VINUNIVERSITY

CURRICULUM FRAMEWORK

PROGRAM CODE: 7520103

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

Applicable for the intake beginning in 2021 - 2022

(Decision 421a/2023/QĐ-VUNI, Dated: Dec 9th, 2023 by the Provost of VinUniversity)

This curriculum framework has been reviewed and validated by Cornell University

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1. VINUNI GRADUATE ATTRIBUTES

Generic graduate attributes are a set of skills, attributes, and values that all learners should achieve regardless of discipline or field of study; should be measurable and broad. The five Generic Graduate Attributes for VinUni, framed around the EXCEL Model, are listed as below:

2. PROGRAM EXPECTED OUTCOMES

2.1 Program Profile

Name of the program degree	Bachelor of Science in Mechanical engineering
Program duration	to be completed in 4 years on a full-time basis
Total credits	***Option 1 Single major:*** 125 credits
	Option 2 Major + minor in Robotics or Product Design or Technopreneur or another minor: 131 credits

2.2 Program Purpose

The overall aim of the program is to nurture and develop young leaders in mechanical engineering with clear direction and vision, creativity and sound personal values; who pave the way for the development of science and technology, to increase labor productivity and to benefit society.

2.3 Program Educational Objectives and Student Outcomes

2.3.1 Program Educational Objectives

The educational objectives of the Bachelor of Science in Mechanical Engineering program are that within a few years of graduation, a majority of our graduates will demonstrate excellence in top graduate programs; or in technical and managerial leadership tracks in technology-based industries or other sectors; or pursuing entrepreneurial ventures. In these roles they will:

1. Apply basic knowledge of mechanical engineering principles and in-depth knowledge of one area of concentration to solve a full range of technical and societal problems;

2. Conceive, design, and realize products, systems, and services, while properly respecting economic, environmental, cultural, safety, and ethical standards or constraints;

3. Be leaders with an entrepreneurial mindset, effective communicators, and informed decision makers as members of multidisciplinary teams, supporting collaborative and inclusive environments;

4. Discover and apply new knowledge, and engage in life-long learning for the profession of engineering;

5. Engage with their communities, profession, the nation, and the world.

2.3.2 Student Outcomes

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics;

2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors;

3. An ability to communicate effectively with a range of audiences;

4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts;

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives;

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions;

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies;

8. An entrepreneurial mindset and a recognition of the importance of traditional values, national pride and global awareness.

3. CURRICULUM STRUCTURE

3.1 Curriculum Composition

No.	Curriculum Components	Number of Credits	Credit Distribution (%/Total Credits)
I	**GENERAL EDUCATION**	**27**	**21.6%**
I.1	*University Core Requirement*	10	8%
I.2	*Distributional Requirement*	17	13.6%
I.3	*Co-curricular Learning*	Non-credit	
II	**PROFESSIONAL EDUCATION**	**98**	**78.4%**
II.1	*College Core Requirement*	39	31.2%
II.2	*Major Core Requirement*	17	13.6%
II.3	*Major Foundation Requirement*	15	12%
II.4	*Area of Concentration (Elective)*	12	9.6%
II.5	*Free Electives (minor*)*	9 (15*)	7.2%
II.6	*Co-op/Internship (at least 640 hours)*	Non-credit	
II.7	*Capstone Design*	6	4.8%
	TOTAL	**125 (131*)**	**100%**

***** ***Instead of taking 9 credits of free electives, students have an option of taking 15 credits to fulfill the requirements of a minor***

3.2 Courses and Credit Distribution by Courses

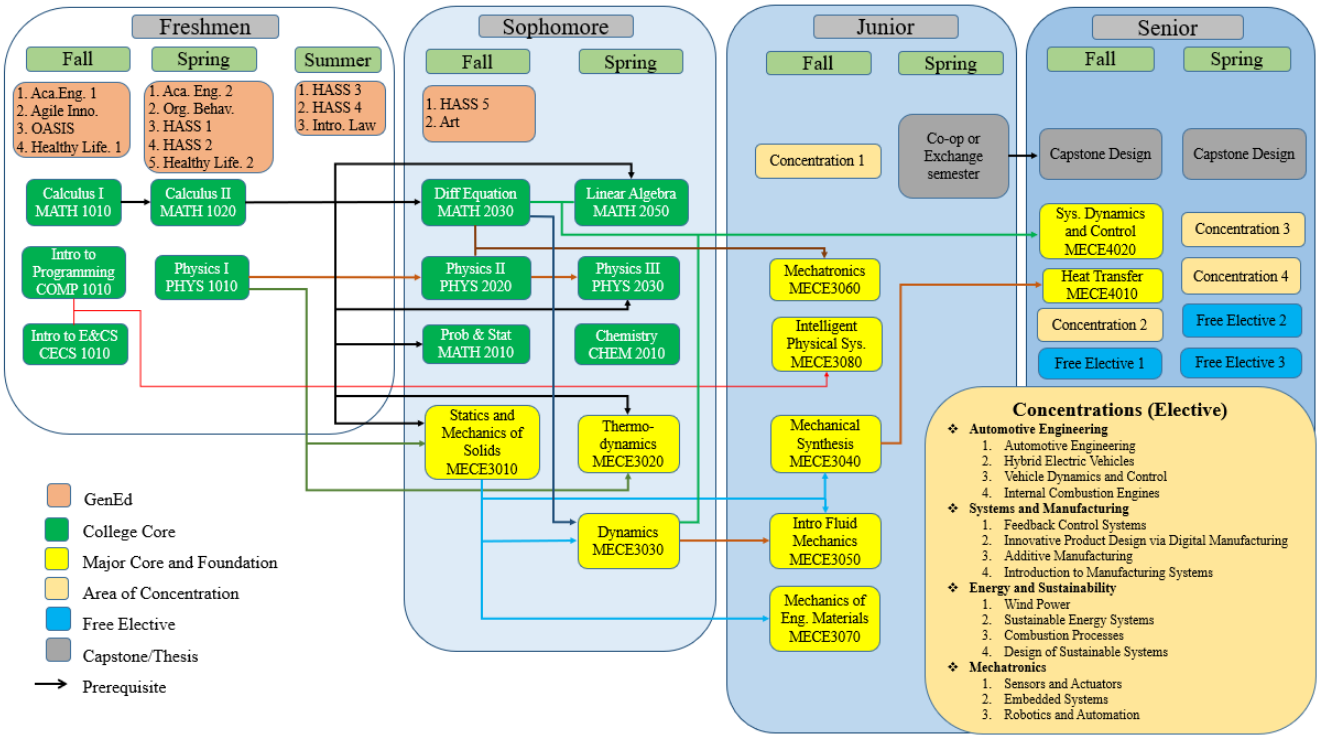
No	Code	Name of Courses	Total	Credit Allocation	
				Theory	Practice
I	**GENERAL EDUCATION (GenED)**		***27***		
I.1	**University Core Requirement**		***10***		
1	ENGL1010	Academic English 1	*3*		
2	ENGL1020	Academic English 2	*3*		
3	LEAD1020	Organizational Behavior	*2*		
4	ENTR1020	Agile Innovation	*2*		
I.2	**Distributional Requirement**		***17***		
5	HASS1020	Marxism-Leninism Political Economy (Global Political Economy)	*2*		
6	HASS1010	Marxism-Leninism Philosophy (Philosophy Science and Society)	*3*		
7	HASS1030	Scientific Socialism (Politics and Social Change)	*2*		
8	HASS1050	History of the Communist Party (Vietnam: History and Culture I)	*2*		
9	HASS1040/ HASS1041	Ho Chi Minh Ideology (Vietnam: History and Culture II)	*2*		
10	LAW1010	Introduction to Law	*2*		
11	ARTS1010	Culture - Arts	1		
12	VCOR1011	OASIS	3		
I.3	**Co-curricular Learning**				
13	VCOR1020	Healthy Lifestyle	*Non-credit*		*45 hrs*
14	VCOR1030	National Defense Education	*Non-credit*		*165 hrs*
15	LEAD1030	Leadership Bootcamp	*Non-credit*		*45 hrs*
16	ENTR1010	Entrepreneurship Initiatives	*Non-credit*		*45 hrs*
17	COSL1010	Community Service Learning	*Non-credit*		*45 hrs*
18	GLEX1010	Global Experience	*Non-credit*		*45 hrs*
II	**PROFESSIONAL EDUCATION**				
II.1	**College Core Requirement**		***39***		
19	MATH2010	Probability and Statistics	*4*	3	1
20	MATH1010	Calculus I	4	3	1
21	MATH1020	Calculus II	4	3	1
22	MATH2030	Differential Equations	3	2	1
23	MATH2050	Linear Algebra	4	3	1

