00**													
Maximum CDIO skills level		**0**	**4**	**4**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

PK3RE	Character Building: Citizenship

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																Assessment Method
		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	Able to convey conceptual and empirical arguments about functions and roles citizenship in strengthening Indonesian identity.								4										
2	Able to have comprehensive knowledge and synergize utilization Science and Technology with elements of nationality which include; the 1945 Constitution, the Legal System and Governance, Democracy, Geopolitics and Geostrategy and State Defense							4											
3	Able to make the right decisions by prioritizing interests national affairs, upholding human rights and fair international relations							4											
4	Upholding attitudes and values: respecting diversity, being able to work together, have trustworthiness, social sensitivity and high love towards the people, nation and state of Indonesia							4											
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**0**	**0**	**0**	**0**	**0**	**12**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**16**																	
Course Credits Hours		**2**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**1,50**	**0,50**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,00**	**0,00**	**0,00**	**0,00**	**2,00**													
Maximum CDIO skills level		**0**	**0**	**0**	**0**	**0**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

PK4RE	Indonesian

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain academic ethics and the different types and systematics of scientific writing correctly.										3								
2	Explain the Indonesian formulation used in scientific writing with taking into account the principles of grammatical rules, PUEBI, and KBBI.										3								
3	Knowing the references related to scientific papers.										3								
4	Identify the formulation of the Indonesian language in writing scientific papers.										3								
5	Use the Indonesian formulation properly and correctly in the preparation scientific writing.										4								
6	Students are skilled in conveying the results of ideas/ideas orally including presentation techniques.										4								
7	Write e-mails effectively, technical reports, and instruction manuals.										4								
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	
Sum of levels		24																	
Course Credits Hours		2																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		0,00	0,00	2,00	0,00	0,00													
Maximum CDIO skills level		0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE104	Computer Aided Design and Drafting

Course Description

Introduces the use of computer-aided design & drafting (CADD) software to create 3D models complete with detailed documentation such as dimensions, materilas used and even details the design process. Topics include blue print reading, orthographic projection, sectioning, assembly drawing and basic solid modelling.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain design concepts and CADD software terminology.		3													3			
2	Demonstrates design methods, tools, and features of CADD software commonly used to make parts.		3													3			
3	Add parts to an assembly, specify mates, and use in-context design methods.		3																
4	Create and edit 3D models from samples, sketches, or written descriptions.		3																
5	Create multiple views, orientations, references frame, and bills of materilas for 2D or 3D models.		3																
6	Use industry labels and symbols related to drafting.		3																
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**18**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	
Sum of levels		**24**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**2,25**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,75**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**2,25**	**0,75**	**0,00**	**0,00**	**0,00**													
Maximum CDIO skills level		**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE105	Machine Tools Lab

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Demonstrate their abilities to read and interpret drawings.										3								
2	Select the appropriate equipment needed to produce each part.					3													
3	Use mechanical work bench tools including vise, drilling machine, thread die, thread tap, punch, file, hacksaw, grinding, jig saw, milling, bending and cutting machine.		3																
4	Select a measuring instrument to inspect the dimensional and geometric features of a given component, i.e. : steel square, vernier calliper, and micrometer.					3													
5	Implement Work Health and Safety standard in the workspace.																	3	
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**3**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	
Sum of levels		**15**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,60**	**0,00**	**0,00**	**1,20**	**0,00**	**0,00**	**0,00**	**0,00**	**0,60**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,60**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,60**	**0,60**	**0,60**	**1,20**	**0,00**													
Maximum CDIO skills level		**0**	**3**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE605	Motion Planning

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																Assessment Method
		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	Explain the application of motion planning in various fields.			3															
2	Apply motion planning with the discrete planning method.			4															
3	Apply motion planning with sampling based method.			4															
4	Design motion plans with sensing uncertainty conditions.			4															
5	Explain the application of the optimization method.			3															
6	Explain the optimization method with a deterministic approach.			3															
7	Design optimization methods with heuristic and metaheuristic approaches.			4															
8	Apply optimization with the particle swarm method.			4															
9	Apply optimization with genetic algorithm method.			4															
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sum of levels		33																	
Course Credits Hours		3																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	3,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		3,00	0,00	0,00	0,00	0,00													
Maximum CDIO skills level		0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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
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4.4 DESIGNING
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Student Outcomes (SOs)

SO-1: 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;
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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE106	Applied Calculus

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Use matrices to solve linear system problems.	3																	
2	Use complex numbers in electronics.	3																	
3	Use trigonometry in electronics and mechanics.	3																	
4	Calculate indeterminate form using limits function.	3																	
5	Analyze the use of derivatives.	3																	
6	Solve problems of differential and integral equations.	3																	
7	Explain concepts of differential equation.	3																	
8	Explain differential equations of 1st and 2nd order.	3																	
9	Analyze mechanical and physical system nodels using differential equations.					3													
10	Use Laplace transform to solve differential equation.	3																	
11																			
12																			
13																			
14																			
15																			
Summary		**27**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**30**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**2,70**	**0,00**	**0,00**	**0,00**	**0,30**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**2,70**	**0,00**	**0,00**	**0,30**	**0,00**													
Maximum CDIO skills level		**3**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
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3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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
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4.4 DESIGNING
4.5 IMPLEMENTING
4.6 OPERATING

Student Outcomes (SOs)

SO-1: 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;
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SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE107	Work Health and Safety

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain health and safety responsibilities and why it's important to work safely.								3										
2	Explain difference between hazards and risks.								3										
3	Identify potential workplace safety and health hazards and determine how to mitigate the hazards through engineering controls, administrative controls and personal protective equipment.		3																
4	Improve upon safety performance within the workplace: Health and Safety Management System, health and safety responsibilities, and system and procedures including: emergency procedures, Safe Systems of Work, Personal Protective Equipment (PPE), Permit-to-Work, safety signs, first aid arrangements and accident reporting.								3										
5	Write risk assessment report of health and safety at workplace.										3								
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**3**	**0**	**0**	**0**	**0**	**0**	**9**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**15**																	
Course Credits Hours		**2**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,40**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**1,20**	**0,00**	**0,40**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,40**	**0,00**	**0,40**	**0,00**	**1,20**													
Maximum CDIO skills level		**0**	**3**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE201	Rapid Prototyping Project
Course Description	
Equip students with a deep design thinking skills of ideation, prototyping, and iteration. Consistently generate more and better ideas by using CDIO approach to braindstorming 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.	

