Mechanical Engineering Program

Introduction

Mechanical Engineering is one of the core disciplines of engineering. It encompasses a large number of sub-disciplines that are at the heart of both traditional and leading-edge technologies. Mechanical engineers can be found in leadership roles in almost every industrial sector, ranging from electronics and aerospace to civil transportation and consumer household products. The program is also designed to prepare students for graduate study in mechanical and materials engineering. The undergraduate mechanical engineering program recognizes that students have various career paths to choose from within the wide variety of industrial environments available to mechanical engineers. For this reason, mechanical engineering students do earn a *concentration* during their senior year. Concentrations give them the chance to specialize in one area of mechanical engineering. They can choose to take elective courses related to one group of specialty.

Vision

Mechanical Engineering Program is to be nationally and internationally recognized as a leader in both research and education in mechanical engineering

Mission

To produce high quality mechanical engineers who can undertake challenging assignments, excel in higher education and research, and provide effective solutions of real-life engineering problems by considering ethical, social, and environmental standards

Program Educational Objectives

In accordance with University and College of Engineering missions, graduates of Mechanical Engineering Program are expected to:

1. Embark on a career as mechanical engineers in industry or enterprise, and serve with continued excellence to reach leadership positions
2. Pursue advanced education, research and development, and other creative and innovative efforts in science, engineering, and other professional careers
3. Exercise self-learning and strive for continuous personal and professional improvement
4. Conform to ethical and social responsibilities while serving the community at large.

Program Outcomes

We expect our graduates would have an ability to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. Communicate effectively with a range of audiences
4. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. Acquire and apply new knowledge as needed, using appropriate learning strategies
8. List/explain fundamental principles of engineering and science
9. Describe essential concepts of mechanical engineering and its domains

Job Opportunities in the Labor Market

Mechanical Engineering graduates are expected to:

1. Design and supervise mechanical services of the facilities, including air conditioning, heating, cooling systems, drainage, firefighting, security, and industrial safety.
2. Maintain and operate machines in civil and/or military sectors.
3. Participate in the operation and maintenance of power plants.
4. Operate and monitor production lines in manufacturing industry.
5. Design machines and production lines and supervise their installation.
6. Utilize renewable energy for heating, cooling, desalination, and other industrial and household purposes.
7. Procure materials and equipment for engineering projects and fulfill consumers' requirements through trading companies.
8. Control and develop quality of industrial products.

9. Implement engineering education and research related to mechanical engineering domains.
10. Design, operate, and maintain heat exchangers, pumps, turbines, engines, and heavy equipment.

Overview of the Curriculum

Course Coding

The Mechanical Engineering courses are numbered according to specialization, program year, and the offered sequence. The symbol ME stands for Mechanical Engineering, and each course code is of 3 digits.

The first digit, according to the following Table, denotes year of course level as per study plan:

First Digit	Level of Course
1	First year
2	Second year
3	Third year
4	Fourth year

The second digit, according to the following Table, represents the specialization field in the program:

Second Number	Specialization
0	General Engineering
1	Materials and Solid Mechanics
2	Thermal and Fluid Sciences
3	Control Theory and System Dynamics
4	Power Generation and Energy Conversion
5	Heating, Ventilation, and Air Conditioning (HVAC)
6	Manufacturing Engineering and Safety
7	Computational Methods
8	Graduation Project Courses, Seminar or Engineering Training

The third digit denotes the sequence number of the course in a certain specialization field in a given year. The number 9, as the third digit is reserved for Engineering Training and Special Topic courses.

Example: ME 451 means

Code	First Digit	Second Digit	Third Digit
ME	**4**	**5**	**1**
Department (Mechanical Engineering)	**Level** (Fourth year)	**Field** (HVAC)	The sequence number of the field courses

Undergraduate Curriculum of the Mechanical Engineering Program

The curriculum leading to the degree of **Bachelor's degree of Mechanical Engineering** requires **137 credits** and is organized as follows:

University requirement	**14** Credit Hours
College of Engineering requirement	**59** Credit Hours
Department requirement	**64** Credit Hours
Total Credit Hours:	**137** Credit Hours

- University requirement (Quran, Tawheed,..etc)
- College of Engineering requirements include:
  1. Mathematics and Basic Sciences. (33 credit hours)
  2. General Engineering. (23 credit hours)
  3. Technical Writing in English. (3 credit hours)
- Department requirement includes core courses and Technical Electives. (64 credit hours)

1- General Engineering

The following courses are required as *General Engineering* in the undergraduate curriculum of the Mechanical Engineering Program

Course Code	Course Title	Credits	Pre-requisite	Corequisite
GE 100	Introduction to Engineering	0	None	
GE 103	Engineering Graphics and Design	3	None	
CS 108	Computer Programming	3	MATH 115	
GE 201	Statics	3	MATH 116, PHYS 117	
GE 202	Dynamics	3	GE 201	
GE 303	Engineering Economy	3	MATH 236	
GE 305	Fundamentals of Electrical Engineering	3	MATH 116 PHYS 118 PHYS 120	
GE 399	Engineering Training	0	Completion of 90 Credits	
GE 401	Project Management	3	STAT 215	
GE 302	Professional Ethics for Engineers	2	GE 399	
	Total Credit Hours	**23**		

2- Mechanical Engineering Program Requirements

The course requirements of Mechanical Engineering Program are divided into two parts. The first consists of compulsory courses with 55 credit hours, while the second comprises technical elective courses with a total number of 9 credit hours. Details of these requirements, including the areas of the technical elective courses, are listed below:

1. Mechanical Engineering Core Courses

The following 55 credit hours must be taken by all students in the Mechanical Engineering Program:

Course Code	Course Name	Credits	Prerequisite	Co-requisite
ME 211	Materials Science and Engineering	3	GE 100, MATH 115, CHEM 104	
ME 213	Mechanics of Materials Lab	1		ME 216
ME 216	Mechanics of Materials	3	GE 103, ME 211, GE 201	
ME 221	Thermodynamics I	3	MATH 116, CHEM 104	
ME 222	Fluid Mechanics	3	ME 221, GE 201	
ME 223	Thermo-fluids Lab	1		ME 222
ME 323	Thermodynamics II	3	ME 221	
ME 324	Heat Transfer	3	ME 222	
ME 325	Heat Transfer Lab	1		ME 324
ME 331	Mechanics of Machines	3	MATH 236, GE 202	
ME 333	Mechanical Vibrations	3	MATH 236, GE 202	
ME 334	Automatic Control	3	ME 333	
ME 363	Manufacturing Technology	3	ME 216	
ME 364	Manufacturing Technology Lab	1		ME 363
ME 365	Machine Design I	3	ME 216	
ME 436	System Dynamics and Modeling	3	ME 333	
ME 441	Internal Combustion Engines	3	ME 323	
ME 451	HVAC Systems	3	ME 324	
ME 465	Machine Design II	3	ME 331, ME 365	
ME 466	Industrial and Environmental Safety	2		
ME 493	Graduation Project I	2	Completion of 100 Credit hours + Department Approval	
ME 494	Graduation Project II	2	ME 493	
	Total Credit Hours	**55**		

2. Mechanical Engineering Elective Courses

The students in Mechanical Engineering Program are required to select three electives from the offered courses in the following specialization fields:

2.1 Materials Engineering and Processing

Course Code	Course Name	Credits	Prerequisite
ME 411	Mechanical Behavior of Materials	3	ME 216
ME 412	Nanomaterials	3	ME 216, ME 363
ME 413	Corrosion Engineering	3	ME 211
ME 414	Processing of Polymer Materials	3	ME 216 ME 363
ME 415	Tribology	3	ME 324 ME 365
ME 419	Special Topics	3	To be decided by the instructor

2.2 Control Theory and System Dynamics

Course Code	Course Name	Credits	Prerequisite
ME 433	Mechatronics	3	CS 108, GE 202, GE 305
ME 434	Introduction to Robotics	3	ME 334, ME 436
ME 435	Automotive Control	3	ME 334
ME 439	Special Topics	3	To be decided by the instructor

2.3 Thermal Sciences, Power Generation and Energy Conversion

Course Code	Course Name	Credits	Prerequisite
ME 421	Design and Analysis of Thermal Systems	3	ME 323
ME 442	Power and Desalination Plants	3	ME 323
ME 443	Turbomachinery	3	ME 323
ME 444	Gas Turbine Engines	3	ME 323
ME 445	Introduction to Nuclear Energy	3	ME 323, ME 324
ME 446	Gas Dynamics	3	ME 222, ME 323
ME 449	Special Topics	3	To be decided by the instructor

2,4 Manufacturing Engineering and Safety

Course Code	Course Name	Credits	Prerequisite
ME 461	Computer Aided Design/Computer Aided Manufacturing	3	ME 363
ME 462	Advanced Manufacturing Technology	3	ME 363
ME 463	Metal Forming	3	ME 216 ME 365
ME 464	Risk Assessment and Safety Management	3	ME 466, GE 303
ME 469	Special Topics	3	To be decided by the instructor

2,5 Computational Methods in Mechanical Engineering

Course Code	Course Name	Credits	Prerequisite
ME 471	Introduction to Finite Element Methods	3	MATH 236, MATH 346
ME 472	Engineering Optimization	3	MATH 346
ME 473	Computational Fluid Dynamics	3	MATH 346, ME 324
ME 479	Special Topics	3	To be decided by the instructor

Mechanical and Industrial Engineering Department
College of Engineering
Al Imam Mohammad Ibn Saud Islamic University
Riyadh, Kingdom of Saudi Arabia

Mechanical Engineering Program [Required Credit Hours = 137]

General Education	Math & Basic Sciences	Engineering Fundamentals	Engineering Depths
17 Credit Hours	33 Credit Hours	23 Credit Hours	64 Credit Hours

FIRST YEAR (FRESHMAN)

FALL	SPRING
CUL 101 [2] Islamic Culture	IDE 133 [2] Tawheed
MATH 115 [3] Calculus I	MATH 116 [3] Calculus II PRE: MATH 115
PHYS 117 [3] Physics I	PHYS 118 [3] Physics II PRE: PHYS 117, PHYS 119
PHYS 119 [1] Physics I Lab CO: PHYS117	PHYS 120 [1] Physics II Lab PRE:PHYS 117, PHYS 119 CO: PHYS 118
CHEM 104 [3] General Chemistry	STAT 215 [3] Probability and Statistics for Engineers PRE: MATH 115
CHEM 105 [1] General Chemistry Lab CO: CHEM 104	GE 100 [0] Introduction to Engineering
ENGL 200 [3] Technical Writing in English	GE 103 [3] Engineering Graphics and Design
	CS 108 [3] Computer Programming PRE: MATH 115
[7 / 16]	[8 / 18]