No	Code	Name of Courses	Total	Credit Allocation	
				Theory	Practice
24	PHYS2010	Physics I	4	3	1
25	PHYS2020	Physics II	3	2	1
26	PHYS2030	Physics III	2	2	0
27	CHEM2010	Chemistry	3	2	1
28	CECS1010	Introduction to Engineering and Computer Science	4	2	2
29	COMP1010	Introduction to Programming	4	2	2
II.2	**Major Core requirement**		***17***		
30	MECE3010	Statics and Mechanics of Solids	4	3	1
31	MECE3020	Thermodynamics	3	3	0
32	MECE3030	Dynamics	3	3	0
33	MECE3040	Mechanical Synthesis	4	3	1
34	MECE3050	Introductory Fluid Mechanics	3	2	1
II.3	**Major Foundation requirement**		***15***		
35	MECE4010	Heat Transfer	3	3	0
36	MECE3060	Mechatronics	3	2	1
37	MECE4020	System Dynamics and Control	3	2	1
38	MECE3070	Mechanics of Engineering Materials	3	2	1
39	MECE3080	Intelligent Physical Systems (Interdisciplinary Engineering Design Project)	3	2	1 (lab + project)
II.4	**Area of Concentration (Elective) (Select one)**				
II.4.1	***Automotive Engineering***		***12***		
1	MECE3090	Automotive Engineering	3	2	1
2	MECE4030	Hybrid Electric Vehicles	3	2	1
3	MECE4040	Vehicle Dynamics and Control	3	2	1
4	MECE4050	Internal Combustion Engines	3	2	1
II.4.2	***Systems and Manufacturing***		***12***		
1	MECE3100	Introduction to Manufacturing Systems	3	2	1
2	MECE4060	Innovative Product Design via Digital Manufacturing	3	2	1
3	MECE4070	Additive Manufacturing	3	2	1
4	MECE4080	Feedback Control Systems	3	2	1
II.4.3	***Energy and Sustainability***		***12***		
1	MECE3110	Wind Power	3	3	
2	MECE4090	Sustainable Energy Systems	3	3	
3	MECE4100	Combustion Processes	3	3	
4	MECE4110	Design of Sustainable Systems	3	3	
II.4.4	***Mechatronics***		***12***		
1	MECE4120	Sensors and Actuators	4	3	1
2	ELEC4020	Embedded Systems	4	3	1

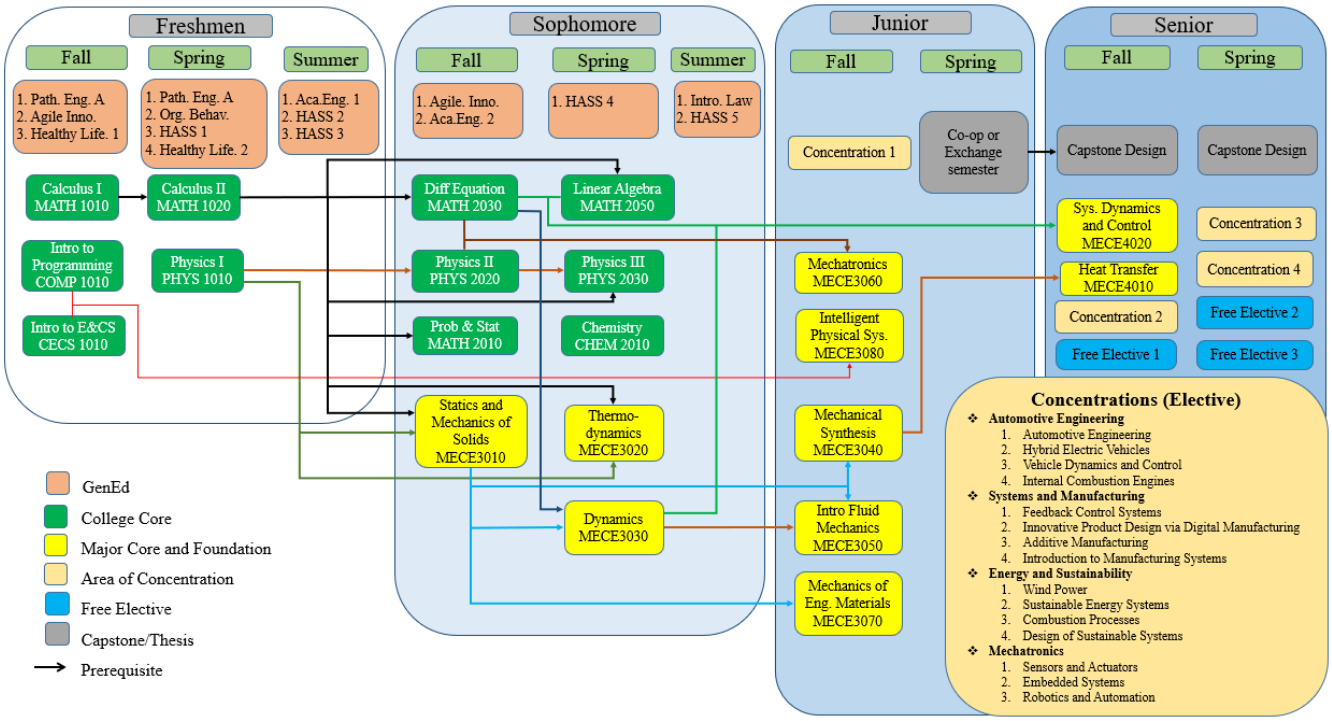
No	Code	Name of Courses	Total	Credit Allocation	
				Theory	Practice
3	ELEC4060	Robotics and Automation	4	3	1
II.5	**Free Electives (or minor)**		*9 (15)*		
II.6	**Co-op/Internship**		0		
1	MECE3870	Internship	640 hrs		
II.7	**Capstone Design**		6		6
1	MECE4890	Capstone Design	6		6

