German Jordanian University

School of Applied Technical Sciences
Department of Mechatronics Engineering
Bachelor of Science in Mechatronics Engineering

Dual Study Plan 2024

I. Program Objectives

Mechatronics Engineering program emphasizes the application of technologies and tools in the short term, and the ability to discover, acquire, and adapt new knowledge and skills in the long term, such that our graduates are prepared to:

a. Pursue a successful professional career in local, German, and international markets or higher studies in the different fields of Mechatronics Engineering.
b. Provide students with a strong foundation in the fundamentals of Mechanical, Electrical, and Computer Engineering and their integration in state of art technologies.
c. Define, design, model, analyze, test, and incorporate principles of Mechatronics and systems engineering.
d. Employ mathematical, computational, and experimental techniques, and interpersonal and critical thinking skills in solving practical problems in the diverse fields of Mechatronics and multidisciplinary Systems Engineering.
e. lead/manage design, development of strong practical experience obtained through solid hands-on learning methodologies.
f. Communicate effectively and function in various multidisciplinary and culturally diverse teams and engage in life-long learning and professional development.
g. Understand the ethical, cultural, and environmental considerations of the Mechatronics Engineering.

II. Learning Outcomes

The B.Sc. program in Mechatronics Engineering provides students with an understanding of fundamental Mechatronics and Artificial Intelligence Engineering concepts, methodologies, and technologies as demonstrated by the following program learning outcomes (PLOs) and their associated key performance indicators (KPIs):

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

Key Performance Indicator (KPI)	**Level**
PLO 1.1. Understanding complex engineering problems	Knowledge
PLO 1.2. Formulating complex engineering problems by transferring and applying principles of engineering, science, and mathematics	Competencies
PLO 1.3. Practicing principles of engineering, science, and mathematics to solve complex engineering problems	Skills

PLO 2. The 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

Key Performance Indicator (KPI)	**Level**
PLO 2.1. Understanding engineering design requirements, strategy, constraints considering public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Knowledge
PLO 2.2. Practicing engineering processes to develop and evaluate feasible solutions against specifications/ requirements with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Skills

PLO 3. The ability to communicate effectively with a range of audiences

Key Performance Indicator (KPI)	Level
PLO 3.1. Taking responsibility for composing and constructing clear and professional content, reports and graphical communication documents	Competencies
PLO 3.2. Taking responsibility for developing and composing clear and professional presentations/views to a range of audience	Competencies

PLO 4. The 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

Key Performance Indicator (KPI)	Level
PLO 4.1. Understanding ethical and professional responsibilities in engineering situations	Knowledge
PLO 4.2. Analyzing the impact of engineering solutions in global, economic, environmental, and societal contexts	Skills

PLO 5. The 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

Key Performance Indicator (KPI)	Level
PLO 5.1. Taking responsibility for group work and working effectively to establish goals and plan tasks to meet the objectives of the team	Competencies
PLO 5.2. Organizing the works of a team in collaborative and inclusive environment and the execution of plans to meet objectives of the team	Skills

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

Key Performance Indicator (KPI)	Level
PLO 6.1. Managing the procedure of an experiment	Competencies
PLO 6.2. Analyzing data collected from an experiment to draw conclusions about the experiment's outcomes	Skills

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

Key Performance Indicator (KPI)	Level
PLO 7.1. Describing new knowledge using appropriate learning strategies	Knowledge
PLO 7.2. Practicing new knowledge using appropriate learning strategies	Skills

Course Delivery Methods

Courses are in one of the following three methods:

- **Face-to-Face (F2F) Method**
  Courses that are taught through face-to-face learning and are delivered at the university campus.
- **Blended (BLD) Method**
  Courses in which teaching consists of face-to-face learning and asynchronous E-learning. The face-to-face learning takes place at the university campus. Asynchronous E-learning takes place through activities, tasks, educational duties, and assignments through the virtual E-learning platforms (Moodle and MyGJU) without direct meetings with course instructors.
- **Online (OL) Method**
  Courses in which teaching consists of synchronous E-learning and asynchronous E-learning. Synchronous E-learning takes place through interactive virtual meetings between instructors and students directly through the virtual E-learning platform (MS Teams). The asynchronous E-learning takes place through activities, tasks, educational duties, and assignments through the virtual E-learning platforms (Moodle and MyGJU) without direct meetings with course instructors.

III. Admission Requirements

To apply for admission, the following minimum requirements must be met:

a. A minimum GPA of 80% in the National High School Certificate or equivalent.
b. Sitting university placement tests.
c. Sitting for the German Language Intensive course offered by the university.

Placement Tests

Applicants must sit for placement tests in the Arabic Language, the English Language, and Mathematics to determine whether the applicant may be required to take remedial courses in the mentioned subjects. Depending on or the applicant scores in the placement tests, some of the following 3-credit-hour remedial courses are required:

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
ARB0099	Elementary Arabic	3	3	3	-	OL	Placement test
ENGL0098	Elementary English	3	3	3	-	F2F	Placement test
ENGL0099	Intermediate English	3	3	3	-	F2F	ENGL0098
MATH0099	Pre-Math	3	3	3	-	OL	Placement test
	Total	**12**	**12**	**12**	**0**		

- Remedial courses are to be completed and passed within the first year of enrollment.
- Passing grade of remedial courses is 60%.
- ECTS (B.Sc.): is the European Credit Transfer System, and Accumulation System, One ECTS is equivalent to 30 actual workloads hours.

IV. Degree Requirements

The requirements to obtain a B.Sc. degree in Mechatronics Engineering are the following:

a. A total of 166 credit hours of compulsory and elective courses, and practical training.
b. A minimum of 12 credit hours of elective courses are to be taken at a partner university in Germany.
c. A minimum of 20-week of International Internship at a company in Germany.
d. A minimum of 9 credit hours in one of the main tracks (Applied Artificial Intelligence Track and Robotics and Autonomous Systems Track)

V. Framework for B.Sc. Degree (Credit hours)

Classification		Credit Hours			ECTS		
		Compulsory	Elective	Total	Compulsory	Elective	Total
University Requirements	Compulsory	21	-	21	25	-	25
	Dual Study	6	-	6	12	-	12
School Requirements		46	-	46	79	-	79
Program Requirements		81	12	93	164	20	184
Total		**154**	**12**	**166**	**280**	**20**	**300**

Course Delivery Method	Credit Hours	Percentage
Online Courses	18	10%
Blended Courses	56	35%
Face-to-Face Courses	92	55%
Total	**166**	**100%**

1. University Requirements: (27 credit hours)

1.1. Compulsory: (21 credit hours)

Course ID	Course Name		Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
					Lect.	Prac.		
ARB100	Arabic		3	3	3	-	OL	ARB0099
ENGL1001	Upper-Intermediate English		3	3	3	-	F2F	ENGL0099
ENGL1002	Advanced English		3	3	3	-	F2F	ENGL1001
GERL101B1	German I B1-Track		3	6	9	-	F2F	-
GERL102B1	German II	B1-Track	3	6	9	-	F2F	GERL101B1
GERL102B2		B2-Track						
MILS100	Military Science		3	2	3	-	OL	-
NE101	National Education		3	2	3	-	OL	-
NEE101	National Education in English							
		Total	**21**	**25**	**33**	**0**		

1.2. Dual Study: (6 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours	Type	Prerequisites / Corequisites
				Prac.		
DS101	Dual Study Practical I	3	3	12 weeks	F2F	-
DS201	Dual Study Practical II	3	3	12 weeks	F2F	ARB0099,ENGL0099, DS101
DS301	Dual Study Practical III	0	6	12 weeks	F2F	DS201
	Total	**6**	**12**			