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain process of rapid prototyping given severe time limitations.		3																
2	Explain rapid prototyping tools i.e.: 3D printer, 3D scanner, PCB prototyping, and laser cutting.		3																
3	Analyze problem quickly and generate innovative solutions, witch can be prototyped.							3											
4	Plan development of a prototype within limited time.															3			
5	Select features which can be implemented quickly.															3			
6	Demonstrate skills in developing a prototype to demonstrate an innovative idea.		3																
7	Present the results of a prototyping session orally in English.											3							
8	Conduct an after-action review of innovation and prototyping process to identify stregth and weakness.					3													
9	Improve ability to work in a diverse team.									3									
10	Improve confidence in the ability to create innovative content.							3											
11	Write technical engineering documents related to product prototype..										3								
12																			
13																			
14																			
15																			
Summary		**0**	**9**	**0**	**0**	**3**	**0**	**6**	**0**	**3**	**3**	**3**	**0**	**0**	**0**	**6**	**0**	**0**	
Sum of levels		**33**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,82**	**0,00**	**0,00**	**0,27**	**0,00**	**0,55**	**0,00**	**0,27**	**0,27**	**0,27**	**0,00**	**0,00**	**0,00**	**0,55**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,82**	**0,55**	**0,55**	**0,27**	**0,82**													
Maximum CDIO skills level		**0**	**3**	**0**	**0**	**3**	**0**	**3**	**0**	**3**	**3**	**3**	**0**	**0**	**0**	**3**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE202	Object Oriented Programming

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain basic programming concepts		3																
2	Explain OOP paradigm concepts (Class, Objects and Constructor)		3																
3	Explain the elements that make up an object (class, instance, method, class variable)		3																
4	Explain the three main principles of object-oriented programming: encapsulation, polymorphism, and inheritance.		3																
5	Explain the benefits of object oriented design and understand when it is an appropriate methodology to use.		3																
6	Design object oriented solutions for small systems involving multiple objects.															3			
7	Implement, test and debug solutions in C++ or python		3			3													
8	Independently find and interpret discipline related documentation.										3								
9	Write clear and efective documentation.										3								
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**18**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	
Sum of levels		**30**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**1,80**	**0,00**	**0,00**	**0,30**	**0,00**	**0,00**	**0,00**	**0,00**	**0,60**	**0,00**	**0,00**	**0,00**	**0,00**	**0,30**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**1,80**	**0,30**	**0,60**	**0,30**	**0,00**													
Maximum CDIO skills level		**0**	**3**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE604	Computer Vision

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																Assessment Method
		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	Explain the concept how the image is formed.			3															
2	Explain the concept of color space and mathematical operation for color space conversion			3															
3	Explain the concept of kernel, filtering operator (convolution and correlation), morphological operator (erode, dilate, opening, closing)			3															
4	Explain the kernel for image processing (blurring, sharpening, and edge detection)			3															
5	Develop computer program for converting color space			4															
6	Develop computer program for implementing filtering operator			4															
7	Develop computer program for implementing morphological operator			4															
8	Explain the concept of image feature and feature detection			3															
9	Develop computer program for feature detection			4															
10	Explain the concept of image recognition and object detection			3															
11	Apply machine learning algorithm and feature detection for image recognition			4															
12	Aplly sliding window object detection using feature and machine learning algorithm			4															
13																			
14																			
15																			
Summary		**0**	**0**	**42**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**42**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**3,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**3,00**	**0,00**	**0,00**	**0,00**	**0,00**													
Maximum CDIO skills level		**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE203	Actuators and Drive Sytems

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Define fluid power systems.		3																
2	Identify process flow on a hydraulics or pneumatic schematic.		3																
3	Build hydraulic or pneumatic circuits.		3			3													
4	Identify causes of faults in pneumatic or hydraulic circuits.					3													
5	Repair faults in pneumatic or hydraulic circuits.		3																
6	Create simple fluid power circuits using standard fluid power symbols.		3																
7	Select proper replacement component per manufacturer's specification sheet.		3																
8	Interpret fluid power symbols on a fluid power circuit drawing.		3								3								
9	Explain electromagnetic, energy conversion, and electrical drive.		3																
10	Explain fundamental elements of drive systems		3																
11	Explain architecture and working principles of the most common electrical motortypes.		3																
12	Choose and use electrical drives and actuators.		3																
13	Select appropriate actuators and drive systems for a particular application.		3																
14																			
15																			
Summary		**0**	**36**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**45**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**2,40**	**0,00**	**0,00**	**0,40**	**0,00**	**0,00**	**0,00**	**0,00**	**0,20**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**2,40**	**0,00**	**0,20**	**0,40**	**0,00**													
Maximum CDIO skills level		**0**	**3**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE204	Statics and Dynamics
Course Description	
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.	