SECOND YEAR (SOPHOMORE)

FALL	SPRING
QUR 100 [2] Quran Kareem	QUR 150 [2] Quran Kareem
ME 221 [3] Thermodynamics I PRE: MATH 116, CHEM 104	ME 222 [3] Fluid Mechanics PRE: GE 201, ME 221
ME 211 [3] Materials Science and Engineering PRE: GE 100, MATH 115, CHEM 104	ME 213 [1] Mechanics of Materials Lab CO: ME 216
MATH 207 [3] Calculus III PRE: MATH 116	ME 216 [3] Mechanics of Materials PRE: GE 103, GE 201, ME 211
MATH 228 [3] Linear Algebra & ODE PRE: MATH 116	MATH 236 [3] Mathematical Methods for Engineers PRE: MATH 207, MATH 228
GE 201 [3] Statics PRE: MATH 116, PHYS 117	GE 202 [3] Dynamics PRE: GE 201
	ME 223 [1] Thermo–fluids Lab CO: ME 222
[6 / 17]	[7 / 16]

THIRD YEAR (JUNIOR)

FALL	SPRING
FIQ 150 [2] Fiqh	NAHU 105 [2] Nahu
ME 323 [3] Thermodynamics II PRE: ME 221	ME 324 [3] Heat Transfer PRE: ME 222
ME 333 [3] Mechanical Vibrations PRE: GE 202, MATH 236	ME 325 [1] Heat Transfer Lab CO: ME 324
ME 363 [3] Manufacturing Technology PRE: ME 216	ME 331 [3] Mechanics of Machines PRE: MATH 236, GE 202
ME 364 [1] Manufacturing Technology Lab CO: ME 363	ME 334 [3] Automatic Control PRE: ME 333
GE 305 [3] Fundamentals of Electrical Engineering PRE: MATH 116, PHYS 118, PHYS 120	ME 365 [3] Machine Design I PRE: ME 216
MATH 346 [3] Numerical Analysis PRE: MATH 236, CS 108	GE 303 [3] Engineering Economy PRE: MATH 236
[7 / 18]	[7 / 18]

SUMMER SEMESTER

GE 399 Engineering Training [0] (Pre-requisite: 90 credits)

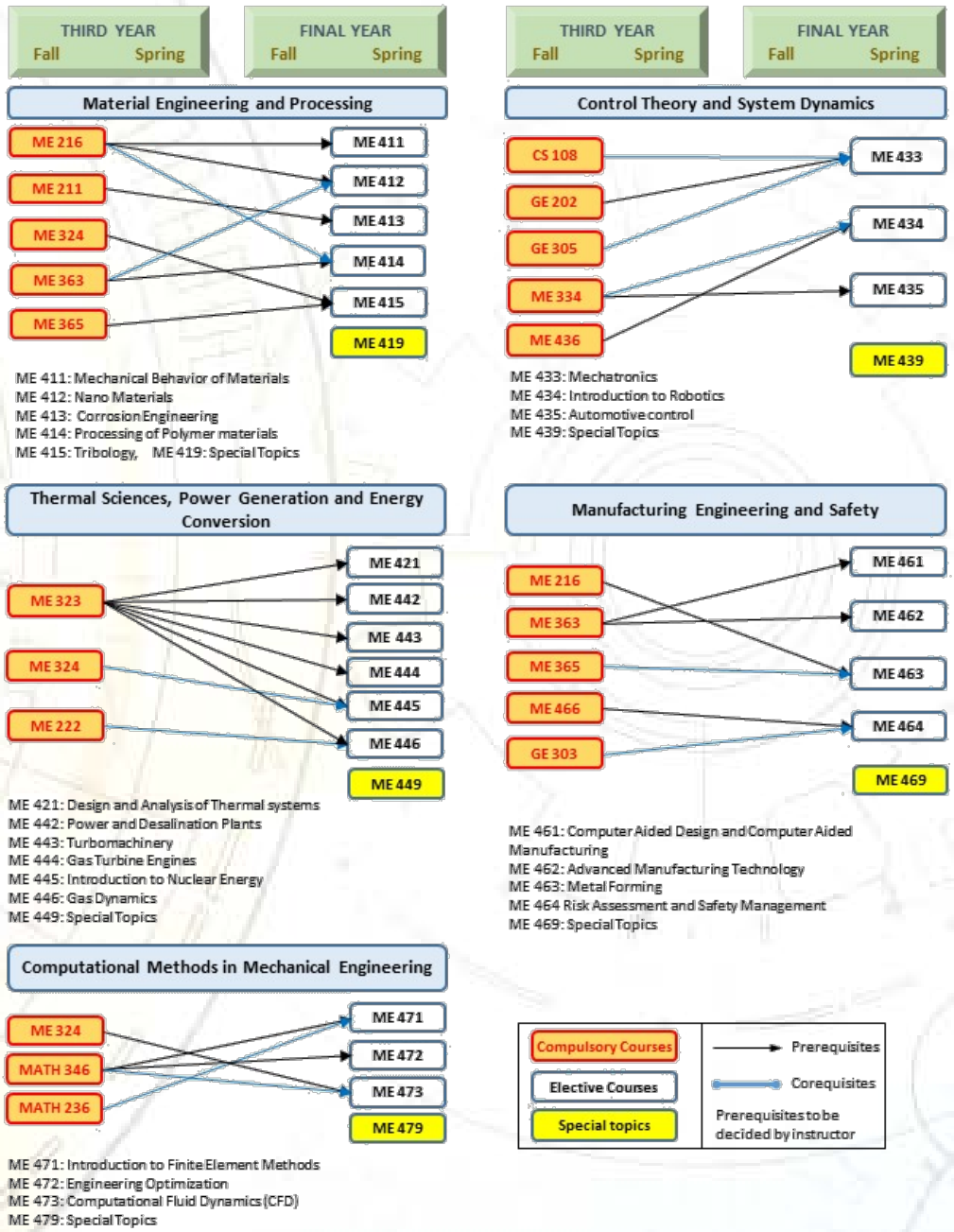
FOURTH YEAR (SENIOR)