2. School Requirements: (46 credit hours)

Course ID	Course Name		Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
					Lect.	Prac.		
IE0121	Probability and Statistics		3	5	3	-	F2F	MATH101
IE0141	Engineering Workshop		1	4	-	3	BLD	-
IE0281-DS	Technical Writing and Engineering Ethics		2	3	2	-	F2F	ENGL1001
IE0361-DS	Engineering Economics		3	5	3	-	OL	IE0121
ME0111-DS	Computer Aided Engineering Drawing		2	4	-	6	BLD	CS116
MECH2102	Statics and Strength		3	5	3	-	BLD	PHYS103, MATH102
CHEM103	General Chemistry		3	5	3	-	F2F	-
CS116	Computing Fundamentals		3	6	3	-	F2F	-
CS1160	Computing Fundamentals Lab		1	0	-	3	BLD	CS116[co]
GERL201B1	German III	B1-Track	3	4	6	-	F2F	ARB0099,ENGL0099, GERL102B1 or GERL102B2
GERL201B2		B2-Track						GERL102B2
GERL202B1	German IV	B1-Track	3	6	9	-	F2F	ARB0099,ENGL0099, GERL201B1 or GERL201B2
GERL202B2		B2-Track						GERL201B2
MATH101	Calculus I		3	5	3	-	BLD	MATH0099
MATH102	Calculus II		3	5	3	-	F2F	MATH101
MATH203	Applied Mathematics for Engineers		3	5	3	-	F2F	ARB0099,ENGL0099, MATH102
MATH205	Differential Equations		3	5	3	-	F2F	ARB0099,ENGL0099, MATH102
PHYS103	Physics I		3	5	3	-	BLD	-
PHYS104	Physics II		3	5	3	-	F2F	PHYS103
PHYS106	General Physics Lab		1	2	-	3	BLD	PHYS103, PHYS104[co]
		Total	**46**	**79**	**50**	**15**		

3. Program Requirements (93 credit hours)

3.1. Program Requirements (Compulsory): (81 credit hours)

3.1.1. Program Requirements (Common): (72 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
ME0214	Electronics for mechatronics	3	5	3	-	F2F	ARB0099,ENGL0099, ENE211
ME0224	Computer Aided MATH for ME	2	5	-	6	BLD	ARB0099,ENGL0099, MATH102, CS116
ME0312	Microcontrollers and IoT	4	6	3	3	BLD	CE212

F2F: Face-to-face BLD: Blended OL: Online co: Corequisite

ME3401	Control Systems		3	5	3	-	F2F	MECH2104, MATH205, ENE211, ME0224
ME0345	Control and Vibration Lab		1	2	-	3	BLD	ME3401
ME3601	Sensors and Signals		3	5	3	-	BLD	ENE211, MATH205
ME0354	Actuators		3	5	3	-	F2F	ENE213, ME3601
ME0355	Sensors and Actuators Lab		1	0	-	3	BLD	ME3601, ME0354 [co]
ME0491	International Internship[a]		12	30	20 weeks		F2F	Dept. Approval
ME0522	Hydraulics and Pneumatics		3	4	2	3	BLD	ME3401
ME5701	Applied Artificial Intelligence and Machine Learning		3	5	3	-	F2F	ME3401, ME3601
ME5501	Robotics Modeling and Control		3	5	3	-	BLD	ME3401
ME0561	Mechatronics Systems Design and Interfacing		3	10	2	3	BLD	ME0312, ME3401, ME0354
ME0577	Automation and Industry 4.0		3	7	2	3	BLD	ME3401
ME0591	Graduation Project I		1	4	-	3	BLD	ME0491, MIN 132CrHr
ME0592	Graduation Project II		3	6	-	9	BLD	ME0591
MECH2104	Dynamics		3	5	3	-	BLD	ARB0099,ENGL0099, MECH2102
CE212	Digital Systems		3	5	3	-	F2F	ARB0099,ENGL0099
CE2120	Digital Systems lab		1	4	-	3	BLD	ARB0099,ENGL0099, CE212 [co]
ENE211	Electrical Circuits I		3	5	3	-	F2F	ARB0099,ENGL0099, PHYS104
ENE213	Electrical Circuits Lab		1	2	-	3	BLD	ARB0099,ENGL0099, ENE211
ENE312	Power Electronics		3	5	3	-	BLD	ME0214
ENE314	Power Electronics Lab		1	2	-	3	BLD	ENE312
GERL301B1	German V	B1-Track	3	6	9	-	F2F	GERL202B1 or GERL202B2
GERL301B2		B2-Track						GERL202B2
GERL302B1	German VI	B1-Track	3	6	6	-	F2F	GERL301B1 or GERL301B2
GERL302B2		B2-Track						GERL301B2
		Total	**72**	**144**	**54**	**45**		

3.1.2. Program Requirements (Applied Artificial Intelligence Track): (9 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
ME5702	Computer Vision and Deep Learning	3	7	3	-	F2F	ME5701
ME5703	Intelligent Control and Reinforcement Learning	3	6	3	-	F2F	ME3401, ME5701
ME5704	Advanced Topics in Artificial Intelligence and Machine Learning	3	7	3	-	BLD	ME5701
	Total	**9**	**20**	**9**	**0**		

3.1.3. Program Requirements (Robotics and Autonomous Systems Track): (9 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
ME5502	Design of Digital Control Systems	3	6	3	-	F2F	ME3401
ME5503	Autonomous Mobile Robots	3	7	3	-	F2F	ME5501
ME5504	Artificial Intelligence in Robots	3	7	3	-	BLD	ME5701, ME5501
	Total	**9**	**20**	**9**	**0**		

[a] The International Internship is prerequisite to all elective courses if registered in Jordan.

3.2. Program Requirements (Electives[b]): (12 credit hours)

A minimum of 12 credit hours of coursework are required. This list is open for modifications based on school council decisions.

For any certain track, compulsory courses from other tracks are considered as electives for that certain track:

- Courses from Robotics and Autonomous Systems Track are considered elective courses for Applied Artificial Intelligence Track.
- Courses from Applied Artificial Intelligence Track are considered elective courses for Robotics and Autonomous Systems Track.

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
ME0402	Advanced Electronics	3	5	3	-	F2F	BSC001
ME0403	Real-Time Computer Control Systems	3	5	3	-	F2F	BSC001
ME0404	Digital Control Systems	3	5	3	-	F2F	BSC001
ME0405	Process Control	3	5	3	-	F2F	BSC001
ME0406	CNC and Manufacturing Control	3	5	3	-	F2F	BSC001
ME0407	Linear Systems	3	5	3	-	F2F	BSC001
ME0408	Mobile Robots	3	5	3	-	F2F	BSC001
ME0409	Autonomous Systems	3	5	3	-	F2F	BSC001
ME0410	Process Automation	3	5	3	-	F2F	BSC001
ME0411	Industrial Robotics	3	5	3	-	F2F	BSC001
ME0412	Mechatronics of Smart Materials	3	5	3	-	F2F	BSC001
ME0413	Mechatronics Projects	3	5	3	-	F2F	BSC001
ME0415	Smart Sensors	3	5	3	-	F2F	BSC001
ME0417	Micro-Electromechanical Systems	3	5	3	-	F2F	BSC001
ME0418	Nano Systems	3	5	3	-	F2F	BSC001
ME0419	Autotronics	3	5	3	-	F2F	BSC001
ME0420	Special Topics in Electrical and Electronics Engineering	3	5	3	-	F2F	BSC001
ME0421	Special Topics in Control Engineering	3	5	3	-	F2F	BSC001
ME0422	Special Topics in Robotics and Automation	3	5	3	-	F2F	BSC001
ME0423	Special Topics in Computer and Digital Sciences	3	5	3	-	F2F	BSC001
ME0424	Special Topics in Mechatronics Technology	3	5	3	-	F2F	BSC001
ME0425	Special Topics I	1	-	1	-	F2F	BSC001

ME0426	Special Topics II	2	-	2	-	F2F	BSC001
IE0344	Manufacturing Processes	4	6	3	3	F2F	BSC001
MECH0332	Machine Design	3	5	3	-	F2F	BSC001
MECH0402	Multi-Body Dynamics	3	5	3	-	F2F	BSC001
MECH0403	Machine Dynamics	3	5	3	-	F2F	BSC001
MECH0531	Mechanical Vibrations	3	5	3	-	F2F	BSC001
CE441	Embedded System Design	3	5	3	-	F2F	BSC001
CE461	Image Processing	3	5	3	-	F2F	BSC001

[b] All Elective courses to be taken at partner university in Germany

Study Plan[c] Guide for a B.Sc. Degree in Mechatronics Engineering (Dual Study)