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Apply static calculations in designing robots.		3																
2	Analyze 2D and 3D force systems on robots.		3																
3	Analyze 2D and 3D equilibrium systems in robot design.		3																
4	Analyze center of mass of the robot.		3																
5	Analyze friction that occurs in the robot.		3																
6	Explain the difference between static, dynamic, kinematic and kinetic correctly.		3																
7	Perform motion analysis using Lagrange mechanics and Newtonian mechanics approaches.		3																
8	Implement Lagrange's equations on a simple manipulator robot.		3																
9	Analyze dynamic model of a simple manipulator robot.		3																
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**27**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**27**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**3,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**3,00**	**0,00**	**0,00**	**0,00**	**0,00**													
Maximum CDIO skills level		**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE701	Final Project : Advanced Robotics
Course Description	
This is the capstone project, a design experience for senior lavel students in robotic engineering. In this project student teams will design, build and test solutions to real-wold problem. Students will work with advanced topics in robotics ie.: motion planning, positioning, teleoperation, control, navigation, human-robot interaction	

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Analyze root causes of a problem or given challenge.				4														
2	Justify proposals and suggestions based on sound technical knowledge.			3							4								
3	Identify and use appropriate technical literature .										4				4	4			
4	Design and develop effective solutions.			4		4										4	4		
5	Analyze the design implications based on the aspects of manufacturability, testability, usability, ease of maintenance and sustainability.				4									4		4			
6	Evaluate design using appropriate methods.						4									4			
7	Write and document all work properly and carefully.										4								
8	Demonstrate effectiveness in communicating technical activities in oral and/or written form, mostly in English.										4	4							
9	Apply project management tools and techniques in effective project execution and closure.																4		
10	Implement and Operate effective solutions for complex engineering challenges.			4		4											4	4	
11	Apply professional and ethical responsibilities of engineering practice.								4										
12	Demonstrate effectiveness as a team member and/or team leader.									4									
13	Assess the designed solutions for complex engineering challenges against societal, health, safety, legal, economic and cultural issues.												4						
14	Evaluate the functionality of prototype against design.					4													
15																			
Summary		**0**	**0**	**11**	**8**	**12**	**4**	**0**	**4**	**4**	**16**	**4**	**4**	**4**	**4**	**16**	**12**	**4**	
Sum of levels		**107**																	
Course Credits Hours		**4**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**0,41**	**0,30**	**0,45**	**0,15**	**0,00**	**0,15**	**0,15**	**0,60**	**0,15**	**0,15**	**0,15**	**0,15**	**0,60**	**0,45**	**0,15**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,41**	**2,09**	**0,75**	**0,45**	**0,30**													
Maximum CDIO skills level		**0**	**0**	**4**	**4**	**4**	**4**	**0**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE205	Engineering Math

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the need and benefits of numerical methods.	3																	
2	Explain the concept of error.	3																	
3	Apply numerical methods to solve linear and non-linear equations.	3																	
4	Calculate the results of derivative and integral values using numerical methods	3																	
5	Solve differential equations using numerical methods.	3																	
6	Solve curve matching problems using numerical methods.	3																	
7	Calculates probabilities and probabilities using basic counting techniques (multiplication rules, combinations, permutations).	3																	
8	Calculates join probabilities and conditional probabilities directly or using Bayes theorem, and checks the independence of an event.	3																	
9	Explain the central limit theorem.	3																	
10	Explain the concept of Bayesian inference.	3																	
11																			
12																			
13																			
14																			
15																			
Summary		**30**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**30**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**3,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**3,00**	**0,00**	**0,00**	**0,00**	**0,00**													
Maximum CDIO skills level		**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE206	Electronic Systems

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Apply circuit laws and theorems to predict the steady state behaviour of simple linear DC circuits.		4																
2	Use piecewise linear models to predict the steady state behaviour of simple diode and transistor circuits, AC and DC motors.		4																
3	Explain the transient behaviour of RLC circuits with reference to their differential equations.		3																
4	Simulate simple analog circuits to verify their behaviour.		3			3										3			
5	Explain the operation of circuits using transistors in switching mode to achieve a variable DC output.		3																
6	Demonstrate practical skills in the simulation, construction and testing of simple electrical and electronic circuits.					4										3	3		
7	Analyse and design simple digital systems based on combinational logic, state machine and programmed microcontroller approaches.		3			3										3			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**20**	**0**	**0**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**3**	**0**	
Sum of levels		**42**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**1,43**	**0,00**	**0,00**	**0,71**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,64**	**0,21**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**1,43**	**0,86**	**0,00**	**0,71**	**0,00**													
Maximum CDIO skills level		**0**	**4**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE207	Design Thinking

Course Description

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

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the critical design thinking skills needed to either improve an existing product or design a new product.															3			
2	Identify customer needs and draft customer needs statements as your first step towards user innovations.				3						3				3				
3	Translate user needs into product specifications quantitatively, and how establishing product metrics can help to define those specifications.														3				
4	Apply creativity, brainstorming, and concept generation process in designing needs solutions.							3								3			
5	Explore prototyping methods, strategies, and real-life examples where these have been applied to create a design that represents customer needs and product specifications.		3																
6	Design of services, identify the potential for innovations within them, and learn how to apply product development frameworks to the service context.														3				
7	Use the modular and integral product architectures in determining the building blocks of a product.						3												
8	Perform financial analysis of your project idea and decide if it is backed by a strong business rationale (Worth-It).													3					
9	Apply design for environment principles to a product life cycle (long term impact of design decisions).												3						
10	Select and implement a product development process (staged, spiral, and agile)that's aligned to your project needs.															3			
11	Develop professional communication skills such as interviewing and crafting professional emails.										3								
12																			
13																			
14																			
15																			
Summary		**0**	**3**	**0**	**3**	**0**	**3**	**3**	**0**	**0**	**6**	**0**	**3**	**3**	**9**	**9**	**0**	**0**	
Sum of levels		**42**																	
Course Credits Hours		**2**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,14**	**0,00**	**0,14**	**0,00**	**0,14**	**0,14**	**0,00**	**0,00**	**0,29**	**0,00**	**0,14**	**0,14**	**0,43**	**0,43**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,14**	**1,43**	**0,29**	**0,00**	**0,14**													
Maximum CDIO skills level		**0**	**3**	**0**	**3**	**0**	**3**	**3**	**0**	**0**	**3**	**0**	**3**	**3**	**3**	**3**	**0**	**0**	

Notes:

1) CDIO Syllabus

1 TECHNICAL KNOWLEDGE AND REASONING

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to

3) Assessment Method:

Written and oral question

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE501	Application of Robotics

