German Jordanian University

School of Applied Technical Sciences
Department of Mechanical and Maintenance Engineering
Bachelor of Science in Mechanical and Maintenance Engineering

Study Plan 2023

I. Program Objectives

Mechanical and Maintenance 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 fields of Mechanical and Maintenance Engineering.
b. Define, design, model, analyze, test and incorporate principles of mechanical processes and systems considering their impacts.
c. Employ mathematical, computational, and experimental techniques, and interpersonal and critical thinking skills in solving practical problems in the diverse fields of Mechanical and Maintenance Engineering aspects.
d. lead/manage design, development of strong practical experience obtained through hands-on learning methodologies.
e. Communicate effectively and function in various multidisciplinary and culturally diverse teams and engage in life-long learning and professional development.
f. Understand the ethical, cultural, and environmental considerations of the Mechanical and Maintenance Engineering profession.

II. Learning Outcomes

The B.Sc. Program in Mechanical and Maintenance Engineering provides students with an understanding of fundamental Mechanical and Maintenance Engineering concepts, methodologies, and technologies as demonstrated by the following program learning outcomes (PLO) 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. The 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 Arabic Language, 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 hours 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 Mechanical and Maintenance Engineering are the following:

a. A total of 168 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 15 credit hours in one of the main tracks (Thermal Systems, Automotive and E-Mobility, and Additive Manufacturing).

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

Classification	Credit Hours			ECTS		
	Compulsory	Elective	Total	Compulsory	Elective	Total
University Requirements	21	6	27	25	6	31
School Requirements	46	-	46	79	-	79
Program Requirements	83	12	95	170	20	190
Total	**150**	**18**	**168**	**274**	**26**	**300**

Course Delivery Method	Credit Hours	Percentage
Online Courses	18	11%
Blended Courses	52	31%
Face-to-Face Courses	98	58%
Total	**168**	**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						OL	-
		Total	**21**	**25**	**33**	**0**		

1.2. Elective: (6 credit hours) (Two courses out of the following)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
DES101	Arts' Appreciation	3	3	3	-	OL	ENGL0098, ARB0099
EI101	Leadership and Emotional Intelligence	3	3	3	-	F2F	ENGL0098
IC101	Intercultural Communications	3	3	3	-	F2F	ENGL0098
PE101	Sports and Health	3	3	3	-	F2F	ARB0099
SE301	Social Entrepreneurship and Enterprises	3	3	3	-	F2F	ENGL0098
SFTS101	Soft Skills	3	3	3	-	OL	ENGL0098
BE302	Business Entrepreneurship	3	3	3	-	OL	ENGL0098
TW303	Technical and Workplace Writing	3	3	3	-	OL	ENGL0098
	Minimum required	**6**	**6**	**6**	**0**		

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

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	Technical Writing and Engineering Ethics		2	3	2	-	F2F	ENGL1001
IE0361	Engineering Economics		3	5	3	-	OL	IE0121
ME0111	Computer Aided Engineering Drawing		2	4	-	6	BLD	CS116
MECH2102	Statics and Strength		3	5	3	-	BLD	ARB0099,ENGL0099, 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						ARB0099,ENGL0099, GERL102B2
GERL202B1	German IV	B1-Track	3	6	9	-	F2F	ARB0099,ENGL0099, GERL201B1 or GERL201B2
GERL202B2		B2-Track						ARB0099,ENGL0099, 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 (98 credit hours)

3.1. Program Requirements (Compulsory): (86 credit hours)

3.1.1. Program Requirements (Common): (71 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
MECH2101	Fundamentals of Mechanical Design	2	4	-	6	BLD	ARB0099,ENGL0099, ME0111
MECH2103	Mechanics of Materials Lab	1	2	-	3	BLD	ARB0099,ENGL0099, PHYS103, MATH102, MECH2102^{co}
MECH2104	Dynamics	3	5	3	-		ARB0099,ENGL0099, MECH2102

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

ME0212	Electrical Circuits and Machines		3	5	3	-	F2F	ARB0099,ENGL0099, PHYS104
ME2103	Electrical Circuits and Machines Lab		1	2	-	3	BLD	ARB0099,ENGL0099, ME0212[co]
MECH2201	Applied Thermodynamics		3	5	3	-	F2F	ARB0099,ENGL0099, MATH102
MECH2202	Fluid Flow and Heat Transfer		3	5	3	-	F2F	ARB0099,ENGL0099, MATH205, MECH2201
MECH3201	Thermofluids Lab		1	2	-	3	BLD	MECH2202
MECH3202	Computer Aided Thermal Engineering		2	4	-	6	BLD	MECH2202
MECH3301	Machine Design		3	6	3	-	F2F	MECH2101, MECH2102
MECH3302	Machine Design Lab		1	2	-	3	BLD	MECH2101, MECH2102, MECH3301[co]
MECH3401	Maintenance Spare Parts Management		3	5	3	-	F2F	IE0121
MECH3801	Computer Aided Mathematics for MECH		2	3	-	6	BLD	MATH203, MATH205
MECH3901	Field Training		0	6	160 hours		F2F	Dept. Approval
MECH4901	International Internship[a]		12	30	20 weeks		F2F	MECH3901
MECH5301	Vibrations and Control		3	5	3	-	F2F	MECH2102, MECH3801
MECH5401	Reliability for Quality Control		3	5	3	-	F2F	IE0121
MECH5402	Management of Maintenance Systems		3	6	3	-	BLD	MECH3401
MECH5801	Artificial Intelligence in Maintenance		3	5	3	-	BLD	MECH3801
MECH5901	Graduation Project I		1	4	-	3	BLD	MECH4901, 132 CrHr
MECH5902	Graduation Project II		3	6	-	9	BLD	MECH5901
IE0348	Materials and Manufacturing Engineering		3	5	3	-	BLD	IE0141, CHEM103
ME0346	Instrumentation & Measurements		2	3	2	-	BLD	MATH205, ME0212
ME0347	Instrumentation & Measurements Lab		1	2	-	3	BLD	MATH205, ME0212, ME0346[co]
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	**68**	**139**	**50**	**45**		

3.1.2. Program Requirements (Thermal Systems Track): (15 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
MECH5501	Heating Ventilation and Air Conditioning	3	6	3	-	F2F	MECH3202
MECH5502	Building Automation	3	5	3	-	BLD	MECH3202, ME0212
MECH5503	Thermal Systems Lab	1	3	-	3	BLD	MECH2201, MECH2202

MECH5504	Turbomachinery	3	5	3	-	BLD	MECH3202
MECH5505	Thermal System Design	3	6	3	-	BLD	MECH3202
MECH5506	Computational Fluids Dynamics	2	6	-	6	BLD	MECH3202
	Total	**15**	**31**	**12**	**9**		

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

3.1.3. Program Requirements (Automotive & E-Mobility Track): (15 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
MECH5601	Theory of Machines	3	6	3	-	F2F	MECH2102, MATH203
MECH5602	Automotive Systems	3	5	3	-	BLD	MECH2102, MECH3301
MECH5603	Automotive Systems Lab	1	3	-	3	BLD	MECH2102, MECH3301, MECH5602[co]
MECH5604	Fundamentals of Vehicle Structure	3	5	3	-	BLD	MECH3301
MECH5605	Vehicle Electrical and Electronics Systems	2	6	2	-	BLD	ME0212
MECH5606	Hybrid and Electric Vehicles	3	6	3	-	BLD	ME0212
	Total	**15**	**31**	**14**	**3**		

3.1.4. Program Requirements (Additive Manufacturing Track): (15 credit hours)

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
MECH5701	Fundamentals of Additive Manufacturing	3	6	3	-	F2F	MECH3301, IE0348
MECH5702	Material Design and Surface Engineering	3	6	3	-	BLD	MECH3301, IE0348
MECH5703	Additive Manufacturing Lab	1	3	-	3	BLD	MECH3301, IE0348, MECH5701[co]
MECH5704	Applications in Additive Manufacturing	3	5	3	-	BLD	MECH5701
MECH5705	Design and Optimization for Additive Manufacturing	2	6	2	-	BLD	MECH5701
MECH5706	Advances in additive Manufacturing	3	5	3	-	BLD	MECH5701
	Total	**15**	**31**	**14**	**3**		

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 additive manufacturing and Automotive and E-Mobility tracks are considered elective courses for Thermal Systems track.
- Courses from additive manufacturing and Thermal Systems tracks are considered elective courses for Automotive and E-Mobility track.
- Courses from Automotive and E-Mobility and Thermal Systems tracks are considered elective courses for Additive Manufacturing track.