3.3 Curriculum Planner

There are two tracks: Main track and Pathway English track (for students who need to improve English requirement)



Program frame work (Main track)



Program frame work (Pathway track)

Main track

Undergraduate Mechanical Engineering Curriculum		GenED Core	College Core	Major core and Foundation	Area of Concentration	Free Electives/ Minor	Practice/ Internship	Graduation Thesis/ Capstone
Year 1 Fall	Calculus I		4					
	Introduction to Programming		4					
	Introduction to Engineering and CS		4					
	Academic English 1	3						
	Agile Innovation	2						
	OASIS	3						
	Healthy Lifestyle	Non-Credit						
Total Semester Credits			**20**					
Year 1 Spring	Calculus II		4					
	Physics I		4					
	Academic English 2	3						
	Organization behaviours	2						
	HASS course 1	2						
	HASS course 2	2						
	Healthy Lifestyle	Non-Credit						
Total Semester Credits			**17**					
Summer 1	HASS course 3	3						
	HASS course 4	2						
	Introduction to Law	2						
Total Semester Credits			**7**					
Year 2 Fall	Differential Equations		3					
	Physics II		3					
	Probability and Statistics		4					
	HASS course 5	2						
	Art	1						
	Statics and Mechanics of Solids			4				
Total Semester Credits			**17**					
Year 2 Spring	Linear Algebra		4					
	Physics III		2					
	Chemistry		3					
	Thermodynamics			3				
	Dynamics			3				
Total Semester Credits			**15**					
Summer 2	Internship or exchange program						Non Credit	
Year 3 Fall	Mechanical Synthesis			4				
	Introductory Fluid Mechanics			3				
	Intelligent Physical Systems (interdisciplinary Design project)			3				
	Mechatronics			3				
	Mechanics of Engineering Materials			3				
	Concentration 1				3			
Total Semester Credits			**19**					
Year 3 Spring	**Co-op semester (No credit)**							
Total Semester Credits			**0**					
Summer 3	Internship or exchange						No credit	
Year 4 Fall	Capstone Design							3
	System Dynamics and Control			3				
	Heat Transfer			3				
	Concentration 2				3			
	Free Elective 1					3		
Total Semester Credits			**15**					
Year 4 Spring	Capstone Design							3
	Concentration 3				3			
	Concentration 4				3			
	Free Elective 2					3		
	Free Elective 3					3		
Total Semester Credits			**15**					

Pathway track:

Undergraduate Mechanical Engineering Curriculum		GenED Core	College Core	Major core and Foundation	Area of Concentration	Free Electives/ Minor	Practice/ Internship	Graduation Thesis/ Capstone
Year 1 Fall	Calculus I		4					
	Introduction to Programming		4					
	Introduction to Engineering and CS		4					
	Pathway English Advanced A	6						
	OASIS	3						
	Healthy Lifestyle	Non-Credit						
Total Semester Credits			**21**					
Year 1 Spring	Calculus II		4					
	Physics I		4					
	Pathway English Advanced B	6						
	Organization behaviours	2						
	HASS course 1	2						
	Healthy Lifestyle	Non-Credit						
Total Semester Credits			**18**					
Summer 1	Academic English 1	3						
	HASS course 2	3						
	HASS course 3	2						
Total Semester Credits			**8**					
Year 2 Fall	Differential Equations		3					
	Physics II		3					
	Probability and Statistics		4					
	Agile innovation	2						
	Academic English 2	3						
	Statics and Mechanics of Solids			3				
Total Semester Credits			**18**					
Year 2 Spring	Linear Algebra		4					
	Physics III		2					
	Chemistry		3					
	HASS course 4	2						
	Thermodynamics			3				
	Dynamics			3				
Total Semester Credits			**17**					
Summer 2	Introduction to Law	2						
	HASS course 5	3						
Total Semester Credits			**5**					
Year 3 Fall	Mechanical Synthesis			4				
	Introductory Fluid Mechanics			3				
	Intelligent Physical Systems (interdisciplinary Design project)			3				
	Mechatronics			3				
	Mechanics of Engineering Materials			3				
	Concentration 1				3			
Total Semester Credits			**19**					
Year 3 Spring	**Co-op semester (No credit)**							
Total Semester Credits			**0**					
Summer 3	Internship or exchange						No credit	
Year 4 Fall	Capstone Design							3
	System Dynamics and Control			3				
	Heat Transfer			3				
	Concentration 2				3			
	Free Elective 1					3		
Total Semester Credits			**15**					
Year 4 Spring	Capstone Design							3
	Concentration 3				3			
	Concentration 4				3			
	Free Elective 2					3		
	Free Elective 3					3		
Total Semester Credits			**15**					