Course Description

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 select suitable robots and associated components for different applications.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																Assessment Method
		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	Explain commonly used robots and their applications.			3															
2	Explain benefits of using robots.			3										3					
3	Conceive the user need or requirements and of possibility apply robotics system.														4				
4	Analyze possibility of implementing robotics system based on user need or requirements.														4				
5	Apply system thinking to design robotics system with safety, quality assurance, delivery time and cost consideration.						4									4			
6	Implement engineering standard for robots development.																4		
7	Select suitable robots and associated components for different applications.				4										4	4			
8	Perform robotics programming.			4													4		
9	Test robot performance to meet with user requirement or specification.					4											4		
10	Apply project management within the team regarding scheduling, resource allocation, activity implementation management, performance evaluation.																4		
11	Create approriate technical documents including project report, manual book and manual instruction.										4								
12	Present the results of project orally in English.											4							
13																			
14																			
15																			
Summary		**0**	**0**	**10**	**4**	**4**	**4**	**0**	**0**	**0**	**4**	**4**	**0**	**3**	**12**	**8**	**16**	**0**	
Sum of levels		**69**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**0,43**	**0,17**	**0,17**	**0,17**	**0,00**	**0,00**	**0,00**	**0,17**	**0,17**	**0,00**	**0,13**	**0,52**	**0,35**	**0,70**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,43**	**2,04**	**0,35**	**0,17**	**0,00**													
Maximum CDIO skills level		**0**	**0**	**4**	**4**	**4**	**4**	**0**	**0**	**0**	**4**	**4**	**0**	**3**	**4**	**4**	**4**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE302	Introduction to Robotics

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Identify robot classifications.			3															
2	Analyze safety considerations when designing a robot.															3			
3	Experiment with robot systems including sensors, actuators, effectors, locomotion, and controllers.					4													
4	Analyze robot kinematics.	3		3															
5	Work as a team to identify specific requirements of robot design.									4					4				
6	Design a robot for specific purpose and specification.															4			
7	Create a prototype to test and troubleshooting the design.					4										4			
8	Integrating sensors, actuators and algorithms for robot control.			3													4		
9	Testing and evaluating robot systems.					4													
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**3**	**0**	**9**	**0**	**12**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**11**	**4**	**0**	
Sum of levels		**47**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,19**	**0,00**	**0,57**	**0,00**	**0,77**	**0,00**	**0,00**	**0,00**	**0,26**	**0,00**	**0,00**	**0,00**	**0,00**	**0,26**	**0,70**	**0,26**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,77**	**1,21**	**0,00**	**0,77**	**0,26**													
Maximum CDIO skills level		**3**	**0**	**3**	**0**	**4**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**4**	**4**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
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SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE303	Design and Simulation
Course Description	
This course introduces standard part, robot mechanism, ergonomis,product design, dynamic simulation in CAD software.	

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the structure of the robot mechanism trough dynamic simulation in CAD software.			3												4			
2	Identify the standart part during robot development according to the robot blueprint.			3												3			
3	Design the mechanical structure with acceptable to the ergonomis requirement for product design.														4	4			
4	Apply system thinking to design robot system including system behaviour, elements, interface among elements, and interactions external to the system.						4												
5	Implement the dynamic simulation before manufacturing utilizing the CAD software.			4												4			
6	Testify the mechanical body part element in real application.					4													
7	Perform document design in accordance with mechanical body part of robot structure.										4					4			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	10	0	4	4	0	0	0	4	0	0	0	4	19	0	0	
Sum of levels		45																	
Course Credits Hours		3																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	0,67	0,00	0,27	0,27	0,00	0,00	0,00	0,27	0,00	0,00	0,00	0,27	1,27	0,00	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		0,67	1,80	0,27	0,27	0,00													
Maximum CDIO skills level		0	0	4	0	4	4	0	0	0	4	0	0	0	4	4	0	0	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE506	Elective Course 1

Course Description

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 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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain perspective on the VR/AR landscape; past, present and future.			3															
2	Explain of fundamental computer vision, computer graphics and human-computer interaction techniques related to VR/AR.			3															
3	Explain insights to key application areas for VR/AR			3															
4	Design VR/AR for specific area.															4			
5	Implement VR/AR experiences.					4											4		
6	Test VR/AR app.																4		
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**0**	**9**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**8**	**0**	
Sum of levels		**25**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**1,08**	**0,00**	**0,48**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,48**	**0,96**	**0,00**	

	SO-1	SO-2	SO-3	SO-4	SO-5
Credit hours distribution per each Student Outcome	**1,08**	**1,44**	**0,00**	**0,48**	**0,00**
Maximum CDIO skills level	**0**	**0**	**3**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**4**	**0**

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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
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4.4 DESIGNING
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Student Outcomes (SOs)

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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE304	Computer Aided Manufacturing

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Interpret a design within the context of how it will be manufactured using CNC machining.										4						4		
2	Write Computer Numerical Control (CNC) codes and apply them to manufacture a component using a CNC machine.		4														4		
3	Use a CNC machining simulator for development and checking of CNC codes.		4														4		
4	Select and design jigs and fixtures to be used in the manufacture of a component.		4														4		
5	Implement manufacturing management and systems such as; product planning, manufacturing sequence, time and cost.																4		
6	Testing the precision level of components.					4													
7	Write a comprehensive report and present the ideas and outcomes.										4								
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**12**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**20**	**0**	
Sum of levels		**44**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,82**	**0,00**	**0,00**	**0,27**	**0,00**	**0,00**	**0,00**	**0,00**	**0,55**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**1,36**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,82**	**1,36**	**0,55**	**0,27**	**0,00**													
Maximum CDIO skills level		**0**	**4**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE702	Localization and Mapping