Course ID	Course Name	Credit Hours	ECTS	Contact Hours		Type	Prerequisites / Corequisites
				Lect.	Prac.		
MECH4201	Advanced Heat Transfer	3	5	3	-	F2F	BSC001
MECH4202	Intermediate Fluid Mechanics	3	5	3	-	F2F	BSC001
MECH4203	Case Studies in Thermal Engineering and Design	3	5	3	-	F2F	BSC001
MECH4204	Thermodynamics of Fluid Flow with Applications	3	5	3	-	F2F	BSC001
MECH4205	Computational Heat Transfer	3	5	3	-	F2F	BSC001
MECH4206	Combustion	3	5	3	-	F2F	BSC001
MECH4207	Gas Turbines	3	5	3	-	F2F	BSC001
MECH4208	Conduction	3	5	3	-	F2F	BSC001
MECH4209	Convection	3	5	3	-	F2F	BSC001
MECH4210	Thermal Radiation Heat Transfer	3	5	3	-	F2F	BSC001
MECH4211	Bioheat and Mass Transfer	3	5	3	-	F2F	BSC001
MECH4212	Two Phase Flow and Heat Transfer	3	5	3	-	F2F	BSC001
MECH4213	Design and Selection of Heat Exchangers	3	5	3	-	F2F	BSC001
MECH4214	Thermal Management of Electronic Systems	3	5	3	-	F2F	BSC001
MECH4215	Renewable Energy	3	5	3	-	F2F	BSC001
MECH4216	Battery Technology	3	5	3	-	F2F	BSC001
MECH4217	Bioenergy	3	5	3	-	F2F	BSC001
MECH4218	Power Grid Technologies	3	5	3	-	F2F	BSC001
MECH4219	Solar Thermal Technologies	3	5	3	-	F2F	BSC001
MECH4301	Structural Dynamics and Durability Analysis	3	5	3	-	F2F	BSC001
MECH4302	Finite Element Methods	3	5	3	-	F2F	BSC001
MECH4303	Multi-Body Dynamics	3	5	3	-	F2F	BSC001
MECH4304	Machine Dynamics	3	5	3	-	F2F	BSC001
MECH4305	Nonlinear Dynamics	3	5	3	-	F2F	BSC001
MECH4401	Automotive Maintenance	3	5	3	-	F2F	BSC001
MECH4402	Building Maintenance	3	5	3	-	F2F	BSC001
MECH4403	Safety & Loss Prevention	3	5	3	-	F2F	BSC001
MECH4404	Maintenance Costing	3	5	3	-	F2F	BSC001
MECH4405	Modern Maintenance Management Systems	3	5	3	-	F2F	BSC001
MECH4406	Systems Engineering	3	5	3	-	F2F	BSC001
MECH4407	Failure Analysis	3	5	3	-	F2F	BSC001
MECH4408	Maintenance, Repair, and Operation Strategies and Planning	3	5	3	-	F2F	BSC001
MECH4409	Human Resource Management	3	5	3	-	F2F	BSC001
MECH4410	Six Sigma	3	5	3	-	F2F	BSC001
MECH4411	Production Management	3	5	3	-	F2F	BSC001
MECH4412	Innovation Management	3	5	3	-	F2F	BSC001
MECH4413	Business Administration for Engineers	3	5	3	-	F2F	BSC001
MECH4414	Ergonomics and Ecodesign	3	5	3	-	F2F	BSC001
MECH4415	Process Management	3	5	3	-	F2F	BSC001

MECH4601	Ignition Systems	3	5	3	-	F2F	BSC001
MECH4602	Electromobility	3	5	3	-	F2F	BSC001
MECH4603	Vehicle Emissions	3	5	3	-	F2F	BSC001
MECH4604	Data-Driven Algorithms in Vehicle Technology	3	5	3	-	F2F	BSC001
MECH4605	Driver Assistance Systems and Autonomous Driving	3	5	3	-	F2F	BSC001
MECH4606	Automotive and Railway Safety	3	5	3	-	F2F	BSC001
MECH4607	Railway Telematics Architectures	3	5	3	-	F2F	BSC001
MECH4608	Planning of Railway Systems	3	5	3	-	F2F	BSC001
MECH4609	Railway Construction	3	5	3	-	F2F	BSC001
MECH4610	Railway Operations Management	3	5	3	-	F2F	BSC001
MECH4701	CAD/CAM/Rapid Prototyping	3	5	3	-	F2F	BSC001
MECH4702	Micro and ultra-precision machining	3	5	3	-	F2F	BSC001
MECH4703	Primary Shaping, Forming, and Machining	3	5	3	-	F2F	BSC001
MECH4704	Joining, Coating, and Assembly	3	5	3	-	F2F	BSC001
MECH4705	Laser Material Processing	3	5	3	-	F2F	BSC001
MECH4801	Human-Machine-Interaction	3	5	3	-	F2F	BSC001
MECH4802	Smart Factory	3	5	3	-	F2F	BSC001
MECH4803	Smart Systems and Adaptive Structures	3	5	3	-	F2F	BSC001
MECH4804	Electrical Propulsion Systems	3	5	3	-	F2F	BSC001
MECH4910	Special Topics in Thermal Systems	3	5	3	-	F2F	BSC001
MECH4902	Special Topics in Energy Engineering	3	5	3	-	F2F	BSC001
MECH4903	Special Topics in Applied Mechanics	3	5	3	-	F2F	BSC001
MECH4904	Special Topics in Maintenance Engineering	3	5	3	-	F2F	BSC001
MECH4905	Special Topics in Engineering Management	3	5	3	-	F2F	BSC001
MECH4906	Special Topics in Automotive and E-mobility	3	5	3	-	F2F	BSC001
MECH4907	Special Topics in Manufacturing Engineering	3	5	3	-	F2F	BSC001
MECH4908	Special Topics in Mechatronics Engineering	3	5	3	-	F2F	BSC001
MECH4911	Special Topics I	1	2	1	-	F2F	BSC001
MECH4912	Special Topics II	2	3	2	-	F2F	BSC001
IE0401	Engineering Project Management	3	5	3	-	F2F	BSC001
IE0515	Product Development and Entrepreneurship	3	5	3	-	F2F	BSC001
IE0516	Facilities and Asset Management	3	5	3	-	F2F	BSC001
IE0533	Supply Chain Engineering	3	5	3	-	F2F	BSC001
IE0562	Industrial Cost Analysis	3	5	3	-	F2F	BSC001
ME0522	Hydraulics and Pneumatics	3	5	3	-	F2F	BSC001
ME0417	Micro-Electromechanical Systems	3	5	3	-	F2F	BSC001
ME0548	Control Systems II	3	5	3	-	F2F	BSC001
ME0551	Robotics	3	5	3	-	F2F	BSC001
ME0571	Machine Intelligence I	3	5	3	-	F2F	BSC001
ME0577	Automation and Industry 4.0	3	5	3	-	F2F	BSC001

CE441	Embedded System Design	3	5	3	-	F2F	BSC001
ENE432	Power Plants Engineering	3	5	3	-	F2F	BSC001
ENE433	Solar Energy I	3	5	3	-	F2F	BSC001
ENE525	Fuel Cell & Hydrogen Production Technology	3	5	3	-	F2F	BSC001
ENE531	Environmental and Energy Engineering	3	5	3	-	F2F	BSC001
ENE520	Thermal Energy Storage	3	5	3	-	F2F	BSC001
ENE537	Energy Efficiency, Management, and Laws	3	5	3	-	F2F	BSC001
MGT418	Quality Management	3	5	3	-	F2F	BSC001
	Total	**12**	**20**	**12**	**0**		

[b] All elective courses to be taken at a partner university in Germany.

Study Plan[c] Guide for a B.Sc. Degree in Mechanical and Maintenance Engineering

First Year							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
ENGL1001	Upper-Intermediate English	3	3	3	-	F2F	ENGL0099
CS116	Computing Fundamentals	3	6	3	-	F2F	-
CS1160	Computing Fundamentals Lab	1	0	-	3	BLD	CS116[co]
GERL101B1	German I B1-Track	3	6	9	-	F2F	-
MATH101	Calculus I	3	5	3	-	BLD	MATH099
PHYS103	Physics I	3	5	3	-	BLD	-
IE0141	Engineering Workshop	1	4	-	3	BLD	-
	Total	**17**	**29**	**21**	**6**		

First Year							
Second Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
CHEM103	General Chemistry	3	5	3	-	F2F	-
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]
IE0121	Probability and Statistics	3	5	3	-	F2F	MATH101
	Total	**19**	**31**	**24**	**3**		

[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.**		
ME0111	Computer Aided Engineering Drawing		2	4	-	6	BLD	CS116
MECH2101	Fundamentals of Mechanical Design		2	4	-	6	BLD	ARB0099,ENGL0099, ME0111
MECH2102	Statics and Strength		3	5	3	-	F2F	ARB0099,ENGL0099, PHYS103, MATH102
MECH2201	Applied Thermodynamics		3	5	3	-	F2F	ARB0099,ENGL0099, MATH102
GERL201B1	Mechanics of Materials Lab	B1-Track	3	4	6	-	F2F	ARB0099,ENGL0099, GERL102B1 or GERL102B2
GERL201B2		B2-Track						GERL102B2
MATH205	Differential Equations		3	5	3	-	F2F	ARB0099,ENGL0099, MATH102
IE0281	Technical Writing and Engineering Ethics		2	3	2	-	F2F	ENGL1001
		Total	**18**	**30**	**17**	**12**		

Second Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
MECH2103	Mechanics of Materials Lab		1	2	-	3	BLD	ARB0099,ENGL0099, PHYS103, MATH102, MECH2102^{co}
MECH2104	Dynamics		3	5	3	-	F2F	ARB0099,ENGL0099, MECH2102
GERL202B1	German IV	3	3	6	9	-	F2F	ARB0099,ENGL0099, GERL201B1 or GERL201B2
GERL202B2		3						ARB0099,ENGL0099, GERL201B2
MATH203	Applied Math for Engineers		3	5	3	-	F2F	ARB0099,ENGL0099, MATH102
MECH2202	Fluid Flow and Heat Transfer		3	5	3	-	F2F	ARB0099,ENGL0099, MATH205, MECH2201
ME0212	Electrical Circuits and Machines		3	5	3	-	F2F	ARB0099,ENGL0099, PHYS104
ME0213	Electrical Circuits and Machines Lab		1	2	-	3	BLD	ARB0099,ENGL0099, PHYS104, ME0212^{co}
		Total	**17**	**30**	**21**	**6**		

Third Year								
First Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
MECH3201	Thermofluids Lab		1	2	-	3	BLD	MECH2202
MECH3801	Computer Aided Mathematics for MECH		2	3	-	6	BLD	MATH203, MATH205
MECH3901	Field Training		0	6	160 hours		F2F	Dept. Approval, IE0281
ME0346	Instrumentation & Measurements		2	3	2	-	BLD	MATH205, ME0212
IE0348	Materials and Manufacturing Engineering		3	5	3	-	BLD	IE0141, CHEM103
GERL301B1	German V	B1-Track	3	6	9	-	F2F	GERL202B1 or GERL202B2
GERL301B2		B2-Track						GERL202B2
ARB100	Arabic		3	3	3	-	OL	ARB099
-	University Elective I		3	3	3	-	-	-
		Total	**17**	**31**	**20**	**9**		