3.4 Course Descriptions

ENTR1020 Agile Innovation

2 credits

Pre-requisites: None

The purpose of this course is to provide students with a basic understanding of the entrepreneurial and innovation mindset and provide students the opportunity to learn about and develop behaviors correlated with successful entrepreneurs and innovators. Skills to be taught include opportunity identification, idea generation, design thinking, building and leading an innovative team, optimizing creativity, seeking customer feedback, and prototyping. This hands-on course will allow students to refine their innovation skills and develop confidence in their creativity skill set. This course involves lectures and in-team innovation experience, generating an innovative product concept. The course is intended for a mix of students from various academic disciplines, such as medicine, nursing, engineering, business, real estate, and hospitality. The course will focus on identifying opportunities in a changing environment. Students will gain a broader perspective of both the challenges and opportunities related to technology and social change. (i.e. unmet customer needs and opportunities for future ventures). As part of the course all students will engage in a 3-day hackathon. For the hackathon event, students will form teams and will identify problems and generate solutions to real-world problems. Students will learn and apply team innovation processes, business model innovation, design thinking, creativity management, product pitches, data analysis, critical thinking, and product innovation. This course will also help students build their professional network.

ENGL1010 Academic English 1

3 credits

Pre-requisites: None or Pathway English Advanced B for Pathway track

This course is designed as a continuation of the Pathway English Program Advanced course to further develop students' competency in the English language and introduce and develop students' academic skills and literacies. Academic English 1 is the first of two courses in the General Education Program aimed at developing students' English language and skill competencies for English medium instruction at the university level. Students in this course will continue to develop their academic English language ability in Reading, Listening, Writing, and Speaking. While this course seeks to improve the overall capacity of the students' English language and academic literacy skills, there is an emphasis on the development of academic writing

at the essay level and oral communication skills to prepare students for Academic English 2 and long-term success in university-level coursework.

ENGL1020 Academic English 2

3 credits

Pre-requisites: Academic English 1

Academic English 2 reinforces and expands the language and academic skills developed in Academic English 1. Students will continue to expand and refine their range and accuracy of English but will now focus more intensively on the skill of writing. The principle aim of this course is to transition from the written essay to the research paper, augmenting students' academic writing skills to prepare them for the type of writing that is essential to their university studies. After identifying a key academic question, through a scaffolded and multistage approach, students will demonstrate a diversity of writing skills to create a coherent research paper and share their findings with an interdisciplinary audience through formal presentations. Students will further develop their academic inquiry skills, synthesizing and critically evaluating knowledge from various sources, creating new connections and ultimately crafting their own original ideas.

LEAD1020 Organization behaviors

2 credits

Pre-requisites: None

This course introduces students theoretically and practically to key facets of leadership in organizations. It lays the foundations for students' preparation to being influential leaders who can effectively work in local and global teams. The course covers aspects of self-leadership through developing self-awareness, critical thinking, resilience, and a global mindset. It builds interpersonal leadership through addressing perspective taking, conflict management, and effective feedback, and strengthens team leadership skills. Students develop skills through theoretical lectures, case study analysis, individual and team assignments, and self-reflection.

HASS1030 Scientific Socialism (Politics and Social Change)

2 credits

Pre-requisites: None

Introduction to Political Science is intended to be a survey course and thus, it covers briefly various topics in the broad field of political science. The purpose of this course

is to provide a bird's-eye view of political science and social science inquiry, as well as equip students with the tools needed to explore the subject further on their own.

This course will familiarize students with important fundamental concepts in political science through concrete and exciting examples and cases studies, as well as stimulating and thought-provoking class activities. The goal is to build a lively learning environment where students are equipped with a systematic approach to learning political science and other kinds of social sciences. After the course, students will have the analytical, presentational, research and data analysis skills that are critical to higher-level specialized classes.

The class will first consider the fundamental concepts of political science and the scientific method. Next, we will cover substantive topics simultaneously from the point of view of sub-areas such as: Comparative Politics, International Relations, Marxist – Leninist Political Economy, and Scientific Socialism. By the end of the course, students should be fundamentally prepared to explore, research, and critique issues related to politics in the real world.

HASS1010 Marxism-Leninism Philosophy (Philosophy, Science and Society)

3 credits

Pre-requisites: None

Philosophy, Science & Society (PSS) provides students with a broad survey of key ideas in Philosophy, its relevance to society and the way we think we understand the world, or to put it broadly, "science." We begin the course with an overview of the role of Philosophy and Metaphysics as we embark on this journey of critically re-examining the way we look at our world. In the second part of the course, we take a deep dive into questions of Epistemology, based on which students can orient and develop their creative thinking, philosophy of humanity and action. We follow up with an exploration of trends that came into being with the "social turn" of epistemology found in the critical works of Thomas Kuhn and later in the burgeoning body of works clustered as Sociology of Science. Following this radical re-thinking, we return to the fundamental questions about humanity posed in Social Philosophy and Ethics, to round up our critical inquiry of the complex relationship among philosophy, science and society.

PSS is one of four courses in the General Education Program forming the ideology/national education component required for higher education curriculum as directed by the Ministry of Education & Training, Socialist Republic of Vietnam. This course forms 3 credits out of a total of 12 credits dedicated to this requirement for higher education curriculum. These four courses are written to achieve the primary objective of helping students understand core values of both country and university

through objective and critical academic lenses in a global context. As these courses will be taught in English to students for whom English is mainly a second language at VinUniversity, each course is designed to be delivered in the spirit of content-based language learning approach to help students both develop English language competency (focusing on speaking, listening and reading) and basic understanding of the content.

HASS1020 Marxism-Leninism Political Economy (Global Political Economy)

2 credits

Pre-requisites: None

This course is designed to help students develop a critical lens to understand social reality and social issues, including pressing questions, such as: What is Vietnam's place in the world? What are the opportunities and challenges for Vietnam in the current configuration of the global political economy? To do so, we begin with a brief introduction to the study of political economy, informed by different persuasions in Marx-Leninism, political science, economic, sociology, anthropology, and history. Students will gain a nuanced understanding of this interdisciplinary field through hands-on workshops and exercises on the principles of scientific and logical arguments. The second part of this course will focus on specific issues related to globalization and international integration. In particular, we focus on the role of development, modernization, and regional development in Vietnam's prospects in the world. Our case studies pay special attention to the immediate regions surrounding Vietnam, namely ASEAN, East Asia (in particular, China) and South Asia. In the third and final part of this course, we examine the expressions of global inequality and consider how individuals and communities within Vietnam can move forward in an ever-globalizing world.