FALL	SPRING
ME 451 [3] HVAC Systems PRE: ME 324	HST 101 [2] Asseerah Annabawia
ME 436 [3] System Dynamics and Modeling PRE: ME 333	ME 441 [3] Internal Combustion Engines PRE: ME 323
ME 465 [3] Machine Design II PRE: ME 365, ME 331	ME 466 [2] Industrial and Environmental Safety
ME 493 [2] Graduation Project I PRE: Completion of 100 Cr.H + Approval of Dept.	ME 494 [2] Graduation Project II PRE: ME 493
ME 4•• [3] Elective I	ME 4•• [3] Elective II
GE 401 [3] Project Management PRE: STAT 215	ME 4•• [3] Elective III
	GE 302 [2] Professional Ethics for Engineers PRE: GE 399
[6 / 17]	[7 / 17]

No. of Courses / Credits each semester:

Mechanical and Industrial Engineering Department
College of Engineering
Al Imam Mohammad Ibn Saud Islamic University, Riyadh, Kingdom of Saudi Arabia

Mechanical Engineering Program - Elective Courses



Mechanical Engineering Undergraduate Curriculum

First Year (Freshman)

Level - 1

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	CUL 101	Islamic Culture	2	2		
2	ENGL 200	Technical Writing in English	3	3		1
3	CHEM 104	General Chemistry	3	3		1
4	CHEM 105	General Chemistry Lab	1		2	
5	MATH 115	Calculus I	3	3		2
6	PHYS 117	Physics I	3	3		1
7	PHYS 119	Physics I Lab	1		2	
		Total Semester Hours	**16**	**14**	**4**	**5**

Level - 2

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	IDE 133	Tawheed	2	2		
2	GE 100	Introduction to Engineering	0			2
3	GE 103	Engineering Graphics and Design	3	2	2	
4	CS 108	Computer Programming	3	2	2	
5	MATH 116	Calculus II	3	3		2
6	PHYS 118	Physics II	3	3		1
7	PHYS 120	Physics II Lab	1		2	
8	STAT 215	Probability and Statistics for Engineers	3	3		1
		Total Semester Hours	**18**	**15**	**6**	**6**
		Cumulative Hours	**34**	**29**	**10**	**11**

Second Year (Sophomore)

Level - 3

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	QUR 100	Quran Kareem	2	2		
2	MATH 207	Calculus III	3	3		2
3	MATH 228	Linear Algebra and Ordinary Differential Equations	3	3		2
4	GE 201	Statics	3	3		1
5	ME 211	Materials Science and Engineering	3	3		1
6	ME 221	Thermodynamics I	3	3		1
		Total Semester Hours	**17**	**17**		**7**
		Cumulative Hours	**51**	**46**	**10**	**18**

Level - 4

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	QUR 150	Quran Kareem	2	2		
2	MATH 236	Mathematical Methods for Engineers	3	3		2
3	GE 202	Dynamics	3	3		1
4	ME 213	Mechanics of Materials lab	1		2	
5	ME 216	Mechanics of Materials	3	3		1
6	ME 222	Fluid Mechanics	3	3		1
7	ME 223	Thermo-fluids Lab	1		2	
		Total Semester Hours	**16**	**14**	**4**	**5**
		Cumulative Hours	**67**	**60**	**14**	**23**

Third Year (Junior)

Level - 5

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	FIQ 150	Fiqh	2	2		
2	MATH 346	Numerical Analysis	3	3		2
3	GE 305	Fundamentals of Electrical Engineering	3	3		1
4	ME 323	Thermodynamics II	3	3		1
5	ME 333	Mechanical Vibrations	3	3		1
6	ME 363	Manufacturing Technology	3	3		1
7	ME 364	Manufacturing Technology Lab	1		2	
		Total Semester Hours	**18**	**17**	**2**	**6**
		Cumulative Hours	**85**	**77**	**16**	**29**

Level - 6

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	NAHU 105	Nahu	2	2		
2	GE 303	Engineering Economy	3	3		1
3	ME 324	Heat Transfer	3	3		1
4	ME 325	Heat Transfer Lab	1		2	
5	ME 331	Mechanics of Machines	3	3		1
6	ME 334	Automatic Control	3	2	2	1
7	ME 365	Machine Design I	3	3		1
		Total Semester Hours	**18**	**16**	**4**	**5**
		Cumulative Hours	**103**	**93**	**20**	**34**

Engineering Training

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	GE 399	Engineering Training	0	0	0	0
		Total Semester Hours	**0**	**0**	**0**	**0**
		Cumulative Hours	**103**	**93**	**20**	**34**

Fourth Year (Senior)