Third Year								
Second Semester								
Course ID	**Course Name**		**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
					Lect.	**Prac.**		
MECH3202	Computer Aided Thermal Engineering		2	4	-	6	BLD	MECH2202
MECH3301	Machine Design		3	6	3	-	F2F	MECH2101, MECH2102
MECH3302	Machine Design Lab		1	2	-	3	BLD	MECH3301^{co}
MECH3401	Maintenance Spare Parts Management		3	5	3	-	F2F	IE0121
ME0347	Instrumentation & Measurements Lab		1	2	-	3	BLD	MATH205, ME0212, ME0346^{co}
GERL302B1	German VI	B1-Track	3	6	6	-	F2F	GERL301B1 or GERL301B2
GERL302B2		B2-Track						GERL301B2
MILS100	Military Science		3	2	3	-	OL	-
NE101	National Education		3	2	3	-	OL	-
		Total	**19**	**29**	**18**	**12**		

Fourth Year							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
-	Technical Elective	3	5	-	-	-	BSC001
-	Technical Elective	3	5	-	-	-	BSC001
-	Technical Elective	3	5	-	-	-	BSC001
-	Technical Elective	3	5	-	-	-	BSC001
MECH5401	Reliability for Quality Control	3	5	3	-	F2F	IE0121
MECH5801	Artificial Intelligence in Maintenance	3	5	3	-	BLD	MECH3801
	Total	**18**	**30**	**-**	**-**		

Fourth Year							
Second Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
MECH4901	International Internship[d]	12	30	20 weeks		F2F	MECH3901, Dept. Approval
	Total	**12**	**30**	**-**	**-**		

Prerequisite courses for the German year

Passing the following courses:

- MECH3202: Computer Aided Thermal Engineering
- MECH3301: Machine Design
- MECH3401: Maintenance Spare Parts Management

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

Fifth Year (Thermal Systems Track)							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
MECH5501	Heating Ventilation & Air Conditioning	3	6	3	-	F2F	MECH3202
MECH5502	Building Automation	3	5	3	-	BLD	MECH3202, ME0212
MECH5901	Graduation Project I	1	4	-	3	BLD	MECH4901, 132 CrHr
MECH5301	Vibrations and Control	3	5	3	-	F2F	MECH2104, MECH3801
MECH5503	Thermal Systems Lab	1	3	-	3	BLD	MECH2201, MECH2202
IE0361	Engineering Economics	3	5	3	-	OL	IE0121
-	University Elective II	3	3	3	-	-	-
	Total	**17**	**31**	**15**	**6**		

Fifth Year (Thermal Systems Track)							
Second Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
MECH5504	Turbomachinery	3	5	3	-	BLD	MECH3202
MECH5505	Thermal System Design	3	6	3	-	BLD	MECH3202
MECH5506	Computational Fluids Dynamics	2	6	-	6	BLD	MECH3202
MECH5902	Graduation Project II	3	6	-	9	BLD	MECH5901
MECH5402	Management of Maintenance Systems	3	6	3	-	BLD	MECH3401
	Total	**14**	**29**	**9**	**15**		

Fifth Year (Automotive and E-Mobility Track)							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
MECH5601	Theory of Machines	3	6	3	-	F2F	MECH2102, MATH203
MECH5602	Automotive Systems	3	5	3	-	BLD	MECH2102, MECH3301
MECH5901	Graduation Project I	1	4	-	3	BLD	MECH4901, 132 CrHr
MECH5301	Vibrations and Control	3	5	3	-	F2F	MECH2104, MECH3801
MECH5603	Automotive Systems Lab	1	3	-	3	BLD	MECH2102, MECH3301, MECH5602^{co}
IE0361	Engineering Economics	3	5	3	-	OL	IE0121
-	University Elective II	3	3	3	-		-
	Total	**17**	**31**	**15**	**6**		

Fifth Year (Automotive and E-Mobility Track)							
Second Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
MECH5604	Fundamentals of Vehicle Structure	3	5	3	-	BLD	MECH3301
MECH5605	Vehicle Electrical and Electronics Systems	2	6		6	BLD	ME0212
MECH5606	Hybrid and Electric Vehicles	3	6	3	-	BLD	ME0212
MECH5902	Graduation Project II	3	6	-	9	BLD	MECH5901
MECH5402	Management of Maintenance Systems	3	6	3	-	BLD	MECH3401
	Total	**14**	**29**	**9**	**15**		

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

Fifth Year (Additive Manufacturing Track)							
First Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
MECH5701	Fundamentals of Additive Manufacturing	3	6	3	-	F2F	MECH3301, IE0348
MECH5702	Material Design and Surface Engineering	3	6	3	-	BLD	MECH3301, IE0348
MECH5901	Graduation Project I	1	4	-	3	BLD	MECH4901, 132 CrHr
MECH5301	Vibrations and Control	3	5	3	-	F2F	MECH2104, MECH3801
MECH5703	Additive Manufacturing Lab	1	3	-	3	BLD	MECH3301, IE0348, MECH5701^{co}
IE0361	Engineering Economics	3	5	3	-	OL	IE0121
-	University Elective II	3	3	3	-	-	-
	Total	**17**	**32**	**15**	**6**		

Fifth Year (Additive Manufacturing Track)							
Second Semester							
Course ID	**Course Name**	**Credit Hours**	**ECTS**	**Contact Hours**		**Type**	**Prerequisites / Corequisites**
				Lect.	**Prac.**		
MECH5704	Applications in Additive Manufacturing	3	5	3	-	BLD	MECH5701
MECH5705	Design and Optimization for Additive Manufacturing	2	6		6	BLD	MECH5701
MECH5706	Advances in additive Manufacturing	3	5	3	-	BLD	MECH5701
MECH5902	Graduation Project II	3	6	-	9	BLD	MECH5901
MECH5402	Management of Maintenance Systems	3	6	3	-	BLD	MECH3401
	Total	**14**	**28**	**9**	**15**		

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

VI. Compulsory Courses Offered by Mechanical and Maintenance Engineering Department

MECH2101 Fundamentals of Mechanical Design **2 Cr Hr (0,6)** **4 ECTS**

Introduction to mechanical design principles; fundamentals of mechanical engineering working drawings and their standards (views, sections, assembly drawings, exploded views, bill of materials); dimensional and geometrical tolerances; limits and fits; surface finish; structural profiles; welding and welding symbols; introduction to various types of mechanical elements in terms of function, terminology, geometry and common standards (mechanical fasteners, power screws, springs, shafts and associated components, bearings and seals, gears, belts, roller chains, wire robes, couplings and mechanical joints). A 3D CAD software package is used in this course where many of its capabilities, toolboxes and element libraries are put to use.

Prerequisites: ARB0099,ENGL0099, ME0111

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

The course covers the core of the applied mechanics (statics) in addition to an introduction to the strength of materials, including the followings: Vector mechanics of forces and moments and resultants, equilibrium of particles and rigid bodies in two and three dimensions, Shear force and Bending moment diagrams for beams, internal loadings, geometric properties, stress and strain, mechanical properties of materials, axial load, bending, transverse shear, design of beams, column buckling.

Prerequisites: ARB0099,ENGL0099, PHYS103, MATH102

MECH2103 Mechanics of Materials Lab **1 Cr Hr (0,3)** **2 ECTS**

Tension test; Compression test; Torsion test; Hardness test; Impact test; Fatigue test; Creep test; Deflection of beams; Buckling of columns; Strain measurements; Pressure vessels; Heat treatment and Microstructure.

Prerequisites: ARB0099,ENGL0099, PHYS103, MATH101

Corequisites: MECH2102

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

Kinematics and kinetics of particles, planar kinematics and kinetics of a rigid bodies, Newton's Law, Principles of work and energy for particles and rigid bodies, impulse and momentum.

Prerequisites: ARB0099,ENGL0099, MECH2102

MECH2201 Applied Thermodynamics **3 Cr Hr (3,0)** **5 ECTS**

Students get acquainted with the fundamentals of Thermodynamic concepts and definitions, states, properties, systems, control volume; processes, cycles, and units; pure substances, equation of states, table of properties; work and heat; the first law, internal energy and enthalpy; conservation of mass; steady-state flow and unsteady flow processes; the second law, heat engines and refrigerators, reversible processes, entropy, Clausius inequality, principle of the increase of entropy, efficiencies. Carnot cycle, Otto cycle, Diesel cycle, Rankine cycle, vapor compression refrigeration cycles.

Prerequisites: ARB0099,ENGL0099, MATH102

MECH2202 Fluid flow and heat transfer **3 Cr Hr (3,0)** **5 ECTS**

Fundamental concepts in fluid mechanics, Properties of fluids, Pressure and fluid statics, Mass, Bernoulli, and energy equations, Momentum analysis of flow systems, Internal incompressible viscous flow, mechanisms of heat transfer: conduction, convection and radiation, Heat conduction equations, External and internal forced convection; Natural convection.

Prerequisites: ARB0099,ENGL0099, MATH205, MECH2201

MECH3201 Thermofluids Lab **1 Cr Hr (0,3)** **2 ECTS**

The lab includes experiments covering the topics in the field of Thermofluids sciences: Thermal Radiation, Linear Heat conduction, Combined free and forced convection, rotary machines (centrifugal pumps and compressors), Open wind tunnel, Adiabatic gas law, Heat Engines and Heat pump, heat exchangers (cross flow, shell and tube), Marcet Boiler, Vapor Compression Refrigerator and Heat Pump, Steam Power Plant, Stirling Engine

Prerequisites: MECH2202

MECH3202 Computer-Aided Thermal Engineering **2 Cr Hr (0,6)** **4 ECTS**

Thermal engineering is an established hypernym for engineering thermodynamics, fluid mechanics and heat transfer. CATE is conceived as a computer lab with a related thermofluid software as software tool. Students are first introduced to the usage and features of the utilized software before being taught how to do programming. The latter is done using examples from thermal engineering such as: turbulent flow in pipes, water pumps, Brayton cycle, Rankin cycles, heat pumps, Heat exchangers. The objective is to practice a methodical approach to programming.