First Year							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
CHEM103	General Chemistry	3	5	3	-	F2F	-
CS116	Computing Fundamentals	3	6	3	-	F2F	
ENGL1001	Upper-Intermediate English	3	3	3	-	F2F	ENGL0099
GERL101B1	German I B1-Track	3	6	9	-	F2F	-
MATH101	Calculus I	3	5	3	-	BLD	MATH099
PHYS103	Physics I	3	5	3	-	BLD	
	Total	**18**	**30**	**24**	**0**		

First Year							
Second Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
CS1160	Computing Fundamentals Lab	1	0	-	3	BLD	CS116 [co]
IE0121	Probability and Statistics	3	5	3	-	F2F	MATH101
ENGL1002	Advanced English	3	3	3	-	F2F	ENGL1001
GERL102B1	German II B1-Track	3	6	9	-	F2F	GERL101B1
GERL102B2	German II B2-Track						
MATH102	Calculus II	3	5	3	-	F2F	MATH101
PHYS104	Physics II	3	5	3	-	F2F	PHYS103
PHYS106	General Physics Lab	1	2	-	3	BLD	PHYS103, PHYS104[co]
	Total	**17**	**26**	**21**	**6**		

First Year						
Summer Semester						
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**	**Type**	**Prerequisites / Corequisites**
				Prac.		
DS101	Dual Study Practical I	3	3	12 weeks	F2F	-
ME0111-DS	Computer Aided Engineering Drawing	2	4	6	BLD	CS116
	Total	**5**	**7**			

[c] The following study plan guide does not take into account possible remedial courses.

F2F: Face-to-face BLD: Blended OL: Online co: Corequisite

Second Year								
First Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
MECH2102	Statics and Strength		3	5	3	-	BLD	ARB0099,ENGL0099, PHYS103, MATH102
CE212	Digital Systems		3	5	3	-	F2F	ARB0099,ENGL0099,
CE2120	Digital Systems Lab		1	4	-	3	BLD	ARB0099,ENGL0099, CE212^{co}
ENE211	Electrical Circuits I		3	5	3	-	F2F	ARB0099,ENGL0099, PHYS104
GERL201B1	German III	B1-Track	3	4	6	-	F2F	ARB0099,ENGL0099, GERL102B1 or GERL102B2
GERL201B2		B2-Track						ARB0099,ENGL0099, GERL102B2
MATH205	Differential Equations		3	5	3	-	F2F	ARB0099,ENGL0099, MATH102
		Total	**16**	**28**	**18**	**3**		

Second Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
ME0214	Electronics for Mechatronics		3	5	3	-	F2F	ARB0099,ENGL0099, ENE211
ME0224	Computer Aided MATH for ME		2	5	-	6	BLD	ARB0099,ENGL0099, MATH102, CS116
MECH2104	Dynamics		3	5	3	-	BLD	ARB0099,ENGL0099, MECH2102
ENE213	Electrical Circuits I Lab		1	2	-	3	BLD	ARB0099,ENGL0099, ENE211
GERL202B1	German IV	B1-Track	3	6	9	-	F2F	ARB0099,ENGL0099, GERL201B1 or GERL201B2
GERL202B2		B2-Track						ARB0099,ENGL0099, GERL201B2
MATH203	Applied Math for Engineers		3	5	3	-	F2F	ARB0099,ENGL0099, MATH102
		Total	**15**	**28**	**18**	**9**		

Second Year							
Summer Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**	**Type**	**Prerequisites / Corequisites**	
				Prac.			
DS201	Dual Study Practical II	3	3	12 weeks	F2F	ARB0099,ENGL0099, DS101	
IE0281-DS	Technical Writing and Engineering Ethics	2	3	2	F2F	ENGL1001	
	Total	**5**	**6**				

F2F: Face-to-face BLD: Blended OL: Online co: Corequisite

Third Year								
First Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
ME0312	Microcontrollers and IoT		4	6	3	3	BLD	CE212
ENE312	Power Electronics		3	5	3	-	BLD	ME0214
ME3401	Control Systems		3	5	3	-	F2F	MECH2104, MATH205, ENE211, ME0224
ME3601	Sensors and Signals		3	5	3	-	BLD	ENE211, MATH205
GERL301B1	German V	B1-Track	3	6	9	-	F2F	GERL202B1 or GERL202B2
GERL301B2		B2-Track						GERL202B2
		Total	**16**	**27**	**21**	**3**		

Third Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
ME0345	Control and Vibration Lab		1	2	-	3	BLD	ME3401
ME0354	Actuators		3	5	3	-	F2F	ENE213, ME3601
ME0522	Hydraulics and Pneumatics		3	4	2	3	BLD	ME3401
ME0355	Sensors and Actuators Lab		1	0	-	3	BLD	ME3601, ME0354 co
ME5701	Applied Artificial Intelligence and Machine Learning		3	5	3	-	F2F	ME3401, ME3601
ENE314	Power Electronics Lab		1	2	-	3	BLD	ENE312
GERL302B1	German VI	B1-Track	3	6	6	-	F2F	GERL301B1 or GERL301B2
GERL302B2		B2-Track						GERL301B2
ARB100	Arabic		3	3	3	-	OL	ARB099
		Total	**18**	**27**	**17**	**12**		

Third Year						
Summer Semester						
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**	**Type**	**Prerequisites / Corequisites**
				Prac.		
DS301	Dual Study Practical III	0	6	12 weeks	F2F	DS201
IE0361-DS	Engineering Economics	3	5	3	OL	IE0121
	Total	**3**	**11**			

F2F: Face-to-face BLD: Blended OL: Online co: Corequisite

Fourth Year							
First Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
-	Technical Elective	3	5	3		-	-
-	Technical Elective	3	5	3		-	-
-	Technical Elective	3	5	3		-	-
-	Technical Elective	3	5	3		-	-
ME5501	Robotics Modeling and Control	3	5	3	-	BLD	ME3401
	Total	**15**	**25**	**15**	**0**		

Fourth Year							
Second Semester							
Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
ME0491	International Internship[d]	12	30	20 weeks		-	DEP. APPROV
	Total	**12**	**30**	**0**	**0**		

Prerequisite courses for the German year

Passing four out of the five following courses:

- ME3401 Control Systems
- ME0354 Actuators
- ME0214 Electronics for Mechatronics
- ME0312 Microcontrollers and IoT

[d] Courses attended and/or passed during International Internship are not transferable

Fifth Year (Applied Artificial Intelligence Track)							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
ME5704	Advanced Topics in Artificial Intelligence and Machine Learning	3	7	3	-	BLD	ME5701
ME0577	Automation and Industry 4.0	3	7	2	3	BLD	ME3401
ME0591	Graduation Project I	1	4	-	3	BLD	ME0491, MIN 132CH
NE101	National Education	3	2	3	-	OL	-
NEE101	National Education in English						
IE0141	Engineering Workshop	1	4	-	3	BLD	
ME5703	Intelligent Control and Reinforcement Learning	3	6	3	-	F2F	ME3401, ME5701
	Total	**14**	**30**	**11**	**9**		

Fifth Year (Applied Artificial Intelligence Track)							
Second Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
ME0561	Mechatronics Systems Design and Interfacing	3	10	2	3	BLD	ME0312, ME3401, ME0354
ME5702	Computer Vision and Deep Learning	3	7	3	-	F2F	ME5701
ME0592	Graduation Project II	3	6	-	9	BLD	ME0591
MILS100	Military Science	3	2	3	-	OL	-
	Total	**12**	**25**	**8**	**12**		

Fifth Year (Robotics and Autonomous Systems Track)							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
ME5504	Artificial Intelligence in Robots	3	7	3	-	BLD	ME5701, ME5501
ME0577	Automation and Industry 4.0	3	7	2	3	BLD	ME3401
ME0591	Graduation Project I	1	4	-	3	BLD	ME0491, MIN 132CH
NE101	National Education	3	2	3	-	OL	-
NEE101	National Education in English						
IE0141	Engineering Workshop	1	4	-	3	BLD	
ME5502	Design of Digital Control Systems	3	6	3	-	F2F	ME3401
	Total	**14**	**30**	**11**	**9**		

Fifth Year (Robotics and Autonomous Systems Track)							
Second Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
ME0561	Mechatronics Systems Design and Interfacing	3	10	2	3	BLD	ME0312, ME3401, ME0354
ME5503	Autonomous Mobile Robots	3	7	3	-	F2F	ME5501
ME0592	Graduation Project II	3	6	-	9	BLD	ME0591
MILS100	Military Science	3	2	3	-	OL	-
	Total	**12**	**25**	**8**	**12**		

VI. Compulsory Courses Offered by Mechatronics Department

ME0111-DS Computer Aided Engineering Drawing **2 Cr Hr (0,6)** **4 ECTS**

The use of computer aided software in drawing such as AutoCAD. Geometric construction. Orthographic and Isometric projections; Sketching, sectioning, dimensioning and layering. Model layout (wire-frame, surface, and solid modeling), plotting to scale, blocks and attributes, Introduction to descriptive geometry, perspective drawing, engineering applications.