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain basic probabilistic concepts.			3															
2	Explain formal model of robot environment interaction.			3															
3	Explain Bayes filters, the recursive algorithm for state estimation.			3															
4	Summarize representational and computational issues that arise when implementing Bayes filters.			3															
5	Define a taxonomy of localization problems.			3															
6	Apply Markov localization for determining robot pose.			4															
7	Apply EKF localization for estimating robot pose.			4															
8	Apply UKF Localization for self-localization.			4															
9	Explain the concept of Grid Localization.			3															
10	Develop computer program for Monte Carlo Localization algorithm.			4		4													
11	Develop computer program for creating an environment map with occupancy grid mapping algorithm.			4		4													
12	Apply Simultaneous Localization and Mapping (SLAM) algorithm for mapping and localization.			4		4													
13																			
14																			
15																			
Summary		**0**	**0**	**42**	**0**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**54**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**2,33**	**0,00**	**0,67**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**2,33**	**0,00**	**0,00**	**0,67**	**0,00**													
Maximum CDIO skills level		**0**	**0**	**4**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
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3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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
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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE305	Control System

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the linear feedback control system for robotics.		3																
2	Design the feedback control system of the robot utilizing the mathematic or state variable model.	4														4			
3	Implement digital control system to the robot design.																4		
4	Analyzing the steady-state and time response from the robot system regarding the robot stability.					4													
5	Develop a manuscript report of the whole control perfromance on the robot.										4								
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**4**	**3**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**4**	**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]		**0,52**	**0,39**	**0,00**	**0,00**	**0,52**	**0,00**	**0,00**	**0,00**	**0,00**	**0,52**	**0,00**	**0,00**	**0,00**	**0,00**	**0,52**	**0,52**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,91**	**1,04**	**0,52**	**0,52**	**0,00**													
Maximum CDIO skills level		**4**	**3**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**4**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE503	Manipulator Robots

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the description of positions, orientations, frames.			3															
2	Demonstrate usage of translations, rotations, and transformations equation.			4															
3	Explain description of link, link-connection, joint Space, and cartesian space.			3															
4	Develop computer program for solving manipulator kinematics.			4															
5	Develop computer program for solving inverse manipulator kinematics.			4															
6	Explain the concept of jacobians, singularities, and static forces in manipulators.	3	3	3															
7	Experiment with cartesian transformation of velocities and static forces in computer simulation.					4													
8	Analyze manipulator dynamics, rigid body acceleration, and mass distribution.					4													
9	Experiment using dynamic simulation with iterative newton–euler dynamic formulation.	4				4													
10	Develop computer program for pick-and-place and packaging applications.			4		4													
11																			
12																			
13																			
14																			
15																			
Summary		**7**	**3**	**25**	**0**	**16**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**51**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,41**	**0,18**	**1,47**	**0,00**	**0,94**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**2,06**	**0,00**	**0,00**	**0,94**	**0,00**													
Maximum CDIO skills level		**4**	**3**	**4**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE306	Engineering Project Management

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Apply project selection methods to evaluate the feasibility of projects.				4														
2	Determine and document project goals and performance requirements by working closely with project stakeholders.										4				4				
3	Define and document product or service deliverables.										4								
4	Select appropriate project management practices, tools, and methodologies.														4				
5	Define, analyze, refine, and document project requirements, assumptions, and constraints.														4				
6	Define and document project schedule, budget, resources, and quality.															4			
7	Define performance criteria to support quality assurance.																4		
8	Assess and document project risks.														4				
9	Develop a Work Breakdown Structure (WBS).																4		
10	Analyze and refine project time and cost estimates to define project baseline, schedule and budget.																4		
11	Develop a project plan.																4		
12	Manage project progress by applying performance reporting, analysis and progress measurement techniques to ensure activities are executed as planned.																4		
13	Communicate project progress to stakeholders.										4						4		
14	Understand how to select, lead, and manage project teams.									4									
15	Identify needs for corrective action, obtain approvals, and evaluate effectiveness.									4									
16	Recognize and respond to risk events and issues.							3											
17	Obtain final acceptance of deliverables from appropriate stakeholders.																	3	
18	Document lessons learned.										4								
19	Facilitate administrative and financial project closure.										4								
Summary		**0**	**0**	**0**	**4**	**0**	**0**	**3**	**0**	**8**	**20**	**0**	**0**	**0**	**16**	**4**	**24**	**3**	
Sum of levels		**82**																	
Course Credits Hours		**2**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**0,00**	**0,10**	**0,00**	**0,00**	**0,07**	**0,00**	**0,20**	**0,49**	**0,00**	**0,00**	**0,00**	**0,39**	**0,10**	**0,59**	**0,07**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,00**	**1,24**	**0,49**	**0,00**	**0,27**													
Maximum CDIO skills level		**0**	**0**	**0**	**4**	**0**	**0**	**3**	**0**	**4**	**4**	**0**	**0**	**0**	**4**	**4**	**4**	**3**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
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SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE401	Agile Innovation Project

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain Agile methodology and framework														3				
2	Identify priority needs and robotics capabilities														3				
3	Apply system thinking to design robotics system based on user requirements.						4												
4	Develope robotics solutions in close collaboration with end user	4	4	4		4					4					4	4		
5	Testing the robotics solutions in a real context by a larger group of end users and gathering data to further develop algorithms in the robot					4					4							3	
6	Evaluate the value of the robotics solution under real life conditions and investigate its potential market													4				3	
7	Demonstrate knowledge of effective practices for writing technical engineering documents including project report, manual book and manual instruction.										4								
8	Present the results of project orally in English.											3							
9	Apply project management within the team regarding scheduling, resource allocation, activity implementation management, performance evaluation.									4							4		
10																			
11																			
12																			
13																			
14																			
15																			
Summary		4	4	4	0	8	4	0	0	4	12	3	0	4	6	4	8	6	
Sum of levels		71																	
Course Credits Hours		3																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,17	0,17	0,17	0,00	0,34	0,17	0,00	0,00	0,17	0,51	0,13	0,00	0,17	0,25	0,17	0,34	0,25	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		0,51	1,35	0,63	0,34	0,17													
Maximum CDIO skills level		4	4	4	0	4	4	0	0	4	4	3	0	4	3	4	4	3	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
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3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE402	Robot Operating System (ROS)