Prerequisites: MATH205, MECH2201

MECH3301 Machine Design **3 Cr Hr (3,0)** **6 ECTS**

The Machine Design course includes various materials needed to design mechanical elements. Initially students will be familiar with some concepts and definitions, and then they will be introduced to general considerations and procedure of machine design: Introduction, Selected topics in stress and deflection analyses, rotating rings, contact stresses, short columns, strain energy and energy methods, failures Resulting from static and variable loadings, fatigue. Finally, the students will be introduced to the basic design principles of some machine elements and their selection (shafts, power screws, threaded fasteners, weldments, mechanical springs).

Prerequisites: MECH2101, MECH2102

MECH3302 Machine Design Lab **1 Cr Hr (0,3)** **2 ECTS**

An integrated CAD/FEA software package is utilized in this lab, and the following topics are covered: Different types of joints and common mechanical elements; Mechanisms kinematic and kinetic analysis; Basic Vibration analysis; Linear FEM stress and deflection analysis (line elements, 2D elements, and 3D elements); Fatigue analysis; Buckling analysis; Mechanisms stress analysis; Thermal stresses; Bolted connections & Contact stresses; Basic structural vibrations analysis.

Prerequisites: MECH2101, MECH2102
Corequisites: MECH3301

MECH3401 Maintenance Spare Parts Management **3 Cr Hr (3,0)** **5 ECTS**

Introduction to spare parts (definitions and classifications), introduction to maintenance terminology (planned and unplanned maintenance actions, machine total time), forecasting of spare parts needed for equipment maintenance, inventory management: inventory and supply chains, types of inventory, inventory costs, inventory measures, inventory reduction tactics, Economic Order Quantity (EOQ), inventory control systems, ABC analysis, special inventory models.

Prerequisites: IE0121

MECH3801 Computer Aided Mathematics for MECH **2 Cr Hr (0,6)** **3 ECTS**

Introduction to various software tools used in industry, including Numerical and Symbolic mathematical analysis software. Application of these software packages to engineering problems such as command line programming, numerical methods, data analysis and visualization, data acquisition, instrumentation, system simulation and control design, discrete event simulation.

Prerequisites: MATH203, MATH205

MECH3901 Field Training **0 Cr Hr (0,0)** **6 ECTS**

160 hours of training at a company in Jordan

Prerequisites: Dept. Approval, IE0281

MECH4901 International Internship **12 Cr Hr (0,0)** **30 ECTS**

Twenty-weeks of internship at a company in Germany

Prerequisites: MECH3901

MECH5301 Vibrations and Control **3 Cr Hr (3,0)** **5 ECTS**

Dynamic systems modeling in time and frequency domains. Fundamentals of vibrations of single and multi-degree of freedom systems. Natural and forced vibrations. Eigenvalue problem. System stability. Control systems design using root locus techniques. Feedback control systems including PID and Lead-Lag techniques. Filter design.

Prerequisites: MECH2104, MECH3801

MECH5401 Reliability for Quality Control **3 Cr Hr (3,0)** **5 ECTS**

Study and application of statistical models and methods for defining, measuring and evaluating reliability of systems, structures and components: lifetime distributions, reliability functions, reliability configurations, reliability estimation, parametric reliability models, accelerated life testing, reliability improvement, estimation of reliability parameters from experimental data, importance measures. Introduction to statistically based quality control and improvement methods.

Prerequisites: IE0121

MECH5402 Management of Maintenance Systems **3 Cr Hr (3,0)** **6 ECTS**

Reliability, availability, maintainability, and safety of industrial structures, systems, and components, maintenance intervention approaches (i.e., corrective, scheduled, condition-based and predictive), maintenance decision-making strategies, and techniques for risk assessment and the ways of establishing and running them effectively across multiple industries. The course will also cover the cost estimation and scheduling of maintenance activities and their key performance parameters.

Prerequisites: MECH3401

MECH5501 Heating Ventilation and Air Conditioning **3 Cr Hr (3,0)** **6 ECTS**

Introduction to HVAC economics, HVAC systems, Psychometrics, Indoor air quality/comfort issues, Heat transmission in building structures, Space heating load, Solar radiation, Space cooling load, Fans and duct system design, Pumps and piping design.

Prerequisites: MECH3202

MECH5502 Building Automation **3 Cr Hr (3,0)** **5 ECTS**

The course is related to building control, intelligent building and building automation systems (BAS). Topics include: Control Theory, device technology (sensors, control elements), digital direct control (DDC), human machine interface (HMI), BAS design, specification and protocols, energy conservation control strategies, communication systems, and system maintenance. Applications: HVAC control devices, lighting control systems, Fire alarm systems, Video Surveillance systems, Voice-Data-Video systems, Access control systems, Data Networks and networks integration.

Prerequisites: MECH3202, ME0212

MECH5503 Thermal Systems Lab **1 Cr Hr (0,3)** **3 ECTS**

Thermal conductivity of building materials, film and dropwise condensation processes, air conditioning, combustion process, bomb calorimeter, exhaust gas analyzer, thermal imaging camera and thermal radiators

Prerequisites: MECH2201, MECH2202

MECH5504 Turbomachinery **3 Cr Hr (3,0)** **5 ECTS**

The focus of this course is on the understanding of the basic principles of various types of turbomachines. Through covering the basic fluid mechanics and thermodynamics with a detailed discussion of the governing equations. Topics to be covered: dimensional analysis for rotating machinery, the basic theory of turbomachines, incompressible flow machines such as hydraulic turbines, pumps, fans, and blowers, compressible flow machines such as gas turbines, compressors, and steam turbines.

Prerequisites: MECH3202

MECH5505 Thermal System Design **3 Cr Hr (3,0)** **6 ECTS**

This course provides tools to design energy efficient, cost effective and reliable equipment/systems at optimum conditions. Systems analysis applied to chillers, heat pumps, evaporators, condensers, expansion devices, cooling towers, boilers and furnaces, design and integration of thermal systems, modelling and simulation and of thermal system, optimization of thermal systems designs.

Prerequisites: MECH3202

MECH5506 Computational Fluid Dynamics **2 Cr Hr (0,6)** **6 ECTS**

This course will focus on the terminology, principles and methods of CFD - Computational Fluid Dynamics. It Aims at developing students' understanding of the conservation laws applied to fluid motion and heat transfer and basic computational methods including explicit, implicit methods, discretization schemes and stability analysis; Develop practical expertise in solving CFD problems with a commercial CFD code. CFD can be applied in many areas of engineering, including aerodynamics, hydrodynamics, air-conditioning, heat transfer, combustion, etc.

Prerequisites: MECH3202

MECH5601 Theory of Machines **3 Cr Hr (3,0)** **6 ECTS**

Position analysis, mechanisms, vector analysis of velocity and acceleration, analytic and graphical loop closure methods, cam design, spur, bevel, and helical gears, gear trains, force analysis, static and dynamic balance of rotors, synthesis of linkage, spatial mechanisms, and Steering mechanics.

Prerequisites: MECH2102, MATH203

MECH5602 Automotive Systems **3 Cr Hr (3,0)** **5 ECTS**

The course will introduce to the students several systems in the automobile including different transmission systems such as the manual, automatic, and the continuously variable transmission (CVT). Besides, the main elements of the cooling systems will be discussed. Additionally, several types of braking systems such as mechanical, hydraulic, magnetic, and electric braking systems will be demonstrated. Drum and disc brakes will be illustrated, and single and dual acting brakes will be presented. Furthermore, the exhaust systems and its main parts and construction will be explained. Likewise, suspension and safety automobile systems will be clarified.

Prerequisites: MECH2102, MECH3301

MECH5603 Automotive Systems Lab **1 Cr Hr (0,3)** **3 ECTS**

Bomb Calorimeter, Exhaust Gas Analyzer, Internal Combustion Engine, Combustion Process, Stirling Engine, Car Model (demonstration, de-assemble and assemble of different systems such as suspension system, engine block and combustion chambers, wipers system, and brake pedal system, hand brake system), Vibration Experiments (Free and damped response of simple mass-spring-damper systems, static and dynamic balancing, harmonically excited systems, base excitation, etc.)

Prerequisites: MECH2102, MECH3301

Corequisites: MECH5602

MECH5604 Fundamentals of Vehicle Structure **3 Cr Hr (3,0)** **5 ECTS**

The importance for this course will be on obtaining insight into auto body structural behavior and the relationship to the vehicle. Body structure element performance will be examined including thin-walled members, panels, joints, spot welds, and local attachments. Structural models for the main requirements will be analyzed. These include global body bending, body torsion, crashworthiness, and vibration behavior. The importance of bending and torsion stiffness on the perceived level of refinement will be considered, and tools for analysis will be established. Moreover, fluid-solid interaction will be introduced including the drag and lift coefficients, and the aerodynamic forces.

Prerequisites: MECH3301

MECH5605 Vehicle Electrical and Electronics Systems **2 Cr Hr (2,0)** **6 ECTS**

This course introduces diagnosis and repair of automotive electrical and electronic systems. Topics covered include electrical and electronic principles, tools and test equipment, electrical systems and circuits, batteries, charging systems, starting systems, ignition systems, electronic fuel control, lighting, auxiliaries, instrumentation, air conditioning, chassis electrical systems., and comfort and safety.

Prerequisites: ME0212

MECH5606 Hybrid and Electric Vehicles **3 Cr Hr (3,0)** **6 ECTS**

Hybrid and electric vehicles are currently the dominant technologies in the new generation of automobiles. This course examines the sub-systems of hybrid and electrified vehicles—including the engine—as well as the integration of these sub-systems into the vehicle. The course covers the modeling and analysis of vehicles with electrified propulsion systems, including electric vehicles, hybrids, plug-in, and fuel cell vehicles. The course will introduce students to the concepts and terminology, state-of-the-art developments, energy conversion and storage options, and system integration.

Prerequisites: ME0212

MECH5701 Fundamentals of Additive Manufacturing **3 Cr Hr (3,0)** **6 ECTS**

Comprehensive study of the fundamentals, process characteristics, practical applications of the 7 ASTM AM processes including material jetting, powder bed fusion, vat polymerization, material extrusion, direct energy deposition, sheet lamination, binder jetting, Design, and process preparation for additive manufacturing. Printing processes and post-processing. Case studies of AM in Industry.