Prerequisites: CS116

ME0214 Electronics for Mechatronics **3 Cr Hr (3,0)** **5 ECTS**

Introduction to (semiconductor) electronic devices. Semiconductor p-n junction, the transistor. Analysis and synthesis of linear and nonlinear electronic circuits containing diodes and transistors. Elementary analog circuit analysis. Fundamentals of transistors and voltage amplification. Characterization of MOS transistors for circuit simulation. Common-source amplifiers, MOSFET source-follower buffer stage, differential amplifier stage, and MOSFET current sources. Operational amplifiers. Development of a Basic CMOS Operational amplifier.

Prerequisites: ARB0099, ENGL0099, ENE211

ME0224 Computer Aided MATH for ME **2 Cr Hr (0,6)** **5 ECTS**

Introduction to Matlab/Simulink, introduction to LabVIEW, introduction to Python with engineering applications including practical exercises. Application of these software packages to engineering problems such as command line programming, numerical methods, data acquisition, data analysis and visualization and system simulation. Applications of numerical methods to solve linear and nonlinear systems of equations, ordinary differential equations, function reconstruction and curve fitting, and numerical integration and differentiation.

Prerequisites: ARB0099, ENGL0099, MATH102, CS116

ME0312 Microcontrollers and IoT **4 Cr Hr (3,3)** **6 ECTS**

Embedded systems characteristics. Microprocessors versus micro-controllers. Micro-controller characteristics. General-purpose micro-controllers. Interrupts, counters/timers, Input/output ports. Micro-controller programming. Instruction set. Program development and use of assemblers. Memory maps and addressing modes. Digital to analogue and analogue to digital conversion in micro controllers. Data acquisition and distribution. Serial and parallel communications. Real-time system and its constraints. Interfacing to external devices. Power consumption consideration. Introduction to the Internet of Things (IoT); IoT concepts, IOT hardware and software, IOT communication and networking protocols, as well as the integration with embedded systems in networked control systems. Experiments using both simulation and practical implementation of the basic building blocks of a micro-controller including timers, counters, PWM generation, I/O techniques and requirements, A/D conversion, and serial communications. Experiments to explore the system design process using the hardware-software co design process as well as the use of IOT in control and communication networks

Prerequisites: CE212

ME3401 Control Systems **3 Cr Hr (3,0)** **5 ECTS**

Modeling of dynamic systems, linearization of nonlinear systems, transient response, transfer function, block diagrams, steady state error and stability, root locus, PID control, lead, lag, and lead-lag control, Bode plots, and Nyquist stability criterion.

Prerequisites: MECH2104, MATH205, ENE211, ME0224

ME0345 Control and Vibration Lab **1 Cr Hr (0,3)** **2 ECTS**

Free vibration of simple mass-spring systems, free damped response of simple mass-spring-damper systems, static and dynamic balancing, harmonically excited systems, frequency response of the harmonically excited

systems, frequency response with base excitation, introduction to Control, mass spring-damper system simulation, PID Controllers, simple and inverted pendulum control, fluid level and temperature control, servo systems, and twin rotor control.

Prerequisites: ME3401

ME3601 Sensors and Signals **3 Cr Hr (3,0)** **5 ECTS**

Introduction to instrumentation, units, dimensions and standards. Detailed analysis for error in measurements and statistical analysis of experimental data. The use of Op-Amp circuits in instrumentation. Introduction to sampled data analysis, data acquisition techniques, digital to analogue and analogue to digital conversion. mathematical analysis for processing continuous and discrete time signals in both time and frequency domains. Fourier transforms for continuous and discrete time signals, sampling, and Laplace transforms. Overview of sensors and transducers including physical principles, technical characteristics, application scenarios. Integration of sensors into PLC, LABVIEW and computer-based solutions including processing and monitoring techniques with emphasis on practical/industrial applications.

Prerequisites: ENE211, MATH205

ME0354 Actuators **3 Cr Hr (3,0)** **5 ECTS**

DC and AC Electromechanical Actuators. Principles for Electromagnetic actuating circuits, Torque production, and Energy conversion. Conventional DC motors including Brushed/Brushless DC Motors, DC Servo Motors and Stepper Motors. DC Motor drives including power amplifiers and PWM amplifiers for position-controlled actuators. AC Motors including synchronous and induction motors: analysis, performance characteristics, and applications. Overview of AC Motor Drives and Speed Control. Interfacing actuators to computer-based controllers including PLC and LABVIEW.

Prerequisites: ME3601

ME0355 Sensors and Actuators Lab **1 Cr Hr (0,3)** **0 ECTS**

Measurements with different micrometers & Vernier measuring instruments, angular measurements, roundness & concentricity of cylindrical work pieces, tool maker's microscope, optical projectors, surface measurements. Analysis of experimental data and error estimation. Basic electrical measurement and sensing devices: physics of electric, magnetic, chemical sensors, displacement, area, pressure, flow, temperature, thermal and transport properties, force, torque and strain measurements. Smart sensors and networking of sensor systems. Data acquisition and processing. Transformer characteristics. Experiments for interfacing sensors and actuators with computer-based solutions. Testing and operational characteristics of different types of DC motors. Testing and operational characteristics of alternators. Testing and operational characteristics of induction motors. Modeling and simulation of electrical machines using Simulink with external mechanical loads.

Prerequisites: ME3601
Corequisites: ME0354

ME0491 International Internship **12 Cr Hr (3,0)** **30 ECTS**

Twenty-weeks of internship at a company in Germany.

Prerequisites: Dept. Approval

ME0522 Hydraulics and Pneumatics **3 Cr Hr (2,3)** **4 ECTS**

Pneumatic and hydraulic components; compressor, cooler, compressed-air containers, filters, valves, pumps, piping system basic circuits in pneumatics and hydraulics, design and simulation of pneumatic and hydraulic circuits, servo pneumatics and servo hydraulics, basics of servo drives, assembling, measuring techniques.

Prerequisites: ME3401

ME5501 Robotics Modeling and Control **3 Cr Hr (3,0)** **5 ECTS**

Introduction and overview of types and basic components of industrial manipulators, coordinate frames, Planar and spatial transformations, forward and inverse kinematics, trajectory planning, Jacobians and singularities, robot dynamics, force and torques transformations, robot control (linear, nonlinear, and force control), Robot control architectures. Types of sensors used in robotics, such as vision, LiDAR, introduction to mobile robots. Programming using MATLAB Robotics Toolbox and popular robotics frameworks such as ROS.

Prerequisites: ME3401

ME0561 Mechatronics Systems Design and Interfacing **3 Cr Hr (2,3)** **10 ECTS**

Design and planning of the system, purchase (virtual) of different components, sensors and actuator units, machine parts, devices, electric, mechanical, pneumatic, hydraulic components, PLC and control units, assembly, commissioning, interfacing, software and programming, calibration, standard checks, test operation, troubleshooting, documentation, service and maintenance, safety, cost, delivery and disassembly and packing. Course to include communication protocols USB, I2C, Serial, etc…

Prerequisites: ME0312, ME3401, ME0354

ME0577 Automation and Industry 4.0 **3 Cr Hr (2,3)** **7 ECTS**

Introduction to production concepts, serial production lines, assembly systems and types of automation. Programmable Logic Controllers (PLC); Theoretical and applied material, including: application and hardware composition of programmable logic controllers; functional programming blocks such as logic gates including AND, OR etc. as well as latches, timers, counters, and analog blocks; design approaches based on Boolean and structured logic, state machines, flowcharts; programming methodologies including: ladder diagrams, blocks and text-based. Concepts and definitions for Industry 4.0 approaches, Industry 4.0 and the Future of Production. Smart Factory Architecture and overview of Smart Production Systems and Integrated production technology. Enabling technologies for Industry 4.0. Industrial Internet of Things (IIoT) for production systems. The class will address challenges of security and vulnerability, authentication and authorization, data/device security and cloud computing.