Level - 7

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	GE 401	Project Management	3	3		
2	ME 436	System Dynamics and Modeling	3	3		1
4	ME 451	HVAC Systems	3	2	2	1
3	ME 465	Machine Design II	3	3		1
5	ME 493	Graduation Project I	2		4	
6	ME 4**	Elective I	3	3		1
		Total Semester Hours	**17**	**14**	**6**	**4**
		Cumulative Hours	**120**	**107**	**26**	**38**

Level - 8

No.	Course Code	Course Name	Hours			
			Credit	Theory	Lab	Tut
1	HST 101	Asseerah Annabawia	2	2		
2	GE 302	Professional Ethics for Engineers	2	2		
3	ME 441	Internal Combustion Engines	3	2	2	1
4	ME 466	Industrial and Environmental Safety	2	2		
5	ME 494	Graduation Project II	2		4	
6	ME 4**	Elective II	3	3		1
7	ME 4**	Elective III	3	3		1
		Total Semester Hours	**17**	**14**	**6**	**3**
		Cumulative Hours	**137**	**121**	**32**	**41**

Course Description

1. GENERAL ENGINEERING

GE 100	Introduction to Engineering	0 Credit Hour

Introduction to the engineering profession, roles and responsibilities of engineers, professional and ethical aspects of the profession, major engineering disciplines, academic background and requirements of each discipline, sub-specialties within each discipline, job availability and financial benefits, role of professional engineering bodies and societies, teamwork.

GE 103	Engineering Graphics and Design	3 Credit Hours

Use of computer drafting software (AutoCAD) to model parts and assemblies; Use of parametric and non-parametric solids; Surface and wireframe models; Part editing; Two-dimensional documentation of models; Planar projection theory; Sketching of perspective, isometric, multi-view, auxiliary, and section views; Spatial visualization exercises; Dimensioning guidelines; Tolerance techniques; Team or individual design project.

CS 108	Computer Programming	3 Credit Hours

The course introduces students to structured programming techniques. Topics include different control statements (sequence, selection, and repetition), functions, fundamental data types, and data structures (arrays and pointers). Upon successful completion of the course, students will solve computer problems by using structured programming techniques and adequate tools (text editor, compiler, and debugger).

GE 201	Statics	3 Credit Hours

Vector analysis, Forces, Moments, and Couples, Resultants of Force Systems. Equilibrium Analysis and Free-Body Diagrams. Analysis of forces acting on members of Trusses and Frames. Shear-Force and Bending-Moment Distributions. Centroids, Centre of mass, hydraulic pressure. Moment of Inertia, Parallel axis theorem, Polar Moment of Inertia and Product of Inertia.

GE 202	Dynamics	3 Credit Hours

Kinematics and kinetics of particles including Newton’s second law, energy-work principles, and impulse-momentum methods. Planar kinematics and planar kinetics of rigid bodies: translation, rotation about a fixed axis, and general plane motion. Introduction to three-dimensional dynamics of rigid bodies.

GE 303	Engineering Economy	3 Credit Hours

This course investigates methods of economic analysis for decision making among alternative courses of action in engineering, business and government applications. Topics include: Time value of money, Money management, and Equivalence calculations under inflation, Present worth analysis, Annual Equivalence Analysis, Rate of return analysis. Benefit-Cost ratio & profitability index analyses.

GE 305	Fundamentals of Electrical Engineering	3 Credit Hours

Basic laws: Ohm's, KVL, KCL. Resistive networks. Circuit analysis techniques: nodal and mesh analysis. Network theorems: Thevenin's, Norton's, source transformations, superposition, maximum power transfer. Energy storage elements. phasor technique for steady-state sinusoidal response. Transient analysis of first-order circuits.

GE 399	Engineering Training	0 Credit Hour

Eight weeks training in a relevant industry under the supervision of an external supervisor from industry. Each student must submit a technical report about his learning experience during training in addition to fulfilling any other requirements as determined by the department.

GE 401	Project Management	3 Credit Hours

General methodology of managing a technical project from concept to operational use with emphasis on functions, roles, and responsibilities of the project manager. Topics include: Career aspects of project management; Business factors affecting the project, the manager, and the organization; Planning and scheduling using arrow networks, execution, and communications; Project life cycle, risk analysis, reporting, and reaction to critical problems; Labor, materials, and equipment utilization; Cost estimation; Pricing; Contracting; Planning; Cost control, monitoring, and accounting; Project management systems.

GE 302	Professional Ethics for Engineers	2 Credit Hours

Introduction to engineering ethics; definition of a profession, personal and professional ethics, explore many of the ethical issues, discussion of ethical theories, code of ethics, problem solving techniques. Introduce engineer’s rights and responsibilities. Asses Safety, risk and accidents. Explain the Rights and Responsibilities of Engineers.

2. CORE COURSES AND TECHNICAL ELECTIVES

This section contains all the course descriptions for 200, 300, 400 level courses to be taught in Mechanical Engineering Program.

ME 211	Materials Science and Engineering	3 Credit Hours

Introduction to Materials Science, Atomic Structure and Interatomic Bonding, Structures of Metals and Ceramics, Polymer Structures, Polymers properties & processing, Mechanical Properties and Testing, Solidification of Metals and Alloys, Imperfections in Metals and Alloys, Phase Diagrams, Materials Strengthening Mechanisms, Classification of Metal Alloys, Basics of Corrosion and corrosion prevention.