Prerequisites: MECH3301, IE0348

MECH5702 Material Design and Surface Engineering **3 Cr Hr (3,0)** **6 ECTS**

Understanding and manipulating of material's microstructure to avoid failure. Design for strength, toughness, creep resistance, and fatigue resistance. Mechanical, topographical, microstructural, and chemical characterization of surfaces. Methods for processing and modification of component surfaces printed in metals and polymers, including grit blasting, shot peening, grinding, heat treatment, mechanical and chemical polishing. Introduction to various surface conversion and surface coating methods is presented and discussed.

Prerequisites: MECH3301, IE0348

MECH5703 Additive Manufacturing Lab **1 Cr Hr (0,3)** **3 ECTS**

Explore all aspects of metal additive manufacturing including design, prototyping, build preparation, fabrication, post-processing, machining, inspection, and characterization.

Prerequisites: MECH3301, IE0348
Corequisites: MECH5701

MECH5704 Applications in Additive Manufacturing **3 Cr Hr (3,0)** **5 ECTS**

The aim with the course is to give the students an understanding for state-of-the-art of AM in various end-use sectors i.e aerospace and defense, medical devices, dentistry, automotive, consumer goods, tooling, etc. The course will be based on latest literature in the field.

Prerequisites: MECH5701

MECH5705 Design and Optimization for Additive Manufacturing **2 Cr Hr (2,0)** **6 ECTS**

Design methods and tools for additive manufacturing, including opportunistic and restrictive aspects of different additive manufacturing. Hands-on with design tools and slicer tools to generate CAD, STL, G-code, and others file formats. Development of optimization codes for performing stiffness analysis and topology optimization.

Prerequisites: MECH5701

MECH5706 Advances in Additive Manufacturing **3 Cr Hr (3,0)** **5 ECTS**

Fundamentals of sintering and fusion of metals, ceramics, and polymers. Process steps from raw material selection and preparation, design, printing, and post-treatments. Methods for characterization of printed components. Additive manufacturing as a complement to or substitution for conventional production techniques. Various techniques for other additive manufacturing of polymers including extrusion, photopolymerization, material jetting as well as binder jetting and their uses and limitations.

Prerequisites: MECH5701

MECH5801 Artificial Intelligence in Maintenance **3 Cr Hr (3,0)** **5 ECTS**

Principles of Artificial Intelligence (AI) and its application in Prognostics and Health Management (PHM) for Condition-based and Predictive Maintenance. Students will learn how to adopt/adapt the most commonly used AI techniques for developing a comprehensive PHM system capable of accurately detecting abnormalities that can lead to costly breakdowns (fault detection), diagnosing their causes (fault diagnosis), and predicting their evolutions (fault prognosis). By the end of the course, students will have a thorough understanding of AI and how it applies to maintenance management.

Prerequisites: MECH3801

MECH5901 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 mechanical and maintenance engineering.

Prerequisites: MECH4901, 132 CrHr

MECH5902 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 mechanical and maintenance engineering.

Prerequisites: MECH5901

VII. Elective Course Offered by Mechanical and Maintenance Engineering Department

MECH4201 Advanced Heat Transfer **3 Cr Hr (3,0)** **5 ECTS**

Multi-dimensional steady state conduction, analytical, graphical and numerical solutions, one dimensional transient conduction, convective heat transfer in turbulent and high-speed flows, freezing, melting, heat pipe and multimode heat transfer.

Prerequisites: BSC001

MECH4202 Intermediate Fluid Mechanics **3 Cr Hr (3,0)** **5 ECTS**

Bridge between introductory fluid mechanics and advanced graduate level course. Principles of incompressible and compressible flows, boundary layer theory, and analysis using differential formulations of the governing conservation equations. Analysis of phenomena relevant to the practice of engineering is emphasized through problem solving.

Prerequisites: BSC001

MECH4203 Case Studies in Thermal Engineering and Design **3 Cr Hr (3,0)** **5 ECTS**

Characteristics of applied heat transfer problems. Nature of problem specification, incompleteness of needed knowledge base, accuracy issues. Categories of applied heat transfer problems.

Prerequisites: BSC001

MECH4204 Thermodynamics of Fluid Flow with Applications **3 Cr Hr (3,0)** **5 ECTS**

Conservation of mass, momentum, energy. Relevant thermodynamic properties. Nozzles, diffusers, thrust producers, shocks. Fluid-wall frictional interactions. Wall heat transfer, internal heat release. Temperature recovery. Mass addition.

Prerequisites: BSC001

MECH4205 Computational Heat Transfer **3 Cr Hr (3,0)** **5 ECTS**

Numerical solution of heat conduction/analogous physical processes. Develop/use computer program to solve complex problems involving steady/unsteady heat conduction, flow/heat transfer in ducts, flow in porous media.

Prerequisites: BSC001

MECH4206 Combustion **3 Cr Hr (3,0)** **5 ECTS**

Thermodynamics, kinetics, energy and mass transport, pollutants in reacting systems. Reactors, laminar and turbulent flames. Ignition, quenching, and flame stability. Diffusion flames. Combustion in reciprocating engines, furnaces, and turbines, with emphasis on internal combustion engine performance and emissions.

Prerequisites: BSC001

MECH4207 Gas Turbines **3 Cr Hr (3,0)** **5 ECTS**

Gas turbine cycles, regeneration, recuperation, reheat, intercooling, combined cycle plants, and thermochemical regeneration. Axial and radial flow compressors and turbines; combustor designs, energy analysis, emissions, and noise. Turbojet, fanjet, turboprop engine performance. Stationary power plants, vehicular propulsion, hybrid vehicles.

Prerequisites: BSC001

MECH4208 Conduction **3 Cr Hr (3,0)** **5 ECTS**

Advanced understanding/application of conduction/diffusion to heat/mass transfer problems. Solving ordinary/partial differential equations related to physics of diffusion. Special topics in numerical microscale heat transfer.

Prerequisites: BSC001

MECH4209 Convection **3 Cr Hr (3,0)** **5 ECTS**

Heat transfer in fluids flowing around bodies and in tubes/ducts. Forced/natural convection. Laminar/turbulent flow regimes. Turbulent transport and modeling. High-speed flows, viscous dissipation, variable property effects. Application to heat exchange devices. Convective mass transfer.

Prerequisites: BSC001

MECH4210 Thermal Radiation Heat Transfer **3 Cr Hr (3,0)** **5 ECTS**

Blackbody Radiation, Properties for Opaque Surfaces, Diffuse Configuration Factors, Radiant Exchange in Diffuse Enclosures, Radiation Combined with Conduction and Convection, Gas Radiation in Enclosures, Enclosures with Reflecting Surfaces, Windows, Coatings and Semi-transparent Solids, combined heat transfer problems of radiation with convection and/or conduction, analytical and numerical techniques in heat radiation, Engineering applications.

Prerequisites: BSC001

MECH4211 Bioheat and Mass Transfer **3 Cr Hr (3,0)** **5 ECTS**

Analytical/numerical tools to analyze heat/mass transfer phenomenon in cryobiological, hyperthermic, other biomedically relevant applications.

Prerequisites: BSC001

MECH4212 Two Phase Flow and Heat Transfer **3 Cr Hr (3,0)** **5 ECTS**

Nature of multiphase flow. Flow regime maps. Two-phase flow in vertical, horizontal and inclined pipes. Modelling of two-phase flow: homogenous model; drift flux model; drift velocity model; separated model. Annular and stratified flows. Flow in adiabatic pipes. Flow in heated pipes. The critical flow of a two-phase mixture. Pressure drop and heat transfer correlations in pipes.

Prerequisites: BSC001

MECH4213 Design and Selection of Heat Exchangers **3 Cr Hr (3,0)** **5 ECTS**

Conduction and convection of heat transfer-problem: formulation and solution, Optimum thickness of pipe insulation. Double pipe heat exchangers Plate and frame heat exchangers, Cross flow heat exchangers, Analysis of shell and tube heat exchangers, Effectiveness-NTU analysis, Design considerations, Optimum outlet water temperature analysis, flow maldistribution in heat exchangers, transient behavior, flow-induced vibrations, thermal fouling.

Prerequisites: BSC001

MECH4214 Thermal Management of Electronic Systems **3 Cr Hr (3,0)** **5 ECTS**

Introduction to principles of thermal management for controlling heat dissipation in electronics systems. Understanding of how basic heat transfer principles can be applied to the thermal design of electronic packages. Passive and active thermal management techniques for electronic systems & components are considered with regard to fundamental heat transfer modes. Design studies for single- and multi-chip modules, printed circuit board, and high-heat-flux cooling.

Prerequisites: BSC001

MECH4215 Renewable Energy **3 Cr Hr (3,0)** **5 ECTS**

Design and analysis of renewable energy systems and technologies including solar thermal, solar Photovoltaics, wind energy, geothermal energy, biomass, hydropower, fuel cells.

Prerequisites: BSC001

MECH4216 Battery Technology **3 Cr Hr (3,0)** **5 ECTS**

The basics of electrochemistry, material science, and the functional principles of innovative batteries. Types, functions, requirements, targets, designs, materials, manufacturing, production techniques, and R&D trends of Batteries while considering essential parameters, such as efficiency, energy density, service life, safety and costs.

Prerequisites: BSC001

MECH4217 Bioenergy **3 Cr Hr (3,0)** **5 ECTS**

Biomass (species, formation/origin, potential), Processes for converting biomass (thermo-chemical, physico-chemical, bio-chemical) into heat, electricity, and biofuels, potential and perspectives and evaluation of Bioenergy in the current and future global energy mix.

Prerequisites: BSC001

MECH4219 Power Grid Technologies **3 Cr Hr (3,0)** **5 ECTS**

Biomass (species, formation/origin, potential), Processes for converting biomass (thermo-chemical, physio-chemical, bio-chemical) into heat, electricity and biofuels, Potential and perspectives and evaluation of Bioenergy in the current and future global energy mix.