Prerequisites: ME3401

ME0573 Applied Artificial Intelligence and Machine Learning **3 Cr Hr (3,0)** **5 ECTS**

Introduction to artificial intelligence (AI) and focus on the application of state-of the-art machine learning (ML) algorithms for solving real-world engineering problems. The covered topics include data preparation, training, evaluation, performance metrics, supervised learning (regression, classification, neural networks, deep learning, convolutional neural networks, and recurrent neural networks), basics of unsupervised and reinforcement learning, and recommender systems.

Prerequisites: ME3401, ME3601

ME5702 Computer Vision and Deep Learning **3 Cr Hr (3,0)** **7 ECTS**

The course introduces computer vision including fundamentals of image formation, camera imaging geometry, feature detection and matching, image segmentation, stereo, motion estimation and tracking,

video processing, image classification and scene understanding. In-depth discussion for the use of deep learning algorithms for modern computer vision application including the use of convolutional, recurrent, and self-attention networks for classification and localization tasks in intelligent mechatronic systems.

Prerequisites: ME5701

ME5703 Intelligent Control and Reinforcement Learning **3 Cr Hr (3,0)** **6 ECTS**

Introduction to intelligent control methods and their application to the monitoring and control of uncertain, complex dynamical systems. Applications of Neural control systems, fuzzy control systems, and fault diagnosis are presented. The course also provides in-depth discussion for prediction and control using reinforcement learning, including aspects of deep reinforcement learning, i.e., the application of neural networks-based functional approximation to reinforcement learning and control problems. The course covers theory and applications related to the following topics: Markov decision processes. Value function approximation. Policy gradient methods, Actor-critic algorithms. Integration of Learning and Planning. Exploration vs exploitation trade-offs.

Prerequisites: ME3401, ME5701

ME5704 Advanced Topics in Artificial Intelligence and Machine Learning **3 Cr Hr (3,0)** **7 ECTS**

The course covers classical and modern techniques for solving problems in artificial intelligence and machine learning beyond traditional supervised learning, including fitting statistical models, dimensionality reduction, clustering, anomaly detection, density estimation, and exploratory data analysis and visualization. The class also provides foundational knowledge and practical skills, and a functional understanding of how generative AI works including the use of large language models (LLM) and use cases from industry. Topics include introduction to prompt engineering, fine tuning on Large Language Models (LLM), training and evaluating an LLM on new data sets as well as Neural network models for language understanding tasks.

Prerequisites: ME5701

ME5502 Design of Digital Control Systems **3 Cr Hr (3,0)** **6 ECTS**

Sampling and Signal reconstruction, signal analysis and data filtering, z-transform, practical aspects of system identification and digital control, discretization of systems, response and stability analysis of discrete systems, state space representation of discrete systems, controller design methods (digital oe placement, digital PID, etc..), realization of digital controllers, introduction to system identification, System Identification Principles, Recursive Identification Methods (Recursive Least squares, Recursive Maximum likelihood, output Error with Extended Prediction Model, Generalized Least Squares, Applications to real life control systems.

Prerequisites: ME3401

ME5503 Autonomous Mobile Robots **3 Cr Hr (3,0)** **7 ECTS**

This course introduces the most important mechanisms that enable locomotion. The It also discusses mobile robot kinematics by applying principles of kinematics to the whole robot. The challenge of perception, mobile robot localization, and planning and navigation are also discussed. The course also covers intelligent agents, autonomous agents, autonomous robots, intelligent robots and the fine line between intelligent agents and autonomous robots. The course also gives an introduction to the Robot Operating System (ROS) including many of the available tools that are necessary for programming robots focusing on ROS-Industrial (for industrial relevant hardware and applications), computer vision, and SLAM (Simultaneous Localization and Mapping).

Prerequisites: ME5501

ME5504 Artificial Intelligence in Robots **3 Cr Hr (3,0)** **7 ECTS**

Artificial intelligence rule in enabling robotic technologies to solve enterprise problems this course focuses on advanced AI techniques for perception manipulation reasoning and learning and explore methods for integrating these techniques with robots and drones. Students will learn to train their own custom machine learning models to perform object detection and explore the AI software development life cycle and it's specific nuances – Train, Validation, and Evaluation of Intelligent robotic systems. A major project for this course will focus on AI applications for intelligent collaborative robots (Cobots), Autonomous Mobile Robots (AMR), UAVs, or other robotics systems.

Prerequisites: ME5701, ME5501

ME0591 Graduation Project I **1 Cr Hr (0,3)** **4 ECTS**

The first part of a team-based one-year senior design project in the field of mechatronics engineering.

Prerequisites: ME0491, MIN 132CrHr

ME0592 Graduation Project II **3 Cr Hr (0,9)** **6 ECTS**

The second and final part of a team-based one-year senior design project in the field of mechatronics engineering.

Prerequisites ME0591

I. Elective Course Offered by Mechatronics Department

ME0402 Advanced Electronics **3 Cr Hr (3,0)** **5 ECTS**

Physical principles and operational characteristics of advanced semiconductor electronic devices with emphasis on metal-oxide systems, bipolar, high-electron mobility, and field-effect transistors. Topics also include quantum point contact and tunneling devices. Advanced background in solid-state electronic devices intended to help students to continue advanced research in the variety of different branches of semiconductor microelectronics.

Prerequisites: BSC001

ME0403 Real-Time Computer Control Systems **3 Cr Hr (3,0)** **5 ECTS**

Review of continuous control. Dynamic response, Feedback properties, Root locus and frequency response designs. Introduction to digital control. Discrete system analysis. Difference equations, discrete transfer functions, z-transform, Discrete signal analysis. Discrete approximation of differential equations, Effects of Sampling, PID control in discrete systems. Sampled-data systems. Sample & Hold, Spectrum of sampled signals, Data extrapolation, Block diagram analysis. Discrete equivalences. Numerical integration, Pole & zero mapping, Hold equivalence. Design using transforms techniques. Design by emulation, Design by root-locus, Design by frequency response. Implementation of Direct Digital Control algorithms. Implementation of the basic PID algorithm, Synchronization of the control loop, Timing Considerations in Implementation of Control Loops. Hard and soft real-time systems, Real-time scheduling theory, Deadlines in real-time control systems.

Prerequisites: BSC001

ME0404 Digital Control Systems **3 Cr Hr (3,0)** **5 ECTS**

Discrete time control theory, z-transform, sampling and hold operations, A/D and D/A conversions, modeling of digital systems, response evaluation; stability, basis of digital control, modeling of sampled-data systems, system identification using the batch least squares method, time response characteristics, stability analysis techniques, discrete-time approximation of continuous-time controllers, classical design methods based on root locus and frequency response, and modern design methods including state and observer feedback design.

Prerequisites: BSC001

ME0405 Process Control **3 Cr Hr (3,0)** **5 ECTS**

Dynamics of mechanical, food, beverage and chemical processes; system capacity; resistance; piping

complexes; characteristics and dynamics of control valves; control of pressure, speed, PH, mixing ration, Boolean algebra and fluid logic, sequential circuits, process time constants; proportional, reset, and derivative control actions; feedforward and cascade control; direct digital control.

Prerequisites: BSC001

ME0406 CNC and Manufacturing Control **3 Cr Hr (3,0)** **5 ECTS**

Concepts and benefits of computer integrated manufacturing (CIM), design for manufacturing, computer-aided design, process planning, manufacturing (computer numerical control parts programming), and inspection, robots in CIM, production planning and scheduling in CIM, system integration.

Prerequisites: BSC001

ME0407 Linear Systems **3 Cr Hr (3,0)** **5 ECTS**

Review of matrix algebra. State-space description of dynamic systems: linearity, causality, time- invariance, linearization. Solution of state-space equations. Transfer function representation. Discrete-time models. Controllability and observability. Canonical forms and minimal-order realizations. Stability and pole placement. Linear quadratic control. Observer design.