HASS1050 History of the Communist Party (Vietnam: History and Cultures I)

2 credits

Pre-requisites: None

This course is designed to promote critical thinking, inquiry, creating skills by examining the social, cultural, economic and political development of Vietnam since the nineteenth century. From Confucian-inspired ideas of culture and society to the transformation wrought by French colonialism, the rise of the Vietnamese Communist Party, and the revolution of Ho Chi Minh ideology this course engages students to investigate how the Vietnamese have received, adopted, and adapted the various trends of thought introduced to the country throughout modern history.

HASS1040/1041 Ho Chi Minh Ideology (Vietnam: History and Cultures II)

2 credits

Pre-requisites: None

In the past two decades, Vietnam has achieved remarkable economic development while deepening its international ties and committments. As a result, the country is enjoying a transformation rarely seen in human history. This makeover extends to fields as diverse as education, health care, technology, information, transportation, nutrition and real estate. But as Vietnam has developed, so have the complexities it faces, both at home and internationally. How do we make sense of it all?

In reality, Vietnam has long been a global crossroads. However, its history, culture and economy are rarely understood in this way. Vietnam History and Culture (II) considers Vietnam's significance as a point of international intersection since the arrival of French Colonialism to examine its history and contemporary events. Surverying modern Vietnam, the course explores such topics as French colonialism and the end of Dynastic Vietnam, Vietnamese responses to colonialism, the rise of nationalism and Communism, Hồ Chí Minh, the First and Second Indochina Wars, the post-1975 period, and Đổi Mới.

To tell this story, the course approaches events as William Shakespeare famously wrote, "All the world's a stage." In order to dive deep into events and the figures who participated in them, students will be challenged to reenact key moments and engagements on the classroom stage. Just who were Phan Thanh Giản and Phan Đình Phùng? How did Hồ Chí Minh experience September 2, 1945? And what was the air like in Geneva in 1954? Students will imagine themselves at these events and in these roles as well as a host of others.

This course is intended for students both with an aversion to history as well as advanced historians. As Vietnam's legendary economic historian Đặng Phong has argued, only with a strong understanding of history can leaders make appropriate decisions and policy. Therefore, this course aims to train future leaders of all fields, so they can better navigate and assess the complex issues facing Vietnam today as well as make informed judgements about what lies ahead.

LAW1010 Introduction to Law

2 credits

Pre-requisites: None

This course is an introduction to the concept and role of law which considers the nature of the rule of law and its relationship with morality, ethics, politics, and human

rights. It provides students with general knowledge of the law that will serve as a helpful foundation for understanding how the law interacts with other disciplines that they study and pursue in the future. The course covers various aspects from legal theory including the notions of law, rules and legal systems to comparative legal analysis between different bodies of law, branches of international law as well as different means of settling disputes, either at municipal courts or other international forums worldwide. Of these, it focuses on the topic of Vietnamese civil law to help students gain familiarity with fundamental concepts and issues relating to contract formation, implementation and remedies in accordance with Vietnamese law. Throughout the course, students develop critical analysis and problem solving, work-in-group and presentation skills, research literacy in law through theoretical lectures, case law analysis, individual and team assignments, and experiential learning in the form of legal simulation or moot court projects.

ARTS1010 Arts

1 credit

Pre-requisites: None

The Arts component of Vin University General Education Program seeks to cultivate the creative and affective senses in students. This is a part of our mission to provide a well-rounded and broad-based education. Through the "aesthetics," broadly defined, we hope to foster creativity and critical thinking stills among students either through an informed exposure to a particular art form and/or hands-on experiential learning of a particular art form. Being at the dawn of a new era of humanity where digital technology permeates every aspect of our lives, it is critical that students are able to sensitively reflect on the importance of the Arts in society and re-discover what keeps us human.

The Arts component is offered as a singular one-credit course but available in a variety of renditions in each semester. Each course will focus specifically on one particular type of art form, a specific genre or an introductory set of skills. Students are required to complete one arts course offered by the General Education Program during the Third Year or before graduation.

VCOR1020 Healthy Lifestyle

No Credit

Pre-requisites: None

This component provides student with the knowledge to make better choices during their daily routines to build a healthy lifestyle. A healthy lifestyle doesn't just include

external/internal physical wellbeing, but also good mental health. Students receive mentorship that guide and shape their perspective, showcasing the importance of having a well-balanced life. Fitness and exercise will be broken down to a process and science that allows students to have a greater understanding of what it takes to achieve their physical goals. Nutrition and diet will be taught to dispel the myths about how and what you should eat to achieve desired health results. Rounding out the course will be session about mental health, as a healthy body is nothing without a healthy mind. Having clarity of thought and the ability to effectively process information is a key trademark of a healthy lifestyle.

Topics will include workout/fitness styles and how to perform exercises properly and safely, results oriented diet design and nutrition fundamentals, stress management, goal setting, and time management. This course emphasizes practical application of the learned concepts in order to integrate subject matter into student daily routines. The majority of coursework will be held in different environments and venues in order to expose students to the many varieties of fitness tools and resources to maintain a healthy foundation. Students learn through the use of group discussions, case studies, written assessments, 1 on 1 mentorship sessions, and most importantly practical applications in individual and group settings.

VCOR1030 National Defense Education

No Credit

Pre-requisites: None

National Defense Education, under MOET framework, plays a crucial role in building national pride, perseverance, and physical endurance among learners to secure the country's civil defense system. By challenging themselves with early morning rituals, followed by rigid mental and physical requirements as well as schedules, students develop their self-discipline, grit & durability. Various extracurricular activities are integrated to the curriculum to foster inclusivity, maturity & responsibility towards student families and their societies.

LEAD1030 Leadership Bootcamp

No Credit

Pre-requisites: None

The intensive 4-week Boot Camp instills foundational leadership values and skills into incoming students, while bringing the class together and creating esprit de corps. Students will learn and apply basic leadership concepts and skills through hands-on learning. Students will have to work individually and in team-based settings to solve

complex and dynamic problems taken from the military, government, and business sectors. This includes but is not limited to: conducting long distance land navigation, negotiating obstacle courses, analyzing leadership case studies, and more. From developing self-awareness and thinking critically to innovating ideas and displaying resilience, students will learn fundamentals of Self, Interpersonal, and Team

Leadership through theoretical lectures, case study analysis, individual and team practical exercises, and self-reflection.