ME 213	Mechanics of Materials Lab	1 Credit Hour

Material testing against tension, compression and impact testing, investigations of Hooke's law, strain gages measurements of deflection, phenomena of bending, phenomena of hardness via its different tests and theory of torsion and deflection. Phenomena of creep and its effect on temperature. Dynamic testing of materials like fatigue.

ME 216	Mechanics of Materials	3 Credit Hours

Normal and shear stress, normal and shear strain, stress-strain relations for ductile and brittle materials, yield and ultimate stress, elasticity and plasticity, Hooke's law, Poisson's ratio. Axial loading, stress on inclined planes. Torque and torsion, deformation of circular bars under torsion, polar moment of inertia. Pure shear and pure bending, Euler's beam theory, curvature and bending moment, second moment of inertia, normal and shear stress in beams of various cross-sections. Plain stress and strain, Principal and maximum shear stress and strain, Mohr's circle, general 3-d stress-strain relationship in elasticity, buckling of columns.

ME 221	Thermodynamics I	3 Credit Hour

Thermodynamic properties, system, process, cycle and equilibrium. Control mass and control volume analysis. Properties and behaviour of pure substances. First law of Thermodynamics. Steady state and transient processes and their application to thermodynamic systems and devices. Entropy and the Second law of thermodynamics. Ideal gas equation of state and compressibility factor. Simple steam power and vapor compression refrigeration cycles.

ME 222	Fluid Mechanics	3 Credit Hours

Introduction to fluid mechanics, Fluid Properties, Fluid Statics, Flowing Fluids and Pressure Variation, Control Volume Approach and Continuity Equation, Momentum Equation, Surface Resistance with Uniform Laminar Flow, and Flow in Conduits.

ME 223	Thermo Fluid Lab	1 Credit Hour

Introduction to basic fluid mechanics instrumentation, experimental verification and reinforcement of the analytical concepts introduced in ME 221 and ME 222. Pressure drop in pipes, fittings and centrifugal pump performance.

ME 323	Thermodynamics II	3 Credit Hours

Analysis of gas power, vapor power and advanced refrigeration cycles. Availability (exergy), irreversibility and second law efficiency. Moist air properties and psychometric analysis. Combustion analysis. Introduction to compressible fluid flow.

ME 324	Heat Transfer	3 Credit Hours

One-dimensional axial and radial heat conduction. Steady state and transient heat conduction. Analogy of thermal systems with electrical systems (thermal network modelling). Numerical method in heat conduction. Dimensionless numbers. Convection heat transfer in internal and external flows. Conduction-convection systems (lumped capacitance method). Heat exchanger design (the LMTD and NTU methods), Surface radiation properties. Radiation heat transfer from black and grey surfaces.Net radiation exchange in enclosures.

ME 325	Heat Transfer Lab	1 Credit Hour

Practices and measurement techniques for heat transfer and thermal systems. Experimental-problem solving applied to heat transfer.

ME 331	Mechanics of Machines	3 Credit Hours

Introduction to mechanisms, kinematics of mechanisms, position, velocity and acceleration analysis of linkages using graphical and analytical methods, dynamic force analysis of mechanisms.

ME 333	Mechanical Vibrations	3 Credit Hours

This course envelops harmonic and periodic motion including both damped and undamped free and forced vibration, single-and multi-degree-of-freedom systems and matrix techniques suitable for computer simulations.

ME 334	Automatic Control	3 Credit Hours

Theory and analysis of linear closed-loop control systems containing electronic, hydraulic, and mechanical components. Differential equations. Laplace transforms. Stability, Nyquist and Bode diagrams.

ME 363	Manufacturing Technology	3 Credit Hours

Relationship between product engineering and manufacturing engineering. Fundamentals of metal casting, shaping process of plastics, powder metallurgy. fundamentals of metal forming and bulk deformation, metalworking processes and sheet metal working. Theory of machining operations, machine tools, cutting-tool technology. Grinding and other abrasive processes, fundamentals of welding, concepts of advanced manufacturing processes.

ME 364	Manufacturing Technology Lab	1 Credit Hour

Practical demonstration and learning of various manufacturing processes such as metal machining, welding, sheet rolling, shearing, etc. Study and familiarisation with various measuring instruments. Measuring specified dimensions such as lengths, internal and external diameters radii, angles and taper dimensions. Estimating measurement variations. Identifying typical errors. Familiar with various safety measures.

ME 365	Machine Design I	3 Credit Hours

General principles of machine design, reliability and statistical considerations, engineering materials and their mechanical properties, factor of safety, fits & tolerances, deflections and stress analysis for different types of elements, buckling, static strength and failure theories, fatigue strength and failure theories. Basic design principles of some machine elements and their selection (power screws, fasteners, and welded joints). Ethical and social impacts of mechanical design.

ME 436	System Dynamics and Modelling	3 Credit Hours

This course introduces the mathematical modelling and simulation of systems including mechanical, electrical, electro-mechanical, fluid and thermal systems. Topics include frequency response analysis, stability, and feedback control design.

ME 441	Internal Combustion Engines	3 Credit Hours

Engine types and basic operation, cycles and combustion thermodynamics, two-stroke and four-stroke cycles, engine testing and control, friction and wear of engine parts. Air, fuel, cooling and lubrication systems, engine emissions, fuels and lubricants, engine performance.