Prerequisites: BSC001

MECH4219 Solar Thermal Technologies **3 Cr Hr (3,0)** **5 ECTS**

Solar radiation fundamentals. Measurement/processing needed to predict solar irradiance dependence on time, location, and orientation. Characteristics of components in solar thermal systems: collectors, heat exchangers, thermal storage. System performance, low-temperature applications. Concentrating solar energy, including solar thermo-chemical processes, to produce hydrogen/solar power systems and photovoltaics. Solar design project.

Prerequisites: BSC001

MECH4301 Structural Dynamics and Durability Analysis **3 Cr Hr (3,0)** **5 ECTS**

Classification of structural dynamic vibration problems and damage's signs, Free and forced vibrations of single-degree-of-freedom and multiple-degree-of-freedom systems, Development of periodic signals in Fourier series, Numerical analysis of continuous oscillators (1D) and determination of time-dependent stress profiles, Modal analysis and reduction of vibratory systems, Influence of structural damping on the vibration behavior, Determination of collective loads, Wöhler curves and fatigue strength characteristics, Damage accumulation, and Rotordyn vibration and service life analysis.

Prerequisites: BSC001

MECH4302 Finite Element Methods **3 Cr Hr (3,0)** **5 ECTS**

Definitions and simple finite element formulation truss, beam and triangular elements, modeling principles and mesh specification, computer applications and term project

Prerequisites: BSC001

MECH4303 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: BSC001

MECH4304 Machine Dynamics **3 Cr Hr (3,0)** **5 ECTS**

Force analysis of machinery, resonance (symptoms, tests, fixes), rotors dynamics, 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: BSC001

MECH4305 Nonlinear Dynamics **3 Cr Hr (3,0)** **5 ECTS**

The teaching contents cover the nonlinear vibration behaviors of discrete system, autonomous system non-autonomous system, including modeling of nonlinear systems, numerical methods, coexistence of multiple solutions, bifurcation, chaos and stability analysis.

Prerequisites: BSC001

MECH4401 Automotive Maintenance **3 Cr Hr (3,0)** **5 ECTS**

Maintenance of automotive systems: automatic transmission and transaxles, power train and axles, suspension and steering, brakes, electrical/electronic systems, cooling system, heating and air conditioning, control system, and engine performance.

Prerequisites: BSC001

MECH4402 Building Maintenance **3 Cr Hr (3,0)** **5 ECTS**

Building systems overview, building scoping for operational improvement, O&M practices for sustainable buildings, indoor environmental quality, preventive maintenance and troubleshooting principles, HVAC systems maintenance, facility electrical systems maintenance, efficient lighting fundamentals, maintenance of motors and drives.

Prerequisites: BSC001

MECH4403 Safety & Loss Prevention **3 Cr Hr (3,0)** **5 ECTS**

Study of safety elements and hazards associated with different types of machines and work environment, accident recognition and elimination, OSHA standards of maintenance operations, designing and managing of safety operations procedures and guidelines of maintenance, types of losses in production lines and the role of maintenance to reduce it.

Prerequisites: BSC001

MECH4404 Maintenance Costing **3 Cr Hr (3,0)** **5 ECTS**

Elements of maintenance costs including material, spare parts, labor (direct and indirect), overhead, and outsourcing, maintenance costing reports and budgeting activities, financial statements, traditional costing, activity-based costing, fundamental pricing issues and price setting.

Prerequisites: BSC001

MECH4405 Modern Maintenance Management Systems **3 Cr Hr (3,0)** **5 ECTS**

Introduction to maintenance management, an overview of Computerized Maintenance Management Systems (CMMS), its objectives and profitability, software and features, practical applications, and case studies.

Prerequisites: BSC001

MECH4406 Systems Engineering **3 Cr Hr (3,0)** **5 ECTS**

Systems terminology, definitions, issues, and the design process, Systems thinking, needs identification, requirements formulation, architecture definition, technical management, design integration, and verification and validation of designs, Systems engineering standards, Tools, methodologies and procedures for solving complex systems engineering problems, such as in aerospace and defense, transportation, and energy.

Prerequisites: BSC001

MECH4407 Failure Analysis **3 Cr Hr (3,0)** **5 ECTS**

Theory of Failure Analysis, Industry Quality Systems Overview, Failure Mode Effect Analysis (FMEA) overview, process flow, control, prevention, detection, and types, and Application of failure analysis in industries.

Prerequisites: BSC001

MECH4408 Maintenance, Repair, and Operation Strategies and Planning **3 Cr Hr (3,0)** **5 ECTS**

Modern methods of Maintenance, Repair and Operation (MRO) strategic planning and optimization for specific end users' needs while considering the environmental and cost aspects.

Prerequisites: BSC001

MECH4409 Human Resource Management **3 Cr Hr (3,0)** **5 ECTS**

HRM in a changing environment, Introduction to HR functions, Effective job analysis, Employee recruitment, Selecting employees, Training and developing employees, Career development, Performance management, Compensation, Employee benefits.

Prerequisites: BSC001

MECH4410 Six Sigma **3 Cr Hr (3,0)** **5 ECTS**

Introduction to the Define, Measure, Analyze, Improve and Control (DMAIC) method that includes project definition, measurement of the most critical process variables, analysis of the associated data, improvement based on statistical test planning and control of the future process. Six Sigma concepts and methodologies in practice.

Prerequisites: BSC001

MECH4411 Production Management **3 Cr Hr (3,0)** **5 ECTS**

Internal and External production management. The former includes strategic and operational production planning, process design, and production logistics. The latter includes an overview of materials management (determination of material requirements, materials planning, procurement/purchasing, logistics), material procurement and procurement logistics, and material disposal.

Prerequisites: BSC001

MECH4412 Innovation Management **3 Cr Hr (3,0)** **5 ECTS**

Innovation process in technically oriented sectors such as mechanical, plant engineering, and automotive industry, including strategic innovation planning, road mapping, customer benefits through innovation, creative processes and systematic brainstorming, idea generation, evaluation and selection, feasibility study, creation of business cases, product development process, market-ready product distribution, product maintenance, project management and agile methods, intellectual property

Prerequisites: BSC001

MECH4413 Business Administration for Engineers **3 Cr Hr (3,0)** **5 ECTS**

Introduction to business administration, including rational and economic principles, factors of production, basics of management and organization (load, stress, motivation, reward systems), and business accounting (accounting, annual accounts, balance sheet, cost accounting, etc.).

Prerequisites: BSC001

MECH4414 Ergonomics and Ecodesign **3 Cr Hr (3,0)** **5 ECTS**

Basic ergonomic terms, ergonomic aspects in the design process, basics of work physiology, anthropometric workplace design (Human-Machine Interface (HMI)), Machine-Machine-Interface (MMI), the usability, design and structure of a user interface, sustainable development and design, eco-design, global development of resources, energy, ecology, dimensions and strategies of sustainability, circular economy, eco-effectiveness, substitution of components, materials and processes, sustainable design and construction.

Prerequisites: BSC001

MECH4415 Process Management **3 Cr Hr (3,0)** **5 ECTS**

Methods for process optimization and digitization, modeling approaches, skills for carrying out process analyses, process design and controlling, and the optimization potential with examples of value stream analysis.

Prerequisites: BSC001

MECH4601 Ignition Systems **3 Cr Hr (3,0)** **5 ECTS**

Ignition process, Spark ignition, and Spark ignition system design, challenges, new developments, and alternative spark systems.

Prerequisites: BSC001

MECH4602 Electromobility **3 Cr Hr (3,0)** **5 ECTS**

Overview of the history, current state, and future directions of Electric Vehicles (EVs). Introduction to the different types of EVs, components, and technologies adopted/adapted. This course also covers the economic and environmental impacts of EVs, legal and regulatory aspects, and challenges and opportunities associated with their development.

Prerequisites: BSC001

MECH4603 Vehicle Emissions **3 Cr Hr (3,0)** **5 ECTS**

Types of emissions (e.g., dust, gases), emissions vs. imissions, Effects on people and environment, Legal regulations, Sustainability concept, Climate relevant emissions and the greenhouse effect, Generation and reduction of vehicle emissions, Measures to reduce emissions, Exhaust after-treatment/emission reduction, A comparison of emissions from vehicle and drive concepts.

Prerequisites: BSC001

MECH4604 Data-Driven Algorithms in Vehicle Technology **3 Cr Hr (3,0)** **5 ECTS**

Data-driven algorithms in automobile technology, Fundamentals for vehicle routing and relevant data sources, Algorithms for parameter estimation and state classification of the vehicle, Learning methods for driver behavior, and forecasting algorithms to forecast the future energy consumption of a vehicle.

Prerequisites: BSC001

MECH4605 Driver Assistance Systems and Autonomous Driving **3 Cr Hr (3,0)** **5 ECTS**

Development methodology for driver assistance systems, Testing and evaluation procedures, Vehicle physics and modelling, Sensors and actuators, Assistance systems at stabilization level, on-path guidance and navigation level, ACC, parking assistance, lane departure warning, and Future of assistance systems.

Prerequisites: BSC001

MECH4606 Automotive and Railway Safety **3 Cr Hr (3,0)** **5 ECTS**

Introduction to automotive and railway safety, Site investigation and cause-finding procedures, Data collection, evidence reconstruction and presentation, Failure analysis, and Computer simulations for automotive and railway accident investigations.

Prerequisites: BSC001

MECH4607 Railway Telematics Architectures **3 Cr Hr (3,0)** **5 ECTS**

Overview of railway telematics architectures (types, components, etc.) and their applications, Introduction about communication networks, data management and security. Protocols and standards used in railway telematics systems. The design and implementation of railway telematics systems as well as the associated technical/practical challenges.

Prerequisites: BSC001

MECH4608 Planning of Railway Systems **3 Cr Hr (3,0)** **5 ECTS**

Fundamental principles defining the railway as a system and Railway planning and management processes (timetabling, decision-making processes related to a station's location, etc.).

Prerequisites: BSC001

MECH4609 Railway Construction **3 Cr Hr (3,0)** **5 ECTS**

Fundamental knowledge in the design, construction and maintenance of railway lines, Basic concepts and terminology used in the design of railway lines, Concepts comprising the infrastructure and superstructure of railways, and maintenance and operation of railway lines.