VCOR1010 First Year Experience - OASIS

No Credit

Pre-requisites: None

First Year Experience equips students with the necessary tools and problem solving methodologies as students embark on their university education. This course takes an integrated approach that incorporates both academic and nonacademic factors to create an inclusive and supportive community that addresses the social, emotional, and academic needs of students. The goal of this program is to enable students with a clear trajectory of where they want to go and what they want to do in terms of career opportunities and life beyond the walls of VinUni. Additionally, students will be encouraged to take full advantage of the plethora of relationships and resources available to them. This course will prepare students in areas including social and emotional learning, 21st century skills, study skills and time management, research, self-confidence, positive psychology, goal setting, residential life, safety and wellness, and much more. The course material will be delivered through orientation, academic seminars, lectures from guest speakers and industry experts, peer interaction, immersion, and practical application.

ENTR1010 Entrepreneurship Innitiatives

No Credit

Pre-requisites: None

The entrepreneurship program is a framework which provides students with the mindset and skillset to be successful not just in the context of a new venture but in a broad number of settings. While rigorous critical thinking and problem solving skills are developed, the program also prioritizes a growth mindset, curiosity, and initiative which help students to "ask the right questions" and identify new issues at local, regional, and global levels. Through a combination of multi-disciplinary coursework (in the credit requirements of General Education Program and E-Ship minor/major), labs, and co-curricular activities, students are exposed to entrepreneurship, business

and economic issues with emphasis on issues affecting innovative ventures. Students learn through the use of case studies, self-assessments, experiential exercises, readings, discussions, papers, and group activities.

COSL1010 Community Service Learning

No Credit

Pre-requisites: None

This course aims at fostering students' sense of civic and social responsibility as well as their moral personality by engaging them to serve the primary and secondary school students (PSSS) through creatively designing activities, whereby they could apply their knowledge to the monitoring of the PSSS's health conditions and promote the correct and effective ways of enhancing their health awareness. This course is composed of lectures, seminars, workshops and on-site activities. This is a course where the students' problem-solving minds and community-serving hearts converge.

GLEX1010 Global Experience

No Credit

Pre-requisites: None

The module of global experience is a mandatory, non-credit bearing requirement of the GenED program. It is designed in alignment with the component of global awareness from the VinUni Graduate Attributes, forming a nexus that holistically coheres with the other Attributes.

A multi-faceted approach is adopted in enhancing students' global experience through a variety of effective pedagogical channels, such as Semester Abroad/exchange programs, community service learning abroad, cross culture experiences, summer programs and short-term overseas courses.

This module is offered through the collaboration of the General Education Program Committee, Office of Students Affairs and the Colleges.

MATH1010 Calculus I

4 credits

Pre-requisites: High school three years high school mathematics, including trigonometry and logarithms, and at least one course in differential and integral calculus.

This course teaches techniques of integration, finding areas and volumes by integration, exponential growth, partial fractions, infinite sequences and series, tests of convergence, and power series.

MATH1020 Calculus II

4 credits

Pre-requisites: Calculus I

This course gives an introduction to multivariable calculus. Topics include partial derivatives, double and triple integrals, line and surface integrals, vector fields, Green's theorem, Stokes' theorem, and the divergence theorem.

MATH2030 Equations

3 credits

Pre-requisites: Calculus II

Taking with Linear Algebra simultaneously is not recommended.

Course Description:

This course gives an introduction to ordinary and partial differential equations. Topics include first order equations (separable, linear, homogeneous, exact); mathematical modeling (e.g., population growth, terminal velocity); qualitative methods (slope fields, phase plots, equilibria and stability); numerical methods; second order equations (method of undetermined coefficients, application to oscillations and resonance, boundary value problems and eigenvalues); and Fourier series. A substantial part of this course involves partial differential equations, such as the heat equation, the wave equation, and Laplace's equation.

MATH2050 Linear Algebra

4 credits

Pre-requisites: Calculus II

Taking Differential Equations simultaneously is not recommended.

This course teaches linear algebra and its applications. Topics include matrices, determinants, vector spaces, eigenvalues and eigenvectors, orthogonality and inner product spaces; applications include brief introductions to difference equations, Markov chains, and systems of linear ordinary differential equations. This course also includes computer use in solving problems.

MATH2010 Probability and Statistics

4 credits

Pre-requisites: Calculus II

This course gives students a working knowledge of basic probability and statistics and their application to engineering including computer analysis of data and simulation. Topics include random variables, probability distributions, expectation, estimation, testing, experimental design, quality control, and regression.

PHYS2010 Physics I

4 credits

Pre-requisites: Calculus (integration, finding areas and volumes by integration, exponential growth, partial fractions, infinite sequences and series, tests of convergence, and power series).

This course covers the mechanics of particles with focus on kinematics, dynamics, conservation laws, central force fields, periodic motion. Mechanics of many-particle systems: center of mass, rotational mechanics of a rigid body, rotational equilibrium, and fluid mechanics. Temperature, heat, the laws of thermodynamics.

PHYS2020 Physics II

3 credits

Pre-requisites: Physics I

This course covers electrostatics, the behavior of matter in electric fields, DC circuits, magnetic fields, Faraday's law, AC circuits, and electromagnetic waves.

PHYS2030 Physics III: Oscillations, Waves, and Quantum Physics

2 credits

Pre-requisites: Physics II (Electromagnetism), Calculus II

This course covers the physics of oscillations and wave phenomena, including driven oscillations and resonance, mechanical waves, sound waves, electromagnetic waves, standing waves, Doppler effect, polarization, wave reflection and transmission, interference, diffraction, geometric optics and optical instruments, wave properties of particles, particles in potential wells, light emission and absorption, and quantum tunneling.

CHEM2010 Chemistry

3 credits

Pre-requisites: High school chemistry

This course covers basic chemical concepts, such as reactivity and bonding of molecules, introductory quantum mechanics, and intermolecular forces in liquids and solids and gases. Attention will be focused on aspects and applications of chemistry most pertinent to engineering.

CECS1010 Introduction to Engineering and Computer Science

4 credits

Pre-requisites:

This course provides a general introduction to the engineering design process – spanning core topics from problem definition through prototyping and testing, as well as other important considerations such as sustainability, failure analysis, and engineering economics. This course also emphasizes multidisciplinary design via a design project (e.g., design a line following robot) which involves students from different majors of college of engineering and computer science.