ME 451	HVAC Systems	3 Credit Hours

Qualitative and quantitative study in concepts of basic air-conditioning with focus on buildings including building envelope, moist air thermodynamics, human comfort. Thermal load calculations, thermal behaviour of buildings, HVAC systems/equipment, and design of space air-conditioning and its relationship to architectural design.

ME 465	Machine Design II	3 Credit Hours

This course introduces the fundamentals of machine design, including analysis and design of mechanical components. Covers shafts, fasteners, belt and chain drives, brakes, gears, springs and bearings. Includes predicting static and fatigue failures for various loadings and materials. Design techniques and the design of a simple machine.

ME 466	Industrial and Environmental Safety	2 Credit Hours

Accident: accident causes and costs. Appraising safety performance and risk assessment. Analysis of accident causes. Accident reports and records. Job safety analysis. Plant inspection. Accident investigation. Plant layout and arrangement. Plant housekeeping. Maintenance and safety. Material handling and safety. Machine guarding. Explosion and fire prevention. Noise and environmental safety, Personal protection. Planning for emergencies.

ME 493	Graduation Project I	2 Credit Hour

The Graduation Project integrates the various components of the curriculum into a comprehensive design exercise. This course covers the preliminary phase of the Project. In this phase, the students choose a topic and a faculty advisor; define the project scope, which may include theoretical design, experimentation, fabrication or computer simulation and modelling. By the end of the semester, they should complete the Project Goals/Objectives, Project Execution Plan, a thorough literature review and some initial work as defined in the Execution Plan. They must submit a preliminary report of the work done at the end of the semester.

ME 494	Graduation Project II	2 Credit Hours

The type of graduation project has to be a capstone design. A capstone design project should be planned to provide a unified effort in developing teamwork skills, multidisciplinary interaction, communication skills, fundamentals of engineering design processes, and application of engineering design principles to a real engineering project.

ME 411	Mechanical Behaviour of Materials	3 Credit Hours

Studies of stresses and strains in two- and three-dimensional elastic problems. Failure theories and yield criteria. Analysis and design of load-carrying members. Energy methods and stress concentrations. Elastic and plastic behaviour. Fatigue and fracture, and composite materials.

ME 412	Nanomaterials	3 Credit Hours

This course provides a comprehensive introduction to nanomaterials, synthesis/processing techniques used for nanomaterials and also the properties of nanomaterials.

ME 413	Corrosion Engineering	3 Credit Hours

This course is designed to introduce basic and modern concepts of corrosion engineering, including mixed potential theory, types of corrosion, cell potentials, factors influencing the corrosion rate of metals, and prevention techniques. The corrosion properties of materials and their applications are also discussed.

ME 414	Processing of Polymer Materials	3 Credit Hours

Chemistry and classification of polymers, crystal structure and morphology of polymers, physical and chemical characterization of polymers, manufacturing processes of plastics/composites, and properties of polymer composites.

ME 415	Tribology	3 Credit Hours

Nature of solid surfaces. Interaction of solid surfaces. Friction of metals and non-metals (mechanisms, theories, applications). Wear of metals and non-metals (types, mechanisms, theories, applications). Lubrication (methods, types, theories, applications). Lubricants (types, utilization). Selection of materials for tribology applications. Surface Engineering.

ME 419	Special Topics in Materials Engineering and Processing	3 Credit Hours

Topics relevant to specialization of Materials Engineering and Processing to strengthen student's knowledge in this field. This course covers many topics such as Types and Applications of Materials; Synthesis, Fabrication, and Processing of Materials; Composites; Thermal and Magnetic Properties of Materials; Corrosion and Degradation of Materials; Biomaterials; Nanomaterials and Nanotechnology; and Economic, Environmental, and Societal Issues in Materials Engineering.

ME 433	Mechatronics	3 Credit Hours

Focus on the fundamentals of design-oriented mechanical, electrical and computer systems integration. Specifically, analogue and digital electronic design, data acquisition, transducers, actuator technologies and control, design with microprocessors and embedded electronics, and application of control theory.

ME 434	Introduction to Robotics	3 Credit Hours

Forward and inverse kinematics of robot manipulators, path planning, motion planning for mobile robots. Dynamics of robot manipulators, control algorithms, computed torque algorithm, adaptive control algorithms and current topics in mobile robots. Cooperative motion planning of mobile robots and formation control.

ME 435	Automotive Control	3 Credit Hours

Basic engine operation; lambda control, speed control, knock control, fuel injection timing control, ignition control of SI engines; driveline modeling, automatic transmission control, clutch phasing control; wheel model, complete vehicle model; observers, friction coefficient estimators, tire contact patch force estimators; anti-lock brake control, traction control, yaw stability control; drive-by-wire systems.

ME 439	Special Topics in Control Theory and System Dynamics	3 Credit Hours

Topics relevant to specialization in Control Theory and System Dynamics to strengthen student's knowledge in these fields. Any course from other engineering departments or University must be approved by the ME Department Council.

ME 421	Design and Analysis of Thermal Systems	3 Credit Hours

Application of energy and exergy concepts to thermal fluid systems. Modeling and development of thermal systems with particular focus on heat-pumping cycles, such as vapor compression, absorption, and some advanced refrigeration cycles. Students combine the principles of thermodynamics, heat transfer and fluid mechanics to study and develop sustainable environment friendly systems with emphasis on refrigeration systems.