Prerequisites: BSC001

MECH4610 Railway Operations Management **3 Cr Hr (3,0)** **5 ECTS**

Processes of shunting, train preparation and railway operations management as well as their associated time elements and their components with different boundary conditions. Methods and procedures of the route management as well as the railway operations control. Models and procedures for performance studies and dimensioning tasks of the railway infrastructure and the operating processes in the event of disruptions and deviations from the rules of operation.

Prerequisites: BSC001

MECH4701 CAD/CAM/Rapid Prototyping **3 Cr Hr (3,0)** **5 ECTS**

Overview of the additive manufacturing technologies, fields and sub-fields of application of additive manufacturing technologies, the structure of the process chain required for additive manufacturing, manufacturing processes in the field of rapid prototyping, laser stereolithography process, the process for creating CNC programs using CAM systems, techniques for CNC programming, the problems of creating CNC programs, the structure of a CAM system and the way of establishing a simple CAM module.

Prerequisites: BSC001

MECH4702 Micro and ultra-precision machining **3 Cr Hr (3,0)** **5 ECTS**

Introduction to micro and ultra-precision machining: classification, process chains and scaling effects, Abrasive processes: classification, electrochemical ablation, spark erosion, laser material processing, Design of removal processes through multiphysics simulation, Machining processes: classification, basics and fundamentals of micro-machining, micro-machining with geometrically determined cutting edges, Ultra-precision machining: turning, milling and fly cutting.

Prerequisites: BSC001

MECH4703 Primary Shaping, Forming, and Machining **3 Cr Hr (3,0)** **5 ECTS**

Applications and processes in production preparation, in the manufacture of castings and in post-processing, Powder metallurgical production of components, Additive processes for manufacturing components, Methods for the production of ready-to-install parts by forming, Removal: classification and general principles, chemical removal, electrochemical removal, spark erosion, laser material processing, Chips: classification and general principles, chips with geometrically defined cutting edges, chips with geometrically undefined cutting edges.

Prerequisites: BSC001

MECH4704 Joining, Coating, and Assembly **3 Cr Hr (3,0)** **5 ECTS**

Arc welding process, Mechanization and automation and quality assurance procedures, Electron, laser beam and hybrid technologies, Thermal spraying and other innovative coating processes, Mechanical and low-heat joining methods, High-tech thermal cutting processes, Additive generative welding processes, Welding simulation and sensors.

Prerequisites: BSC001

MECH4705 Laser Material Processing **3 Cr Hr (3,0)** **5 ECTS**

Material processing with laser, including laser beam welding and brazing, laser ablation, drilling and cutting surface modification and hardening, laser beam forming, laser assisted additive manufacturing, and ultrafast laser processing.

Prerequisites: BSC001

MECH4801 Human-Machine-Interaction **3 Cr Hr (3,0)** **5 ECTS**

Fundamental concepts and principles of Human Machine Interaction (HMI), User interface design, prototyping and interface analysis methods, Quantitative and qualitative user modeling and interface evaluation methods, Special topics in HMI (ecological and adaptive HMI, speech and handwriting UIs in HMI, engineering aesthetics in HMI, etc.).

Prerequisites: BSC001

MECH4802 Smart Factory **3 Cr Hr (3,0)** **5 ECTS**

Introduction to the concept of the smart factory. The course introduces the various components of the smart factory, including automation, robotics, and the Internet of Things (IoT). Overview of the smart factory's benefits (e.g., enhanced efficiency, etc.), challenges (e.g., data security, etc.), and technologies (e.g., artificial intelligence, cloud computing, etc.).

Prerequisites: BSC001

MECH4803 Smart Systems and Adaptive Structures **3 Cr Hr (3,0)** **5 ECTS**

Principles of smart systems and adaptive structures, including their design, analysis, and control. Sensors, actuators, and controllers used in the design and analysis of smart systems and adaptive structures. Their applications in various engineering applications.

Prerequisites: BSC001

MECH4804 Electrical Propulsion Systems **3 Cr Hr (3,0)** **5 ECTS**

Overview of the different types of electric powertrains and their components (and their interaction) in vehicles and machines (wired, wireless, hybrid drive systems).

Prerequisites: BSC001

MECH4910 Special Topics in Thermal Systems **3 Cr Hr (3,0)** **5 ECTS**

A course on special topics in Thermal Systems

Prerequisites: BSC001

MECH4902 Special Topics in Energy Engineering **3 Cr Hr (3,0)** **5 ECTS**

A course on special topics in Energy Engineering

Prerequisites: BSC001

MECH4903 Special Topics in Applied Mechanics **3 Cr Hr (3,0)** **5 ECTS**

A course on special topics in Applied Mechanics

Prerequisites: BSC001

MECH4904 Special Topics in Maintenance Engineering **3 Cr Hr (3,0)** **5 ECTS**

A course on special topics in Maintenance Engineering

Prerequisites: BSC001

MECH4905 Special Topics in Engineering Management **3 Cr Hr (3,0)** **5 ECTS**

A course on special topics in Engineering management

Prerequisites: BSC001

MECH4906 Special Topics in Automotive and E-mobility **3 Cr Hr (3,0)** **5 ECTS**

A course on special topics in Automotive and E-mobility

Prerequisites: BSC001

MECH4907 Special Topics in Manufacturing Engineering **3 Cr Hr (3,0)** **5 ECTS**

A course on special topics in Manufacturing Engineering

Prerequisites: BSC001

MECH4908 Special Topics in Mechatronics Engineering **3 Cr Hr (3,0)** **5 ECTS**

A course on special topics in Mechatronics Engineering

Prerequisites: BSC001

MECH4911 Special Topics I **1 Cr Hr (1,0)** **2 ECTS**

A course on special topics in one of Mechanical and Maintenance Engineering fields or related fields

Prerequisites: BSC001

MECH4912 Special Topics II **2 Cr Hr (2,0)** **3 ECTS**

A course on special topics in one of Mechanical and Maintenance Engineering fields or related fields

Prerequisites: BSC001

VIII. 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

IE0348 Materials and Manufacturing Engineering **3 Cr Hr (3,0)** **5 ECTS**

Classification and study of engineering materials, their structure, properties, and behavior, typical metals and alloys, plastics and rubber, and ceramic materials; phase equilibrium and manipulation of properties and behavior by adjustment of composition and processing variables; traditional manufacturing processing of materials including metal cutting, casting, rolling, forging, and drawing, and other modern manufacturing processes.

Prerequisites: IE0141, CHEM103

IE0361 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

IE0401 Engineering Project Management **3 Cr Hr (3,0)** **5 ECTS**

Examines the organization, planning, and controlling of projects and provides practical knowledge on managing project scope, schedule and resources. Topics include Cost estimation and the budgeting process, project life cycle, work breakdown structure and Gantt charts, network diagrams (CPM and PERT), and resource allocation decisions. Concepts are applied through team projects using project management software. Competence with a set of tools and methods for product design and development.

Prerequisites: BSC001

IE0515 Product Development and Entrepreneurship **3 Cr Hr (3,0)** **5 ECTS**

Integration of the marketing, design, and manufacturing functions of organizations in creating entrepreneurial and new innovative products. Tools and methods for product design and development. Multiple functions in creating a new product (marketing, finance, industrial design, engineering, production), Definition of entrepreneurs and entrepreneurship, Entrepreneurship in economic theory, Historical development of entrepreneurship, Type of entrepreneurship and features and types of businesses and entrepreneurs, Sources of business ideas, Innovation and entrepreneurship, Entrepreneurship and small business.

Prerequisites: BSC001

IE0516 Facility and Asset Management **3 Cr Hr (3,0)** **5 ECTS**

Students learn the concepts and methodology of facilities planning as well as layout planning, optimization algorithms applied to facilities layout, selection of material handling systems, and operations of warehouse. Students acquire knowledge and skills in the areas of strategic facilities planning and manufacturing facilities design. Students carry independent project work and research in the field.

Prerequisites: BSC001

IE0533 Supply Chain Engineering **3 Cr Hr (3,0)** **5 ECTS**

The module covers topics related to supply chain design, planning, and integration. This includes sourcing decisions, logistic systems, capacity analyses, aggregate planning, and distribution networks. The module also discusses latest development in supply chain management including sustainability and technology applications. The team project portion of the module allows the students to model and evaluate a real-world supply chain. This includes developing a SIPOC structure, setting KPIs, and optimizing the supply chain network.

Prerequisites: BSC001

IE0562 Industrial Cost analysis **3 Cr Hr (3,0)** **5 ECTS**

Students gain knowledge regarding managerial accounting and cost concepts, classifications and calculations. Module also introduces ABC and other costing methods such as cost for pricing, cost evaluation and improvement, costs for decision making, budgeting, and variance analysis. Students are introduced to financial balance sheet calculations, depreciation, assets and liabilities, and taxes.

Prerequisites: BSC001

ME0111 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

ME0212 Electrical Circuits and Machines **3 Cr Hr (3,0)** **5 ECTS**

Definitions, circuit laws, simple circuit, circuit analysis techniques; Phasor concept, Sinusoidal steady-state response; Average power and root mean square values, complex power and power factor; Poly-phase circuits, transformers (single phase); Basics in electronics (semiconductor diodes and Op-Amps, transistors, bipolar junction transistor, thyristors); DC machines (separately and shunt), three-phase induction motors, special purpose motors.

Prerequisites: ARB0099,ENGL0099, PHYS104

ME0213 Electrical Circuits and Machines Lab **1 Cr Hr (0,3)** **2 ECTS**

Resistive circuits, potentiometers, superposition, RLC circuits, diode circuits, operational amplifiers and application, transformer, DC motors and generators, single- and three-phase induction motor, three-phase synchronous motors and generators.

Prerequisites: ARB0099,ENGL0099
Corequisites: ME0212

ME0346 Instrumentation & Measurements **3 Cr Hr (3,0)** **5 ECTS**

Introduction to instrumentation, Units, Dimensions and standards, Error measurements, Statistical analysis of experimental data, Op-Amp circuits in instrumentation, Basic electrical measurement and sensing devices: physics of electric, magnetic, chemical sensors displacements, area, pressure, flow, temperature, thermal and transport properties, force, torque and strain measurements. Smart sensors and networking of sensor systems. Data acquisition and processing.