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the fundamental concept about ROS		3																
2	Explain the usage of ROS node, topic, service, action, and parameter		3																
3	Implement ROS command to run node, send message, call service, and load/store parameter		4																
4	Create ROS node using Python/C++		4																
5	Create ROS node for publishing/subcribing ROS topic		4																
6	Create ROS node for calling/handling ROS service		4																
7	Create ROS node for calling/handling ROS action		4																
8	Create ROS node for loading/storing robot parameter		4																
9	Create ROS launch file for running multiple ROS nodes		4																
10	Develop simulation model using ROS and Gazebo		4																
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**38**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**38**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**3,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**3,00**	**0,00**	**0,00**	**0,00**	**0,00**													
Maximum CDIO skills level		**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
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SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE403	Programmable Logic Controllers

Course Description

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) 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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the fundamentals Programmable Logic Controllers systems.		3																
2	Demonstrate knowledge of process control systems.		3																
3	Identify the types of PLC communications and network systems.		3																
4	Design PLC based system for process control															4			
5	Write a working PLC program using ladder logic.		4														4		
6	Use digital and analog I/O		4																
7	Use various timers, counters, fault and interrupt systems.		4																
8	Integrate PLCs into electro-mechanical devices such as motors and pneumatic actuators.		4			4											4		
9	Diagnose and troubleshoot PLCs.					4													
10	Specify safety consideration for personnel, field devices and automated equipment.															3			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**25**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**8**	**0**	
Sum of levels		**48**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**1,56**	**0,00**	**0,00**	**0,50**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,44**	**0,50**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**1,56**	**0,94**	**0,00**	**0,50**	**0,00**													
Maximum CDIO skills level		**0**	**4**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**4**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE704	Entrepreneurship

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explore the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries.													3					
2	Examine the entrepreneurial process from the generation of creative ideas to exploring feasibility to creation of an enterprise for implementation of the ideas.							4						4					
3	Experience the dynamics of participating on a business team and the power inherent in a team relative to individual effort.									4									
4	Create and present a business plan for a technology idea.										4			4					
5	Provide the background, tools, and life skills to participate in the entrepreneurial process within a large company, in a new venture, or as an investor.													4					
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	0	0	0	0	4	0	4	4	0	0	15	0	0	0	0	
Sum of levels		27																	
Course Credits Hours		2																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	0,00	0,00	0,00	0,00	0,30	0,00	0,30	0,30	0,00	0,00	1,11	0,00	0,00	0,00	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		0,00	1,11	0,30	0,00	0,59													
Maximum CDIO skills level		0	0	0	0	0	0	4	0	4	4	0	0	4	0	0	0	0	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE404	Sensor and Data Acquisition

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain concepts in common methods for converting a physical parameter into an electrical quantity.		3																
2	Explain sensors classification and characterization.		3																
3	Uses various sensors commonly used in robots, ie.: wheel or motor encoders, heading or orientation sensors, ground based beacons, active ranging, motion or speed sensors, and vision based sensors.		4			4													
4	Select the right sensor for a given application.															4			
5	Implement sensors into an embedded system in both hardware and software.		4			4													
6	Create hardware and firmware to process sensor signals and feed data to a microprocessor for further evaluation.		4			4													
7	Analyze sensor signal noise and apply proper hardware techniques to reduce it to acceptable levels.					4													
8	Apply sensory fusion algorithms, sampling, reconstruction, computer communications, and robot control through sensory feedback.		4																
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**22**	**0**	**0**	**16**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	
Sum of levels		**42**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**1,57**	**0,00**	**0,00**	**1,14**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,29**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**1,57**	**0,29**	**0,00**	**1,14**	**0,00**													
Maximum CDIO skills level		**0**	**4**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE405	Cloud Robotics

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Identify the basic problems, limitations, strengths and current trends of programmable robotics and automation.			3															
2	Explain the current cloud computing technologies and computing mechanisms for robotics.			3															
3	Create systems for supporting cloud robotics and automation by examining emerging technologies			4		4													
4	Analyse and critique the performance of robotics algorithms and data analytics algorithms for cloud robotics.					4													
5	Apply software programming and cloud computing solutions to create cloud robotics prototype.			4															
6	Apply communication protocol to connect to cloud.			4															
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	18	0	8	0	0	0	0	0	0	0	0	0	0	0	0	
Sum of levels		26																	
Course Credits Hours		3																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	2,08	0,00	0,92	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		2,08	0,00	0,00	0,92	0,00													
Maximum CDIO skills level		0	0	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE801	Industrial Attachment

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Apply knowledge gained in the classroom (or major) to real-world challenges in an industrial environment.	4	4	4															
2	Develop professional skills that value diversity and openness in the workplace.								4										
3	Engage in responsible conduct while working as an intern and allow decisions to be informed by a value-centered life.								4										
4	Develop work attitudes like self-reliance, maturity and self- confidencey.							4											
5	Obtain knowledge of potential careers and develop new interests.								4										
6	Write documents including daily report, email, and final report.										4								
7	Perform written and oral English communication in certain situations.											4							
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**4**	**4**	**4**	**0**	**0**	**0**	**4**	**12**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**36**																	
Course Credits Hours		**20**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**2,22**	**2,22**	**2,22**	**0,00**	**0,00**	**0,00**	**2,22**	**6,67**	**0,00**	**2,22**	**2,22**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**6,67**	**0,00**	**4,44**	**0,00**	**8,89**													
Maximum CDIO skills level		**4**	**4**	**4**	**0**	**0**	**0**	**4**	**4**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE406	English for Written Communication