COMP1010 Introduction to Programming

4 credits

Pre-requisites:

This course teaches programming and problem-solving using Python. Emphasizes principles of software development, style, and testing. Topics include procedures and functions, iteration, recursion, arrays and vectors, strings, an operational model of procedure and function calls, algorithms, exceptions, object-oriented programming, and GUIs (graphical user interfaces).

MECE3010 Statics and Mechanics of Solids

4 credits

Pre-requisites: Physics I, Calculus II

This course covers principles of statics, force systems, and equilibrium in solid structures. Topics include free body diagrams in two and three dimensions; frames; mechanics of deformable solids; stress and strain; axial force; shear force, bending

moment, and torsion in bars and beams; thermal stress; pressure vessels; statically indeterminate problems; buckling and yielding.

MECE3020 Thermodynamics

3 credits

Pre-requisites: Physics I, Calculus II

This course presents the definitions, concepts, and laws of thermodynamics. Topics include the first and second laws, thermodynamic property relationships, and applications to vapor and gas power systems, refrigeration, and heat pump systems. Examples and problems are related to contemporary aspects of energy and power generation and to broader environmental issues.

MECE3030 Dynamics

3 credits

Pre-requisites: Statics and Mechanics of Solids, Differential Equations, Corequisite: Linear Algebra

This course teaches Newtonian dynamics of a particle, systems of particles, rigid bodies, simple mechanisms, and simple harmonic oscillators. Impulse, momentum, angular momentum, work, and energy. Two-dimensional (planar) kinematics including motion relative to a moving reference frame. Three-dimensional rigid-body dynamics are also introduced. Setting up the differential equations of motion and solving them both analytically and numerically with MATLAB. In-lecture laboratory demonstrations illustrate basic principles.

MECE3040 Mechanical Synthesis

4 credits

Pre-requisites: Statics and Mechanics of Solids, Corequisite: Dynamics

This course provides a hands-on introduction to the mechanical design process, from conceptualization through prototype construction and testing. Design projects provide experience in basic prototyping skills using machine tools, 3D printing, and laser cutting, as needed, as well as basic instruction in CAD and technical sketching.

MECE3050 Introductory Fluid Mechanics

3 credits

Pre-requisites: Statics and Mechanics of Solids, Dynamics

This course covers physical properties of fluids, hydrostatics, conservation laws using control volume analysis and using differential analysis, Bernoulli's equation, potential flows, simple viscous flows (solved with Navier-Stokes equations), dimensional analysis, pipe flows, boundary layers. Introduction to compressible flow.

MECE4010 Heat Transfer

3 credits

Pre-requisites: Introductory Fluid Mechanics

This course covers the following topics: steady and unsteady heat conduction; forced and free convection; external and internal flows; radiation heat transfer; and heat exchangers.

MECE3060 Mechatronics

3 credits

Pre-requisites: Physics II, Differential Equations

At the intersection of mechanical and electrical engineering, Mechatronics involves technologies necessary to create automated systems. This course introduces students to the functional elements of modern controlled dynamic systems. Topics include analog circuits - both passive and active components, filter design, diodes, transistors, MOSFETs and power amplification, pulse width modulation, transduction - mechanical and electro-mechanical devices such as electromagnetic systems, gear trains, optical encoders, discretization, aliasing, and microprocessors and programming. Lab experiments culminate in the design, fabrication, and programming of a microprocessor-controlled robotic vehicle, which laboratory groups enter into a class-wide competition.

MECE3080 Intelligent Physical Systems

3 credits

Pre-requisites: Introduction to Engineering, Programming language

This is an interdisciplinary design project course which involves students from different engineering and computer science programs. In this course, students will engage in a holistic design approach to Intelligent Physical Systems which can perceive, reason about, and act upon their environment. This course includes topics on algorithms, sensors, actuators, power, and mechanics. Students will learn the value and trade-offs between theory, simulation, and physical implementations, and gain familiarity with rapid prototyping techniques, system debugging, teamwork,

leadership skills, time management, and how to disseminate work to a broader audience through wiki-pages.

MECE4020 System Dynamics and Control

3 credits

Pre-requisites: Differential Equations, Linear Algebra, Dynamics

This course teaches dynamic behavior of mechanical systems: modeling, analysis techniques, and applications; vibrations of single- and multi-degree offreedom systems; feedback control systems. Computer simulation and experimental studies of vibration and control systems.

MECE3070 Mechanics of Engineering Materials

3 credits

Pre-requisites: Statics and Mechanics of Solids

This course gives an introduction to the broad range of properties and behaviors of engineering materials as they relate to mechanical performance. Emphasis is placed on general states of stress and strain, on elasticity and combined loading effects. Failure criteria including yielding, fracture and fatigue are developed. A general introduction to the function/constraints/objectives approach to material selection associated with mechanical design is provided with candidate material systems coming from metals, polymers, ceramics and/or composites. A general overview of material processing will be presented within this context of material selection.

MECE3090 Automotive Engineering

3 credits

Pre-requisites: Dynamics

This course covers the analysis and design of vehicle components and vehicle systems. Emphasis on automobiles. Engines, transmissions, suspension, brakes, and aerodynamics are discussed. The course uses first principles and applies them to specific systems. The course is highly quantitative, using empirical and analytical approaches.

MECE4030 Hybrid Electric Vehicles

3 credits

Pre-requisites: Dynamics

This course covers electrified powertrain concepts, Energy for Transportation; environmental impact, APUs for hybrid electric vehicles, Modeling of power split devices for hybrid vehicles, Vehicle control hierarchy and power management, Modeling and analysis of series electric hybrid powertrains, Power electronic devices and motors, Modeling and analysis of split hybrid power-trains, Modeling and control issues of batteries, Major design issues and consideration of Hybrids …

MECE4040 Vehicle Dynamics and Control

3 credits

Pre-requisites: Dynamics

This course focuses on tire mechanics and provides a fundamental understanding of feedback control, vehicle handling and ride performance through the development, analysis and critical interpretation of vehicle/system models.

MECE4050 Internal Combustion Engines

3 credits

Pre-requisites: Thermodynamics

This course covers the analytical approach to the engineering problem and performance analysis of internal combustion engines. Topics include thermodynamics, combustion, heat transfer, friction, and other factors affecting engine power, efficiency, and emissions, design and operating characteristics of different types of engines.

