Section 9

Mechanical Design Engineering Program (MDE)

Based on Credit Hours System (CHS)

September 2013

1. INTRODUCTION

The business environment in Egypt is witnessing an evolution in the various branches of industry at large. Modern technologies involving multidisciplinary engineering areas together with varieties of production equipment are brought to use in the various sectors of national industry. Such industries comprise the chemical, processing, manufacturing, engineering, oil and gas, building and construction industries, to name just a few. All these industrial sectors utilize common, specialized, and high–tech equipment for power transmission, production and manufacture. Thus, a growing need is anticipated for qualified "Mechanical Design Engineers" with knowledge and skills enabling utilization of modern tools of engineering analysis and design.

A bachelor degree in mechanical design engineering is offered for students who seek careers as engineers in industry, army, consulting firms and private and governmental agencies. This degree is also appropriate for students who plan to be researchers or who intend to pursue an advanced degree in engineering. A typical program curriculum incorporates analytical tools, creative thought and diversity of skills as well as the state of art of the profession. Mechanical Design engineer may work in: Private and governmental firms, where it is required to design, manufacture, operate, develop or maintain mechanical systems and equipment such as; industrial machinery, automotive, aerospace, power generation and air conditioning equipment.

Experience has shown that imported equipment could suffer unexpected failures during service. The "Mechanical Design Engineer" should be the one who could foresee potential areas of concern, especially in the long term, thus the one who could provide an expert opinion before acquiring such equipment.

Mechanical Design Engineering graduates should also be capable of handling tasks related to product design and development. "Made in Egypt" parts and equipment ought to progressively take a fair share of the inventory, not only to save on initial cost, but also to provide the capability of providing fast, independent and inexpensive remedy of one's own faults.

Recent success stories in national industrial development in countries like Ireland, Finland, Singapore, Malaysia, South Korea, Taiwan, Thailand showed that enhancement of higher engineering education has contributed significantly to modernization of industries in the above countries. Of key importance in this regard, is the capability of engineers and scientists to comprehend modern technologies and hence enable local generation of industrial knowledge. "Mechanical Design Engineers" are expected to be at the forefront of the national Egyptian effort to localize technology development and hence increase the national share in production of global industrial knowledge.

As the country is embarking on ambitious plans of industrial development, it is natural that, a common effort is initiated by universities and government authorities to develop human resources in the field of engineering design. Incentives should be devised to attract students of high caliber, who could be promising in acquiring innovative and creative capabilities in such difficult engineering studies. This can be achieved by

providing study grants that are linked to student performance during the course of his/her study.

The foregoing brief should highlight the expected growth in the job market need for mechanical design engineers–of caliber. Therefore, the Faculty of Engineering at Cairo University is proposing the establishment of a new Mechanical Design Engineering (MDE) program at the Bachelor level based on the credit hours system (CHS) of education. The existing department of Mechanical Design and Production will be the main source of instructors who will mentor students during their study. Other departments of Mechanical Power Engineering, Electrical Power and Machines, Applied Mathematics and Physics, and Metallurgy will have a share in the teaching load of the new "MDE" program.

2. PROGRAM MISSION

The mission of the Mechanical Design Engineering (MDE) Program is to provide the business community with graduates capable of effectively using the scientific and technical knowledge they had acquired as students for satisfying the community's needs for engineers in that discipline. The logic-thinking, problem–solving, team-working and communication skills developed through the MDE program will also contribute to achieving this goal. The program mission is supported by providing the students with carefully designed curricula and good educational experience and resources. The program emphasizes hands-on practice, it is application oriented, it acquaints the student with the relevant design codes and standards necessary for his/her future work, and it builds students capabilities on utilization of computer based analysis and design tools.

3. EDUCATIONAL OBJECTIVES

The mechanical design-engineering program has the following set of educational objectives:

- To provide the students with a solid base of knowledge in science and engineering, readily applicable to solving technical problems, together with the self confidence necessary for doing so.
- To provide the students with broad based professional education that covers the important current and developing issues in mechanical engineering, which is necessary for a productive career, and for being able to search and research in the spirit of continuing education in the field of mechanical design and allied areas.
- To upgrade the skills of students in effective communication, logic thinking, and creativity.