Prerequisites: MATH205, ME0212

ME0347 Instrumentation & Measurements Lab **3 Cr Hr (3,0)** **5 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.

Corequisites: ME0346

ME0522 Hydraulics and Pneumatics **3 Cr Hr (3,0)** **5 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: 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

ME0548 Control Systems II **3 Cr Hr (3,0)** **5 ECTS**

State-space modeling of multi-variable systems, stability, sensitivity, controllability, and observability, optimal observers, Kalman filter, linear quadratic regulators, digital control systems, z-transform, stability, transient response, digital cascade compensators.

Prerequisites: BSC001

ME0551 Robotics **3 Cr Hr (3,0)** **5 ECTS**

Planar and spatial transformations, forward and inverse kinematics, trajectory planning, robot dynamics, robot control (linear, nonlinear, and force control), mobile robots and navigation. Robot control architectures and programming.

Prerequisites: BSC001

ME0571 Machine Intelligence I **3 Cr Hr (3,0)** **5 ECTS**

A review of mathematical logic, statistics and probabilistic important concepts, Principles of the uninformed, informed, local, adversarial search, search with uncertainty, the concept of agents, reward, states, and actions; The basics of most artificial intelligence methods, Introduction to fuzzy logic, Machine learning techniques (supervised and unsupervised), Artificial neural network, Machine learning technique (reinforcement learning), time series analysis for model predictive control, Applications of Artificial Intelligence in robotic, machine vision, categorization, path planning, Ethical considerations and risks of further development of Artificial Intelligence. Logistic regression, SVM, decision trees concepts, Kaggle challenge.

Prerequisites: BSC001

ME0577 Automation and Industry 4.0 **3 Cr Hr (3,0)** **5 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: BSC001

IX. 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.

DES101 Arts' Appreciation **3 Cr Hr (3,0)** **3 ECTS**

An introductory course designed for non-art students to give them the basic knowledge of arts and simple approaches to the understanding of the history, development, elements, criticism, esthetics and materials of different art forms (visual, aural and performing arts). A comparative approach between the different arts is given to enhance the students' global understanding of arts and to give them the ability to look at art works and form their own opinions. The course is combined with examples of audio and visual arts.

Prerequisites: ENGL0099, ARB0099

EI101 Leadership and Emotional Intelligence **3 Cr Hr (3,0)** **3 ECTS**

In this course, students will be introduced to the concept of Emotional Intelligence as a means to improve self-management and relationship management. The operative concepts are applied to social, family, academic and professional relationships with an emphasis on leadership implications. The majority of the curriculum is based upon the book by Daniel Goleman entitled: "Leadership: The Power of Emotional Intelligence," and covers leadership styles and their appropriate applications, the emotional intelligence model, and neurological aspects of the limbic system. The class is a lecture format which encourages student participation

Prerequisites: ENGL0099

IC101 Intercultural Communications **3 Cr Hr (3,0)** **3 ECTS**

This course is designed to provide prospective students (whose majors have an international flavor) with tools that offer powerful possibilities for improving the communication process. We will examine the process of sending and receiving messages between people whose cultural background could lead them to interpret verbal and nonverbal signs differently. We will learn about the diversity of these cultural differences and at the same time learn how we might overcome them. Our efforts to recognize and surmount cultural differences will hopefully open up business opportunities throughout the world and maximize the contribution of all the employees in a diverse workforce.

Prerequisites: ENGL0099

E101 Sports and Health **3 Cr Hr (3,0)** **3 ECTS**

The course focuses on providing students with information related to Sport, fitness and health culture, Voluntary work Nutrition, First Aid. It covers also Special physical preparation and general sports cultural issues.

Prerequisites: ARB0099

SE301 Social Entrepreneurship and Enterprises **3 Cr Hr (3,0)** **3 ECTS**

This course will serve as an introduction to the field of social entrepreneurship and social enterprises. Through lectures, field visits, analyses of relevant literature, case studies and exercises, this course will explore social entrepreneurship's potentials, opportunities and limitations. The topics will cover Defining Social Entrepreneurship. Contextualizing Social Entrepreneurship (need, motives, forms, criteria). Role of Leadership, Creativity and Innovation. Locating SE on the profit/non-profit continuum. SE in the larger fields of development, social change, community activism. Social Enterprises (Missions, Markets, Finances). Ethical business and corporate social responsibility.

Prerequisites: ENGL0099

SFTS101 Soft Skills **3 Cr Hr (3,0)** **3 ECTS**

This course is designed to help develop strong oral and written communication skills. The student will be given opportunities to practice writing and editing professional correspondence and technical reports. Additionally, the student will compose and deliver oral presentations. Assignments will include the use of inductive and deductive approaches to conveying a variety of messages. The course emphasis the use of software tools to prepare presentations, stress management, confidence, and sensitivity to others. It also stresses on resume writing and conducting interviews.

Prerequisites: ENGL0099

BE302 Business Entrepreneurship **3 Cr Hr (3,0)** **3 ECTS**

The course focuses on critical skills necessary to develop appropriate financing strategies for new venture creation and growth. Students will use case studies and team projects in course studies. Three primary topics are covered: first, an overview of the entrepreneurial finance process and involved players; second, performing business valuations; and third, securities law with emphasis on developing term sheets and private placement memorandums. Student teams will complete a valuation and mock securities offering for an existing small to mid-size business. Financial valuations and terms sheets developed by student teams will be presented to a panel of venture capital professionals for evaluation and critique.

Prerequisites: ENGL0099

TW303 Technical and Workplace Writing **3 Cr Hr (3,0)** **3 ECTS**

Technical and Workplace Writing course focuses on essentials; it introduces students to professional and technical writing through a straightforward structure, adding knowledge while practicing different forms and skills. Since this course is a practical one, the course offers the "how" (instructions) and the "what" (examples) with discussion topics and exercises designed to make instruction straightforward. Students are exposed to certain genres, such as web page design, summaries, proposals, user guides, and job application materials. This is why this course is designed with a student/worker in mind, who would greatly benefit from the techniques of writing presented throughout the course.

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.

Prerequisites: ----------

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: ARB0099,ENGL0099, 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: ARB0099,ENGL0099, 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.

Prerequisites: ----------

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: MATH101

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: ARB0099,ENGL0099, 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: ARB0099,ENGL0099, 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: BSC001

ENE432 Power Plants Engineering **3 Cr Hr (3,0)** **5 ECTS**

This course will be divided in two parts: Power cycle review, thermal power plant and power market. Power cycle review covers Vapor-cycles, gas turbine-cycles, and combined-cycles. Thermal power plant covers: components, selection and economics for Steam and gas turbine power plants, which Include steam generators, condenser and condensate, feed-water heating systems which covers Fuel management and boiler automatic control systems, turbine plant, generator plant, turbine and generator control and protection systems, cooling water systems, steam and water cycle, power plant thermal performance and efficiency losses. Power market covers alternative power generation technologies, electricity and gas networks and markets, climate change and energy markets.

Prerequisites: BSC001

ENE433 Solar Energy I **3 Cr Hr (3,0)** **5 ECTS**

Heat transfer phenomena (Radiation, convection, conduction) in solar thermal systems; materials used in solar thermal applications and their properties: selective treatments, phase change materials, transparent insulating surfaces; design methodologies and calculation of solar thermal systems and equipment; heat transfer calculation software; testing of solar collectors and solar thermal systems; applications of solar energy: absorption cooling systems, solar thermal energy system as a primary source of electricity; solar thermal concentration (solar thermos-electric).

Prerequisites: BSC001

ENE525 Fuel Cell & Hydrogen Production Technology **3 Cr Hr (3,0)** **5 ECTS**

Fundamentals of fuel cells and hydrogen production technology, basic structure of fuel cells, operation and conversion of chemical potential energy into electrical energy, evaluation of cell performance, and characterization.

Prerequisites: BSC001

ENE531 Environmental and Energy Engineering **3 Cr Hr (3,0)** **5 ECTS**

Environmental issues associated with human activities, mass and energy transfer, environmental chemistry, water and air pollution, pollutant transport model, pollution management, and risk assessment, and global atmospheric change, physical, chemical, and biological systems related to the quality of water, land, and air environments; topics relating energy to environmental engineering including: carbon production, heat and energy transfer and thermal pollution.

Prerequisites: BSC001

ENE520 Thermal Energy Storage **3 Cr Hr (3,0)** **5 ECTS**

Energy storage technologies with emphasis on thermal energies storage, energy storage strategies for system optimization, sensible heat, latent heat, inorganic phase change materials, organic phase change materials, quasi-latent heat, heat pumps.

Prerequisites: BSC001

ENE537 Energy Efficiency, Management, and Laws **3 Cr Hr (3,0)** **5 ECTS**

This course will be divided in two parts: Power cycle review, thermal power plant and power market. Power cycle review covers Vapor-cycles, gas turbine-cycles, and combined-cycles. Thermal power plant covers: components, selection and economics for Steam and gas turbine power plants, which Include steam generators, condenser and condensate, feed-water heating systems which covers Fuel management and boiler automatic control systems, turbine plant, generator plant, turbine and generator control and protection systems, cooling water systems, steam and water cycle, power plant thermal performance and efficiency losses. Power market covers alternative power generation technologies, electricity and gas networks and markets, climate change and energy markets.

Prerequisites: BSC001

MGT418 Quality Management **3 Cr Hr (3,0)** **5 ECTS**

Total Quality Management (TQM) helps the students to learn to view quality from a variety of functional perspectives, gain a better understanding of the problems associated with improving quality, also quality tools utilized in service and international/environments. This module focuses on the essence, principles, and practices of total quality management (TQM). Some of the ideas and topics that are covered are: process improvement; process orientation; service quality; human resources; customer satisfaction programs; quality function deployment; process control and capability; role of inspection; economics of quality; productivity measurement; learning and organizational performance measures; and teachings of Deming, Juran, and Crosby.

Prerequisites: BSC001