Prerequisites: BSC001

ME0408 Mobile Robots **3 Cr Hr (3,0)** **5 ECTS**

Introduction to variety of autonomous mobile robots, wheeled robots, robot platforms and modeling, control structures, sensing & estimation, localization, motion planning and multi-robot systems. Students will build, experiment with, and compete with mini-mobile robots.

Prerequisites: BSC001

ME0409 Autonomous Systems **3 Cr Hr (3,0)** **5 ECTS**

Introduction to essential aspects of autonomous systems; mobility, flexibility, adaptability, intelligence, modeling, control, sensing and estimation, sensor fusion and data mining, localization and navigation, motion and action planning, scheduling and applications.

Notations and definitions, structure of mechatronics systems, modeling and simulation of mechanical, electrical, hydraulic, pneumatic and thermal subsystems, various mathematical forms of model descriptions, systems of differential equations, transfer functions, state space representations, multi- port systems, merging of models of subsystems into a model of a mechatronic system, linear graphs, bond graphs, multi-energy domain models, introduction and application of simulation software tools

Prerequisites: BSC001

ME0410 Process Automation **3 Cr Hr (3,0)** **5 ECTS**

Definition of industrial processes, structures and layout design, hierarchical concepts, comprehensive view of material, energy and information flow; structure, principles of task planning, placing and final reporting, use of knowledge-based systems for planning and optimization, modeling of product data, use of distributed data base systems.

Prerequisites: BSC001

ME0411 Industrial Robotics **3 Cr Hr (3,0)** **5 ECTS**

Basic robotics technology, application in manufacturing, manipulators and mechanical design, programming languages, intelligence, and control.

Prerequisites: BSC001

ME0412 Mechatronics of Smart Materials **3 Cr Hr (3,0)** **5 ECTS**

Properties of smart materials, classes of smart materials, shape memory alloy materials, piezoelectric materials, smart sensors, smart actuators, and mechatronics of smart materials: modeling, design, digital control, and their applications.

Prerequisites: BSC001

ME0413 Mechatronics Projects **3 Cr Hr (3,0)** **5 ECTS**

Implementation of a mechatronics projects through all stages of modeling, simulation, control, component interface, signal conditioning, subsystem integration, documentation and presentation.

Prerequisites: BSC001

ME0415 Smart Sensors **3 Cr Hr (3,0)** **5 ECTS**

Active sensors: Piezo sensor for force, pressure and vibration, electrodynamic sensors for speed and rotation, photodiodes and thermocouples. Passive sensors: resistive sensors, capacitive sensors, inductance sensors. Analog data processing: operational amplifiers, amplification, addition, multiplication, division, integration and derivation, filtering. Digital data processing: data acquisition, multiplexing, digital filters, programmable devices. A/D-converter: bit-number, resolution, sampling rate, bipolar- and unipolar inputs. D/A-converters: flash, Weighing converter, Dual slope converter IOs, data lines.

Prerequisites: BSC001

ME0417 Micro-Electromechanical Systems **3 Cr Hr (3,0)** **5 ECTS**

Introduction to micromachining processes; mechanical properties of materials used in micromechanical systems; design and fabrication of free standing structures; sacrificial and structural layers; finite element modeling; micromechanical components; solid lubrication of microbearings; special techniques: double-side lithography, anodic bonding, electro-chemical drilling, deep etching, LIGA process, laser microfabrication; influence of IC fabrication processes on the mechanical properties; applications in microdevices; simulation and packaging.

Prerequisites: BSC001

ME0418 Nano Systems **3 Cr Hr (3,0)** **5 ECTS**

Assembly, manipulation and control of materials at the atomic and molecular scale to fabricate structures, devices and systems that have novel properties and functionality.

Prerequisites: BSC001

ME0419 Autotronics **3 Cr Hr (3,0)** **5 ECTS**

Electronic control systems and component in motor vehicle sub-systems, motor vehicle mechanical systems and sub-systems, electrical and electronic principles, faults and diagnosis of automotive electronic systems, engine management, fuel injection, electronics, transmission, stability, and ABS controls.

Prerequisites: BSC001

ME0420 Special Topics in Electrical and Electronics Engineering **3 Cr Hr (3,0)** **5 ECTS**

A course on a special topic in Electrical and Electronics.

Prerequisites: BSC001

ME0421 Special Topics in Control Engineering **3 Cr Hr (3,0)** **5 ECTS**

A course on a special topic in Control Engineering.

Prerequisites: BSC001

ME0422 Special Topics in Robotics and Automation **3 Cr Hr (3,0)** **5 ECTS**

A course on a special topic in Robotics and Automation.

Prerequisites: BSC001

ME0423 Special Topics in Computer and Digital Sciences **3 Cr Hr (3,0)** **5 ECTS**

A course on a special topic in Computer and Digital Sciences.

Prerequisites: BSC001

ME0424 Special Topics in Mechatronics Technology **3 Cr Hr (3,0)** **5 ECTS**

A course on a special topic in Mechatronics Technology.

Prerequisites: BSC001

ME0425 Special Topics I **3 Cr Hr (3,0)** **5 ECTS**

A course on a special topic in mechatronics.

Prerequisites: BSC001

ME0426 Special Topics II **3 Cr Hr (3,0)** **5 ECTS**

A course on a special topic in mechatronics.

Prerequisites: BSC001

II. Course Offered by Other Departments

IE0121 Probability and Statistics **3 Cr Hr (3,0)** **5 ECTS**

Descriptive statistics, probability concepts, discrete and continuous random variables and distributions, joint probability distributions, covariance and correlation of random variables, point and interval estimation for single sample, sampling distributions, and statistical inference for single sample.

Prerequisites: MATH101

IE0141 Engineering Workshop **1 Cr Hr (0,3)** **4 ECTS**

General safety, materials and their classifications, measuring devices and their accuracy, theoretical background and practical exercises including, carpentry, welding, mechanical fasteners, drills, lathes, milling machines, and sheet-metal working.

IE0281 Technical Writing and Engineering Ethics **2 Cr Hr (2,0)** **3 ECTS**

Technical communication, process of writing, presentations, relationship between ethical standards and technology, analysis of ethical dilemmas.

Prerequisites: ENGL1001

IE0361-DS Engineering Economics **3 Cr Hr (3,0)** **5 ECTS**

Principles of engineering economics, cost concepts, time value of money, interest formula, depreciation models, rate of return, cash flow, project evaluation methods, replacement analysis, break even analysis, economic studies for decision making.

Prerequisites: IE0121

IE0344 Manufacturing Processes **4 Cr Hr (3,3)** **6 ECTS**

Overview of typical manufacturing processes (Casting, forming, machining, joining, and finishing). Inhomogeneous deformation and residual stresses, Triaxial stresses and yield criteria, temperature rise, and process efficiency. Failure and fracture, surface properties and friction theories. Metal casting, heat transfer and solidification time. Bulk deformation processes (Forging, Rolling, Drawing, Extrusion), selected topics in joining and metal cutting processes. Economics and selection of manufacturing processes.

Prerequisites: Dept. Approval

MECH2102 Statics and Strength **3 Cr Hr (3,0)** **5 ECTS**

Vector mechanics of forces and moments and resultants, equilibrium of particles and rigid bodies in two and three dimensions, structural analysis, geometric properties, distributed forces, stress and strain, mechanical properties of materials, axial load, torsion, bending, transverse shear, combined loadings, stress and strain transformations, design of beams, column buckling.

Prerequisites: ARB0099, ENGL0099, PHYS103, MATH102

MECH2104 Dynamics **3 Cr Hr (3,0)** **5 ECTS**

Kinematics and kinetics of particles, planar kinematics and kinetics of rigid bodies, Newton's Second Law, Principle of work and energy, Principle of Impulse and momentum.

Prerequisites: ARB0099, ENGL0099, MECH2102

MECH0332 Machine Design **3 Cr Hr (3,0)** **5 ECTS**

Introduction to design process, design considerations, stress analysis and deflection of mechanical elements, energy methods, static strength and failure theories, fatigue strength and failure theories, shafts, nonpermanent joints, mechanical springs, and rolling bearings, CAD software, stress analysis using FEM codes, kinematics simulations, surface generation, 3D printing.