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																Assessment Method
		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	Gather ideas, define and narrow topics, evaluate, select, and order material to write organized paragraphs, essays, reports, emails and business or personal letters.											4							
2	Adjust the content and style of your writing to purpose, audience, and situation.											4							
3	Develop letter-writing strategies.											4							
4	Produce business writing (including reports and memos, emails, and letters) with minimum preparation time.											4							
5	Write scientific papers incorporating the basics of an approved style and format.											4							
6	Write a report that includes analysis and offers recommendations.											4							
7	Write, revise, and edit work to improve content organization, word choice, phrasing, sentence and paragraph structure, spelling, and punctuation.											4							
8	Recognize and correct cliches, jargon, slang, poor tone, and wordiness in sentences.											3							
9	Use computer spelling checkers and grammar checkers appropriately and effectively.											4							
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0	0	
Sum of levels		35																	
Course Credits Hours		2																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,00	0,00	0,00	0,00	0,00	0,00	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		0,00	0,00	2,00	0,00	0,00													
Maximum CDIO skills level		0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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
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4.5 IMPLEMENTING
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Student Outcomes (SOs)

SO-1: 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;
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SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE601	Industrial Robotics Project

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain how robots can increasing safety, productivity and profit for specific industries.				3									3					
2	Analyze of the possibility of redesigning existing robotics systems in the industry.						4							4	4				
3	Analyze industrial robots implementation, their effect on increasing production or performance and reduction of operational costs.				4								4	4	4				
4	Design an industrial robots system by considering security, power consumption and energy efficiency, platform complexity, maintenance strategy, and cybersecurity platform.															4			
5	Implement robot designs using industry standard manufacturing processes.																4		
6	Test robot performance to meet with user requirement or specification.					4											4		
7	Apply project management within the team regarding scheduling, resource allocation, activity implementation management, performance evaluation.																4		
8	Create approriate technical documents including project report, manual book and manual instruction.										4								
9	Present the results of project orally in English.											4							
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	0	7	4	4	0	0	0	4	4	4	11	8	4	12	0	
Sum of levels		62																	
Course Credits Hours		3																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	0,00	0,34	0,19	0,19	0,00	0,00	0,00	0,19	0,19	0,19	0,53	0,39	0,19	0,58	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		0,00	2,42	0,39	0,19	0,00													
Maximum CDIO skills level		0	0	0	4	4	4	0	0	0	4	4	4	4	4	4	4	0	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE407	Technical Writing

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Analyze the audience, purpose, and context of technical communication projects, including cultural and ethical considerations										4								
2	Create technical documents of varied genres to solve practical problems										4								
3	Write effective technical prose										4								
4	Create documents and graphics using principles of effective information design										4								
5	Collaborate on technical communication projects									4									
6	Critically evaluate and choose technologies and tools that are appropriate for technical communication projects.										4								
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	0	0	0	0	0	0	4	20	0	0	0	0	0	0	0	
Sum of levels		24																	
Course Credits Hours		2																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,33	1,67	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		0,00	0,00	1,67	0,00	0,33													
Maximum CDIO skills level		0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE606	Professional Skills and Attitudes

Course Description

This course introduce professional ethics, integrity, responsibility and accountability, professional behavior, proactively planning for one's career, and stay current on world of engineer.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Demonstrate one's ethical standards and principles.								4										
2	Identify the possibility of conflict between professionally ethical imperatives.								3										
3	Demonstrate an understanding that it is acceptable to make mistakes, but that one must be accountable for them								4										
4	Demonstrate a commitment to service.								4										
5	Explain professional courtesy.								3										
6	Explain networks with professionals.								3										
7	Identify one's portfolio of professional skills.								3										
8	Describe the social and technical impact of new technologies and innovations.								3										
9	Discuss a familiarity with current practice/technology in engineering.								4										
10	Explain the links between engineering theory and practice.								3										
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**34**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**34**																	
Course Credits Hours		**2**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**2,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,00**	**0,00**	**0,00**	**0,00**	**2,00**													
Maximum CDIO skills level		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE502	Data Flow Programming

Course Description

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, datalogging, 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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Recognize the main components of the LabVIEW environment and be able to create a new project and VI		3																
2	Use Express VIs to produce a project and create a simple VI		4																
3	Use LabVIEW tools to debug and troubleshoot VIs and how to implement basic error handling techniques		4																
4	Recognize the different components of a LabVIEW loop structure and how to apply a For Loop or a While Loop appropriately		4																
5	Use arrays, clusters, and type definitions and be able to identify applications where using these data structures can be beneficial		4																
6	Create different decision-making structures and be able to identify applications where using these structures can be beneficial.		4																
7	Recognize the benefits of reusing code and will be able to create a subVI with a properly configured connector pane, meaningful icon, documentation, and error handling		3																
8	Recognize the differences between NI DAQ systems and instrument control and how LabVIEW connects to hardware to get real-world measurements		3																
9	Describe the basic concept of file I/O and apply the appropriate File I/O functions to a given scenario.		3																
10	Identify sequential and state programming and explore the State Machine design pattern		3																
11	Recognize when to use local and global variables and be able to determine the result of block diagrams that use variable		3																
12	Develop code that synchronizes data between parallel loops and you learn how to decide which communication method is the most appropriate for different scenarios.		4																
13	Implement common design patterns for single and parallel loop applications		4																
14	Use property nodes, invoke nodes, and control references to programmatically control front panel objects.		4																
15	Create modular LabVIEW code that reads or writes measurement data stored in a file.		4																
16	Use methods to refactor inherited code and experiment with typical issues that appear in inherited code.		4			4													
17	Make necessary code modifications to select and build the appropriate deployment option for a LabVIEW application		4			4													
Summary		**0**	**62**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Sum of levels		**70**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**2,66**	**0,00**	**0,00**	**0,34**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**2,66**	**0,00**	**0,00**	**0,34**	**0,00**													

Maximum CDIO skills level	0	4	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

1) CDIO Syllabus

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

Student Outcomes (SOs)

SO-1: 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;
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SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE504	English for Presentation

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Prepare an oral presentation on academic and professional topics.											4							
2	Effectively deliver an oral presentation on academic and professional topics.											4							
3	Effectively deal with questions from the audience.											4							
4	Aware of their presentation skills and knows how to be effective.											4							
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	
Sum of levels		16																	
Course Credits Hours		2																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	2,00	0,00	0,00	0,00	0,00	0,00	0,00	
		SO-1			SO-2	SO-4	SO-3	SO-5											
Credit hours distribution per each Student Outcome		0,00	0,00	2,00	0,00	0,00													
Maximum CDIO skills level		0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	