MECE3100 Introduction to Manufacturing Systems

3 credits

Pre-requisites:

This course provides ways to analyze manufacturing systems in terms of material flow and storage, information flow, capacities, and times and durations of events. Topics include probability, inventory and queuing models, forecasting, optimization, process analysis, and linear and dynamic systems; flow planning, bottleneck characterization, buffer and batch-size tactics, seasonal planning, and dynamic behavior of production systems. This course also covers automation process, CAD/CAM/CAE and CIMS**.**

MECE4060 Innovative Product Design via Digital Manufacturing

3 credits

Pre-requisites:

This course combines lecture and laboratory on the new product development cycle: iterative design based on prototyping, testing, consumer feedback, and limitations set by mass manufacturing. The course instructs students on methods to identify product concepts for machine designs with commercial potential. Design teams will perform market analysis and explore the intellectual property space around their ideas and rapidly iterate them into a final prototype via digital manufacturing (e.g., 3D CAD files manifested via robotic printing or machining); advanced instruction on these tools will be given, and quantitative marketing will be used as feedback. Early stage prototypes will progress into more sophisticated designs. Scale-up (cost, pricing, tooling) considerations for mass manufacturing will be taken into account, as well as quantitative analysis of machine designs for the expected utility.

MECE4070 Additive Manufacturing

3 credits

Pre-requisites: Introductory Fluid Mechanics

This course teaches fundamental additive manufacturing, 3D printing approaches, including extrusion-based deposition, stereolithography, powder bed-based melting, and inkjet-based deposition. Cultivate a design for-additive manufacturing skillset for CAD and CAM methodologies to produce successful 3D prints.

MECE4080 Feedback Control Systems

3 credits

Pre-requisites: System Dynamics and Control

This course covers the analysis and design of linear systems in both the frequency and time domains. The course includes a laboratory that examines the modeling and control of representative dynamic processes. The frequency domain aspects are analyzed via Laplace transforms, transfer functions, root locus, and frequency response methods. The time domain aspects are analyzed via state space models, stability, controllability, observability, state feedback, and observers.

MECE3110 Wind Power

3 credits

Pre-requisites: Introductory Fluid Mechanics

This course covers the main features of energy conversion by wind turbines. Emphasis on the characterization of the atmospheric boundary layer, the aerodynamics of horizontal axis wind turbines, and performance prediction. Structural effects, power train considerations, siting, and wind farm planning.

MECE4090 Sustainable Energy Systems

3 credits

Pre-requisites: Introductory Fluid Mechanics, Heat transfer

This course critically examines the technology of energy systems that will be acceptable in a world faced with global climate change, local pollution, and declining supplies of oil. The focus is on renewable energy sources (wind, solar, biomass), but other non-carbon-emitting sources (nuclear) and lowered-carbon sources (co-generative gas turbine plants, fuel cells) also are studied. Both the devices and the overall systems are analyzed.

MECE4100 Combustion Processes

3 credits

Pre-requisites: Introductory Fluid Mechanics, Heat transfer

This course gives an introduction to combustion and flame processes, with emphasis on fundamental fluid dynamics, heat and mass transport, and reaction-kinetic processes that govern combustion rates. Topics include thermochemistry, kinetics, vessel explosions, laminar premixed and diffusion flames, and droplet combustion. Optional topics may include complex combustion systems, turbulent flames, fuel cells, or combustion of solids.

MECE4110 Design of Sustainable Systems

3 Credits

Pre-requisites:

This course will focus on the analysis, design, and production of renewable energy (solar, wind, nuclear, hydro, and geothermal, etc.) systems, with a focus on understanding the critical material challenges as well as the design and manufacturing challenges of sustainable energy systems.

MECE4120 Sensors and Actuators

4 credits

Pre-requisites: Intelligent Physical Systems

This course aims to provide students with in-depth knowledge of sensors and actuators through the technologies, future advances, and their applications. Students will learn about instrumenting an engineering system by incorporating sensors, actuators, and associated interface hardware. This course treats the types of sensors, actuators, and interface hardware in separate chapters in which the operating principles, modeling, design considerations and integration, performance specifications, and applications of the individual components are discussed. Throughout the course, students are engaged with case studies, work examples, and exercises related to robotic manipulators, industrial machinery, vehicles, aircraft, thermal and fluid process plants, and computer components.

ELEC4020 Embedded Systems

4 credits

Pre-requisites: Digital Logic and Computer Organization

This course provides an introduction to the design of embedded systems, with an emphasis on understanding the interaction between hardware, software, and the physical world. Topics covered include assembly language programming, interrupts, I/O, concurrency management, scheduling, resource management, and real-time constraints.

ELEC4060 Robotics and Automation

4 credits

Pre-requisites: Control Systems

This course introduces fundamental concepts in robotics and applications. Topics include basics of manipulators, coordinate transformation and kinematics, trajectory planning, control techniques, sensors and devices, robot applications in industrial automation.

MECE3870 Practice/Internship

Pre-requisites: Students must have completed sophomore year.

The professional structured internship offers students opportunities to apply theoretical knowledge to a real-world work environment and know more about

companies that students may be interested in joining after graduation. During the internship, students will have the opportunity to discover and/or confirm their career interests, develop their major knowledge and gain valuable professional skills and connections with industry professionals. Students will complete the program under the guidance and support of a company advisor or Principal Investigator (PI), an industry mentor/ project researcher, and a faculty advisor, who will jointly help students to create SMART learning outcomes (specific, measurable, achievable, relevant and time-bound).

MECE4890 Graduation Thesis/Capstone

6 credits

Pre-requisites: Practice/Internship; Determined by the advisor

This Capstone course is developed for students in the College of Engineering and Computer Science (CECS) to apply technical knowledge and skills acquired in earlier coursework to a project involving actual designs and experiments. Students are strongly encouraged to work on multidiscipline-major topics to produce an end-to-end solution to a complex real-world problem from industry or academia. The assessment methods are formulated from discussions and agreements between the industry and VinUni in accordance with ABET requirements. More specially, the project involves the development of engineering systems or design alternatives, along with testing the implemented systems. The project should focus on advanced technologies, new applications, and their usefulness and benefits in the development of economy and management. In this course, students work in teams of 3 to 5, with at least one student from the Mechanical Engineering (ME) Program and one from the Electrical Engineering (EE) Program, under the supervision of VinUni faculty instructors. Students are enrolled in Capstone I in the first semester to develop or tailor a project proposal and secure instructor approval. In the following semester, they must take Capstone II to complete the project. Students are expected to be present in person for every meeting of the classes in which they are enrolled. They should be able to deliver their work and contribution to the project and engage in professional dialogues about their project during formal presentations.