Prerequisites: MECH2104, MECH2102

MECH0402 Multi-Body Dynamics **3 Cr Hr (3,0)** **5 ECTS**

Principles of kinematics and dynamics in spatial motion, constraint equations describing various types of spatial kinematic joints, algorithms for automatic generation of the constraint equations, techniques for automatic generation of the spatial equations of motion.

Prerequisites: Dept. Approval

MECH0403 Machine Dynamics **3 Cr Hr (3,0)** **5 ECTS**

Force analysis of machinery, resonance (symptoms, tests, fixes), rotors dynamics, and dynamic balance of machinery, analytical determination of unbalance, dynamic behavior of drives and machine frames as complex systems, typical dynamic effects, such as the gyroscopic effect, damping and absorption, shocks.

Prerequisites: Dept. Approval

MECH0531 Mechanical Vibrations **3 Cr Hr (3,0)** **5 ECTS**

Mathematical techniques for linear system vibrations, review of vibrations of single-degree-of freedom systems, vibrations of multi-degree-of-freedom systems, small oscillation theory, free vibration eigenvalue problem, undamped system response, viscously damped systems, vibrations of continuous systems, modes of vibration of strings, bars, and beams.

Prerequisites: MECH2104

III. Courses offered by Other Schools

ARB0099 Elementary Arabic **3 Cr Hr (3,0)** **3 ECTS**

This course aims to develop student's ability to read, comprehend, literary analyze, grammatically analyze, linguistically analyze, poetically analyze, and rhetorically analyze texts properly. The course also includes a selection of Arabic literature in poetry and prose representing different literary ages, in addition to several common forms of writing such as scientific article, news article, and others.

Prerequisites: Placement test

ARB100 Arabic **3 Cr Hr (3,0)** **3 ECTS**

This course aims to improve the student's competence in the various linguistic skills in terms of reading, comprehension, and taste. This is achieved through the study of selected texts with many implications that raise issues in spelling, grammar, composition, meaning, and inference, and the use of an old and modern thesaurus.

Prerequisites: ARB099

ENGL0098 Elementary English **3 Cr Hr (3,0)** **3 ECTS**

Students will focus on English at an elementary level concentrating on the receptive skills of reading and listening, and the productive skills of writing and speaking. These will include such things as independent clauses, verb tenses, model verbs, adverbs, short dialogues, reading simple material and answering short questions, writing short meaningful sentences, listening to short conversations.

Prerequisites: Placement test

ENGL0099 Intermediate English **3 Cr Hr (3,0)** **3 ECTS**

Students will focus on English at a pre-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. These will include such things as comparatives and superlatives, quantifiers, possessive adjectives and pronouns, vocabulary building, role-play activities for speaking, reading comprehension and writing short descriptive paragraphs.

Prerequisites: ENGL098

ENGL1001 Upper-Intermediate English **3 Cr Hr (3,0)** **3 ECTS**

Students will focus on English at an upper-intermediate level concentrating on the receptive skills of reading and listening and the productive skills of writing and speaking. Model verb review, silent letters and proper pronunciation, jobs and careers, requests and offers, more phrasal verbs with vocabulary building, relative clauses and relative pronouns, narrative tenses for writing exercises, wishes and regrets, reading and comprehending longer passages with direct and inference questions of medium difficulty, hypothesizing, and writing fully developed descriptive, argumentative and analytical essays of 350 words.

Prerequisites: ENGL0099

ENGL1002 Advanced English **3 Cr Hr (3,0)** **3 ECTS**

Students will focus on English at an Advanced level. Students will analyze and produce 2 – 3 page essays with an emphasis on argumentation and persuasion working both independently and cooperatively to gather, evaluate, and synthesize necessary information. Class activities include interactive lectures, small group and class discussions, informal debates, peer feedback, individual presentations, focused listening exercises and focused viewing exercises as well as assorted reading, writing, and grammar assignments. There will be some poetry analysis together with reading and understanding a short story and a drama using basic literary terms and concepts.

Prerequisites: ENGL1001

MILS100 Military Science **3 Cr Hr (3,0)** **2 ECTS**

History of the Jordanian Arab Army. United Nations Peace Keeping Forces. Preparation of the nation for defense and liberation. History of the Hashemite Kingdom of Jordan and its development.

NE101 National Education **3 Cr Hr (3,0)** **2 ECTS**

In a context of striving towards democracy like the one Jordan enjoys today, the meaning and practice of active

and responsible citizenship becomes more crucial. It is often argued that democracy requires “democrats” to flourish, and become well established. Democrats are those women and men who recognize pluralism, inclusion, positive engagement, and participation as the main values that govern their interaction with the state as citizens and with each other as diverse people of different interests. In this course you will be able to understand your rights and responsibilities as Jordanian citizen expand your knowledge about the frameworks, and processes that regulates citizen-state relationships as well as the basic necessary skills for you to practice your citizenship rights in a civic manner.

Prerequisites: ENGL0099

GERL101B1 German I B1-Track **3 Cr Hr (9,0)** **6 ECTS**

Can understand and use familiar, everyday expressions and very simple sentences, which aim at the satisfaction of specific needs. Can introduce oneself, and others, and ask others questions to themselves - e.g. where they live, which people they know or what kind of things they have - and can give answers on questions of this kind. Can communicate on a basic level if those involved with him/ her in a conversation speak slowly and clearly and are willing to help.

GERL102B1 German II B1-Track **3 Cr Hr (9,0)** **6 ECTS**

Can understand sentences and frequently used expressions if those are connected with things of immediate meaning (e.g. information to the person and to the family, buying, work, closer environment). Can communicate in simple, routine situations, with the purpose of a simple and direct exchange of information about familiar and common things. Can describe with simple means their own origin and training, direct environment and things that are in connection with direct needs.

Prerequisites: GERL101B1

GERL201B1 German III B1-Track **3 Cr Hr (6,0)** **4 ECTS**

Can understand the main points if no dialect is used and if it concerns familiar things about work, school, spare time etc. Can master most situations, which one encounters on journeys in a German speaking area. Can express oneself simply and coherently about familiar topics and areas of personal interest. Can report experiences and events, describe dreams, hopes and goals and give short reasons or explanations about plans and opinions.

Prerequisites: GERL102B1

GERL202B1 German IV B1-Track **3 Cr Hr (9,0)** **6 ECTS**

Can understand the main contents of complex texts, as well as concrete and abstract topics; even discussions between specialists in his/ her own special field. Can communicate spontaneously and fluidly a normal discussion with native speakers, without larger effort on both sides. Can express oneself clearly, in detail in a broad spectrum of topics, describe a point of view to a current question, and indicate the pro and cons of different possibilities.

Prerequisites: GERL201B1

GERL301B1 German V B1-Track **3 Cr Hr (9,0)** **6 ECTS**

Can understand and seize implicit meanings of a broad spectrum of demanding, longer texts. Can express oneself spontaneously and fluidly, recognizing words without having to search for words frequently. Can use the language effectively and flexibly in social and vocational life or in training and study. Can express oneself clearly, structured and detailed, to complex subjects and use appropriate different means for linkage of texts.

Prerequisites: GERL202B1

GERL302B1 German VI B1-Track **3 Cr Hr (6,0)** **6 ECTS**

German VI is a strongly practice-oriented course in preparation for your German Year. The course includes the modules "Intercultural Communication", "Job Application Training" and the technical languages. In part, it includes a special support program for students who did not achieve their language goal of a full B1 certificate in German V

Prerequisites: GERL301B1

CHEM103 General Chemistry **3 Cr Hr (3,0)** **5 ECTS**

Stoichiometry of formulas and equations. Gases and the kinetic-molecular theory. Quantum theory and atomic structure. The components of matter. The major classes of chemical reactions (precipitation, acid-base, oxidation-reduction, and reversible reactions). Thermodynamics: energy flow and chemical change. Quantum theory and atomic structure. Electron configurations and chemical periodicity. Kinetics: rates and mechanisms of chemical reactions. Equilibrium: The extent of chemical reactions. Acid-base equilibria.