ME 442	Power and Desalination Plants	3 Credit Hours

First law, second law and exergy analysis of steam turbine cycles. Steam generating systems: boiler types, components and auxiliaries, steam turbines, condensers and feed water heaters. Single and multi-effect desalting vapor compression systems. Multistage flash desalination. Reverse osmosis. Scale formation and fouling on heat transfer surfaces and their prevention.

ME 443	Turbomachinery	3 Credit Hours

Applying energy, momentum, and continuity equations of thermo-fluids to turbomachinery. Blade geometry and aerodynamics. Performance and design parameters. Turbomachine design.

ME 444	Gas Turbine Engines	3 Credit Hours

Basic operating principles and analysis of performance characteristics of gas turbine engines for aircraft &vehicular propulsion and stationary power. Turbojet, turbofan and turboprop cycle analysis. Analysis of flow through compressors, turbines, combustors, inlets, nozzles, and regenerators. Component matching and off-design performance.

ME 445	Introduction to Nuclear Energy	3 Credit Hours

Introduction to the fundamentals of nuclear engineering, including power plant design fuel cycle and fuel design. Reactor physics, reactor theory and design and reactor thermo-hydraulics. Radiation protection and safety. Fuel reprocessing and recycling.

ME 446	Gas Dynamics	3 Credit Hours

Sonic wave propagation and Mach number, flow in converging and converging-diverging nozzles, normal and oblique shocks, Prandtl-Meyer, Fano and Rayleigh flows, semi-perfect and real gas behaviour, air-breathing and rocket propulsion systems, supersonic diffusers.

ME 449	Special Topics in Thermal Sciences and Energy	3 Credit Hours

Rankine cycle analysis, fossil-fuel steam generators, energy balances, fans, pumps, cooling towers, steam turbines, availability (second law) analysis of power systems, energy management systems, and rate analysis.

ME 461	Computer Aided Design and Computer Aided Manufacturing (CAD/CAM)	3 Credit Hours

Introduction to Computer Aided Engineering. Solid modeling. Introduction to Finite Element Method. CAD packages. Static linear analysis in one, two, and three dimensions. Steady state thermal analysis. Introduction to non-linear analysis. Optimum design. Computer applications in mechanical design. Automation strategies. Production economics. High volume production systems. Automated flow lines. Assembly and line balancing. Numerical control. NC part programming. DNC, CNC, and adaptive control. Industrial robots. Material handling and storage. Group technology and flexible manufacturing. Quality control and automated inspection. Control systems. Programmable controllers. Computer networks.

ME 462	Advanced Manufacturing Technology	3 Credit Hours

Introduction to advanced manufacturing technologies. Principles, process mechanisms and typical applications of non-traditional machining like Abrasive Jet, Water-Jet, Ultrasonic, Chemical, Electrochemical, Electric-Discharge, Plasma-Arc, Laser-Beam, Electron-Beam. Advanced welding processes. Rapid prototyping/3D printing technologies. Numerical control of machine tools: Automation of manufacturing processes, coordinate systems, types and components of CNC systems, programming for CNC, adaptive control. Computer Integrated Manufacturing CIM. Future of manufacturing.

ME 463	Metal Forming	3 Credit Hours

Yielding criteria, Plastic stress-strain relation, Plane stress and plane strain problems, Determination of flow equation. Applications: instability in thin vessels, thick vessels subjected to internal pressure, and beam under pure bending. Classification of metal forming processes and Technique of analysis:

slab method, upper bound method, slip line field, application to indentation problem. Bulk deformation processes, equipment and die: forging, rolling, extrusion, and rod and wire drawing.

ME 464	Risk Assessment and Safety Management	3 Credit Hours

Basic concepts of risk, reliability and hazard. Potential elements of risk assessment, statistical methods, control charts, appraisal of advanced techniques, fault tree analysis, failure mode and effect analysis. Quantitative structure to activity relationship, analysis of fuzzy model for risk assessment. Analysis of safety program organization through current industry leadership, supervision and management.

ME 469	Special Topics in Manufacturing Engineering and Safety	3 Credit Hours

Introduction to structure-based deformation behaviour of materials, mechanical testing to obtain properties, stress and strain relationships in two and three-dimensional elastic problems, introduction to fracture mechanics, mechanical and manufacturing aspects of extrusion and sheet metal forming, material selection criteria in design, and factor of safety.

ME 471	Introduction to Finite Element Methods	3 Credit Hours

Virtual formulation. Finite element analysis: shape formation, equilibrium conditions, element classification, and assembly of elements, modelling methodology. Structures and elements: trusses, beams, 2-D solids, 3-D solids, axisymmetric solids, thin-walled structures. Dynamic analysis. Heat transfer and thermal analysis.

ME 472	Engineering Optimization	3 Credit Hours

Application of optimization techniques in solving engineering problems. Linear programming, non-linear programming, dynamic programming, integer programming, stochastic programming, genetic algorithms, heuristic methods, queuing theory, and new optimization methods.

ME 473	Computational Fluid Dynamics	3 Credit Hours

Physical and mathematical foundations of computational fluid mechanics with emphasis on applications. Solution methods for model equations and the Euler and the Navier-Stokes equations. The finite volume formulation of the equations. Classification of partial differential equations and solution techniques. Truncation errors, stability, conservation, and monotonicity. Computer projects.

ME 479	Special Topics in Computational Methods in Mechanical Engineering	3 Credit Hours

Topics relevant to specialization in Computational Methods to strengthen students' knowledge in this field. Any course from other engineering departments or University must be approved by the ME Department Council.