Notes:

1) CDIO Syllabus

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

2) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
SO-2: an ability to design systems, components, or processes meeting specified needs for broadly-defined engineering problems appropriate to the discipline;
SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE505	Quality Engineering Principles

Course Description

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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the techniques required to maintain and improve quality within manufacturing organizations including the concepts of quality, quality managements and assurance, and product quality.																3		
2	Explain the industry and engineering standards													3					
3	Design the quality control chart, statistical process control, and quality improvement.															4			
4	Implement the control chart and statistical process control during developing project related to robotics.																4		
5	Test the performance of applying the control chart and statistical process on the real project.																4		
6	Analyse the error which can be occurred during implementing the control chart and statistical process on the real project																4		
7	Write the quality managements and assurance by ulitizing the proper industry and engineering standards and codes.										4						4		
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**3**	**0**	**4**	**19**	**0**	
Sum of levels		**30**																	
Course Credits Hours		**2**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,27**	**0,00**	**0,00**	**0,20**	**0,00**	**0,27**	**1,27**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**0,00**	**1,73**	**0,27**	**0,00**	**0,00**													
Maximum CDIO skills level		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**3**	**0**	**4**	**4**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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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SO-1: 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;
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SO3: 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;
SO-4: an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
SO-5: an ability to function effectively as a member as well as a leader on technical teams.

Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE603	Machine Learning

Course Description

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 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.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the fundamental ML analytic techniques and commonly used algorithm for manufacturing applications.			3															
2	Design a proper ML models on a cloud platform to create enterprise-ready smart manufacturing artificial intelligence (AI)			4															
3	Implement a ML models to cope the enterprise-ready smart manufacturing AI.			4															
4	Train a ML models for the enterprise-ready smart manufacturing AI through on a cloud platform			4															
5	Test ML algorithm models to enhance the prediction performance for enterprise-ready smart manufacturing.					4													
6	Write the project blueprint manuscript related to the ML project by utilizing some technical literature.										4								
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**0**	**15**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**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**	**0,00**	**1,96**	**0,00**	**0,52**	**0,00**	**0,00**	**0,00**	**0,00**	**0,52**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**1,96**	**0,00**	**0,52**	**0,52**	**0,00**													
Maximum CDIO skills level		**0**	**0**	**4**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Notes:

1) CDIO Syllabus

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) Support Level to SO:

1- Poor: to have experienced or been **exposed** to
2- Fair: to be able to **participate** in and contribute to
3- Good: to be able to **understand** and explain
4- Very Good: to be **skilled in the practice** or implementation of
5- Excellent: to be able to lead or **innovate** in

3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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

Student Outcomes (SOs)

SO-1: 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;
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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE607	Elective Course 2

Course Description

This elective course gives students the opportunity to choose courses on specific topics: Mobile Robots, Legged Robots, Medical Robots, Flying Robots and other topics.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																	Assessment Method
		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	Explain the basic systems and technologies applied to mobile robots, legged robots, medical robots or flying robots.			3															
2	Apply kinematic equations for mobile robots, legged robots, medical robots or flying robots.			4		4													
3	Design mobile robots, legged robots, medical robots or flying robots.															4			
4	Simulate or make prototyping of mobile robots, legged robots, medical robots or flying robots.															4	4		
5	Conduct test and measurement for mobile robots, legged robots, medical robots or flying robots prototype or simulation.					4											4		
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		0	0	7	0	8	0	0	0	0	0	0	0	0	0	8	8	0	
Sum of levels		31																	
Course Credits Hours		3																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		0,00	0,00	0,68	0,00	0,77	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,77	0,77	0,00	
		SO-1	SO-2	SO-3	SO-4	SO-5													
Credit hours distribution per each Student Outcome		0,68	1,55	0,00	0,77	0,00													
Maximum CDIO skills level		0	0	4	0	4	0	0	0	0	0	0	0	0	0	4	4	0	

Notes:

1) CDIO Syllabus

1 TECHNICAL KNOWLEDGE AND REASONING
1.1 KNOWLEDGE OF UNDERLYING SCIENCE
1.2 CORE ENGINEERING FUNDAMENTAL KNOWLEDGE
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2.3 SYSTEM THINKING

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3) Assessment Method:

Written and oral question
Performance ratings
Product reviews
Journal and portofolios
Self-report instruments

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
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Mapping the CLOs against the Student Outcomes and CDIO Syllabus

Home

RE703	Robotics Control

Course Description

This course introduces a Behaviour Tree, Finite State Machine (FSM), LQR, Linier System robotic controller system. Student also equiped a proper choosen of robotic controller system which is suitable with the project related to robotics in real application.

No	Course Learning Outcomes (CLOs)	Support Level for each SO and CDIO Syllabus																Assessment Method
		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	Explain the fundamental of Behaviour Tree, FSM, LQR, Linier System on robotics system.			3															
2	Design a proper controller regarding to the robotics project including Behaviour Tree, FSM, LQR, Linier System.			4												4			
3	Implement a suitable robotic controller system on the robotics project.			4													4		
4	Analyzing a choosen controller in robotics project to enhance the performance of controller while running the project in real application.																4		
5	Write the result of controller performance analyzing in proper techical literature.										4								
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Summary		**0**	**0**	**11**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**8**	**0**	
Sum of levels		**27**																	
Course Credits Hours		**3**																	
Credit hour distribution = [(Sum of levels for each CDIO Syllabus / Sum of levels) x Course credit hours]		**0,00**	**0,00**	**1,22**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,44**	**0,00**	**0,00**	**0,00**	**0,00**	**0,44**	**0,89**	**0,00**	
		SO-1	**SO-2**	**SO-3**	**SO-4**	**SO-5**													
Credit hours distribution per each Student Outcome		**1,22**	**1,33**	**0,44**	**0,00**	**0,00**													
Maximum CDIO skills level		**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**	**4**	**0**	

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1) CDIO Syllabus

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