CS116 Computing Fundamentals **3 Cr Hr (3,0)** **6 ECTS**

Basic computer skill; Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation; 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course using Gnu C compiler on a Solaris/Sun environment

CS1160 Computing Fundamentals Lab **1 Cr Hr (0,3)** **0 ECTS**

Basic computer skill; Programming concepts; algorithms: data types, arithmetic, logical, relational, Boolean, and assignment operators, simple input and output statements; programming control structures; data structures: single and multidimensional arrays; character strings; functions; pointers; file structures and representation; 3-hours lab session every week to enhance hands-on experience on topics that are theoretically covered in the course using Gnu C compiler on a Solaris/Sun environment.

Corequisites: CS116

MATH0099 Pre-Math **3 Cr Hr (3,0)** **3 ECTS**

Real numbers and their properties, Solutions of equations and inequalities, Functions, Domain of functions, Operations on functions, Polynomials, Zeros of polynomials, Power, Exponential, Logarithmic, and Trigonometric functions and their graphs, Applications of trigonometry, Analytic Geometry: Lines, circles and parabolas.

Prerequisites: Placement test

MATH101 Calculus I **3 Cr Hr (3,0)** **3 ECTS**

Review of functions, functions, Inverse functions, Inverse trigonometric functions, the concept of limits, Computation of limits, Continuity, Asymptotes, The Derivative, Computation of derivatives, the product and quotient rules, The Chain Rule, Derivatives of Trigonometric, Inverse Trigonometric, Exponential, Logarithmic, and Hyperbolic Functions. Applications of Differentiation: Increasing and Decreasing Functions, Extrema of Functions, Graphs of Functions, Indeterminate Forms and L'Hopital Rule. Antiderivatives, Definite integrals, Fundamental Theorem of Calculus, Integration by Substitutions, Integration by Parts, Applications of integration: Area between curves, Arc length, Volume and Surface Area of Solids of Revolution.

Prerequisites: MATH0099

MATH102 Calculus II **3 Cr Hr (3,0)** **5 ECTS**

Review of Integration, Integration by Trigonometric Substitutions, Integration using Partial Fractions, Improper Integrals. Vectors in 2 and 3 Spaces, The Inner and Cross Products of vectors. Polar Coordinates, Graphs and Arc length of Polar curves. Functions of Several Variables; Domain, Limits, and Continuity. Partial Derivatives, The Chain Rule, The Gradient and Directional Derivatives, Extrema of Functions of Several Variables and Lagrange multipliers. Double Integrals, Area of Plane Region and Volumes of Solids using Double integrals, Triple Integrals, Cylindrical and Spherical Coordinates, Triple Integrals using Cylindrical and Spherical Coordinates.

Prerequisites: MATH102

MATH203 Applied Mathematics for Engineers **3 Cr Hr (3,0)** **5 ECTS**

Vector analysis in Cartesian coordinates. General Curvilinear Coordinates, Vector calculus in general curvilinear coordinates with emphasis on Spherical and Cylindrical coordinates, transformations between different coordinate systems, vector differentiation. Matrices and linear equations; Matrices and Linear Operators; Determinants, Eigenvalues and eigenvectors. Complex Numbers and Complex Variables; Representation of

complex numbers, Powers and roots of complex numbers, Functions of a complex variable. Review of Infinite Series; Infinite series of constant terms, Convergence tests, Power series and radius of convergence, Taylor, and Maclaurin series and Fourier series.

Prerequisites: MATH102

MATH205 Differential Equations **3 Cr Hr (3,0)** **5 ECTS**

Ordinary differential equations; Sturm-Liouville theory, properties of Special Functions, Solution methods including Laplace transform, and Fourier transform. Eigenvalue problems and expansions in orthogonal functions. Partial differential equation: classification, separation of variables, solution by series and transform methods. Models in Applied Mathematics; Applications to illustrate typical problems and methods of applied mathematics in solid and fluid mechanics, fields of physics, deformation and vibration, wave phenomena, diffusion phenomena, heat conduction, chemical and nuclear reactors, and biological processes.

Prerequisites: MATH102

PHYS103 Physics I **3 Cr Hr (3,0)** **5 ECTS**

Physics and measurement. Motion in one dimension. Vectors. Motion in two dimensions. Force and motion. Kinetic energy and work. Potential energy and conservation of energy. Linear momentum and collisions. Rotation. Rolling and angular momentum.

PHYS104 Physics II **3 Cr Hr (3,0)** **5 ECTS**

Electric Fields. Gauss's Law. Electric Potential. Capacitance and Dielectrics. Current and Resistance. Direct Current Circuits. Magnetic Fields. Sources of Magnetic Field. Faraday's Law.

Prerequisites: PHYS103

PHYS106 General Physics Lab **1 Cr Hr (0,3)** **2 ECTS**

Laboratory exercises that apply physical principles introduced in Physics I and Physics II courses. The lab includes the use of data logging techniques, observations, and scientific reasoning in practical situations.

Prerequisites: PHYS103
Corequisites: PHYS104

CE441 Embedded System Design **3 Cr Hr (3,0)** **5 ECTS**

Embedded system concepts, hardware architecture, design and debugging, embedded processor selection, software development methodologies, real-time Linux, synchronization mechanisms, interrupt latency, application programming interface, interrupt service routine, application design considerations.

Prerequisites: ENE211, ME0312

CE212 Digital Systems **3 Cr Hr (3,0)** **5 ECTS**

This course covers fundamentals of digital electronics, Binary number system; Boolean algebra, logic operations, algebra and gates, digital circuits analysis, gate-level and block level design of digital circuits, adders, subtractors, comparators, multiplexers, decoders, analysis, design and applications of sequential circuits: flip-flops, registers, counter, and their design procedures, RAM and ROM memory elements

CE2120 Digital Systems Lab **1 Cr Hr (0,3)** **4 ECTS**

This lab aims to enhance hands-on experience on topics that are theoretically covered in the CE212 digital systems course, including: fundamentals of digital electronics, Binary number system; Boolean algebra, logic operations, algebra and gates, digital circuits analysis, gate-level and block level design of digital circuits, adders, subtractors, comparators, multiplexers, decoders, analysis, design and applications of sequential circuits: flip- flops, registers, counter, and their design procedures, RAM and ROM memory elements. The experiments on all topics vary from functional troubleshooting to gate and block level design implementation.

Corequisites: CE212

CE461 Image Processing **3 Cr Hr (3,0)** **5 ECTS**

This course provides a solid background in digital image processing. A major goal of the course is to introduce students to practical applications of image processing in both industry and research. The course includes three assignments and a project that will enable students to use MATLAB for image computation and visualization.

Prerequisites: MATH203, Math205, CE212

ENE211 Electrical Circuits I **3 Cr Hr (3,0)** **5 ECTS**

Overview: SI units, voltage and current; Ohm's and Kirchhoff"s Laws, circuits with dependent sources; simple resistive circuits: series, parallel and delta to wye; Techniques of circuit analysis: nodal and mesh analyses, source transformation, Thevenin and Norton equivalents; Amplifiers; Inductance, capacitance and mutual inductance; Natural and step responses of RL and RC circuits; Natural and step response of series and parallel RLC circuits; Sinusoidal steady state analysis.

Prerequisites: PHYS104

ENE213 Electrical Circuits Lab **1 Cr Hr (0,3)** **2 ECTS**

Resistive circuits, Potentiometers, Superposition, Thevenin’s theorem and maximum power transfer, RLC current and voltage characteristics, Frequency response of RL, RC and RLC circuits, Series and parallel resonant circuits, Amplifiers.

Prerequisites: ENE211

ENE312 Power Electronics **3 Cr Hr (3,0)** **5 ECTS**

Power semiconductor devices: types drive circuits, protection circuits and power loss calculations. AC-DC converters: uncontrolled, half-controlled and fully controlled single-phase and three-phase rectifiers. AC-AC converters: cycloconverters. DC-AC inverters: single-phase and three-phase. DC-DC converters' topologies analysis and design: stepdown, step-up, and step-down/up converters.

Prerequisites: ME0214

ENE314 Power Electronics Lab **1 Cr Hr (0,3)** **2 ECTS**

Single-phase fully controlled bridge rectifier with static and rotating loads. Single-phase half- controlled bridge rectifier. Three-phase controlled bridge rectifier. Single-phase ac voltage controller. Frequency converter. Single-phase bridge inverter with static and rotating loads. Three-phase bridge inverter. Step-down and step-up converter.

Prerequisites: ENE312