In addition to the general attributes of engineer, the Mechanical design engineer should be able to:

a) Work with mechanical design and manufacturing systems.

b) Use of mathematics, physical and engineering sciences, and systems analysis tools in components and machines and produce design and manufacture.
c) Use different instruments appropriately and carryout experimental design, automatic data acquisition, data analysis, data reduction and interpretation, and data presentation, both orally and in the written form.
d) Use the computer graphics for design, communication and visualization.
e) Use and/or develop computer software, necessary for the design, manufacturing and management of industrial systems and projects.
f) Analyze multidisciplinary mechanical, electrical, thermal and hydraulic systems.
g) Lead or supervise a group of designers or technicians and other work force.

4. PROGRAM LEARNING OUTCOMES

The following academic reference standards represent the general expectation about the qualifications attributes and capabilities that the graduates of the Mechanical Design Engineering program should be able to demonstrate.

4.1 Knowledge and Understanding

On successful completion of the program, graduates must be able to demonstrate an acceptable level of acquired knowledge and understanding of:

a) Concepts, principles and theories relevant to mechanical and manufacturing engineering;
b) Applied science and mathematics, and the technological base relevant to mechanical engineering;
c) The constraints within which an engineering judgment will have to be exercised;
d) The specifications, programming and range of application of CAD and CAD/CAM facilities
e) Relevant contemporary issues in mechanical engineering
f) Basic electrical, control and computer engineering subjects related to the discipline
g) The role of information technology in providing support for mechanical engineers
h) Engineering design principles and techniques
i) Characteristics of engineering materials and their selection criteria;
j) Management and business techniques and practices appropriate to the engineering industry.

4.2 Intellectual Skills

On successful completion of this program, graduates must be able to:

a) Think in a creative and innovative environment, in solving problems, and in designing products, systems, components and processes;
b) Apply the principles of mathematics, science and technology in problem solving scenarios in mechanical engineering;
c) Analyze and interpret numerical data, and design experiments to obtain such data;
d) Design systems, components or processes to meet specific needs through the synthesis of ideas from a range of sources;

e) Evaluate and appraise designs, processes and products, and propose improvements;
f) Assess risks, and take appropriate steps to manage those risks.
g) Use the principles of engineering science in developing solutions to practical mechanical engineering problems.

4.3 Practical and Professional Skills

On successful completion of this program, graduates must be able to:

a) Use a wide range of analytical and technical tools, and equipment, including pertinent software;
b) Prepare engineering drawings, computer graphics and specialized technical reports and communicate accordingly.
c) Carry out specialized engineering designs.
d) Employ modern CAD and CAD/CAM facilities in design and production processes
e) Use basic workshop equipment safely;
f) Understand and apply the principles of safety at work;
g) Analyze experimental results and determine their accuracy and validity;
h) Demonstrate basic organizational and project management skills.
i) Operate and maintain mechanical equipment.
j) Use computational tools and software packages pertaining to the discipline and develop required computer programs
k) Effectively access and reference to relevant technical literature

5. PROGRAM DESCRIPTION

The MDE program offers instruction in numerous topics concerning mechanical design, control engineering, Mechatronics, robotics, manufacturing technology, materials engineering, industrial engineering, and energy systems. At the end of these courses, graduates are expected to gain the knowledge, understanding and comprehension of mechanical systems, design of components and equipment, control technology and automated machinery. The MDE program accepts a maximum of 50 students at the sophomore level. This number may increase (within limits) in the years to come, as the program will have been proven and as the job market demands that increase.

5.1 Curriculum Overview

The curriculum of the MDE program consists of 180 credits spread over 71 courses covering topics in Humanities and Social Sciences (HSS), Basic Sciences (BS), Engineering Sciences (ES), and Applied Engineering Sciences (AS) as required by the Supreme Council of Universities (SCU). Sample courses in each category are presented as follows.

5.1.1 Humanities and Social Sciences Courses

- English language
- Humanities and Engineering
- Ethics and Legislation

- Technical Writing
- Communication and Presentation Skills
- Risk Management
- Fundamentals of Management
- Foreign Language
- Marketing
- Selections of Life-long Skills

5.1.2 Basic Sciences Courses

- Mathematics
- Physics
- Chemistry
- Mechanics
- Economics

5.1.3 Engineering Sciences Courses

- Mechanics of Machines
- Computer Engineering
- Fluid Mechanics
- Stress Analysis
- Numerical Analysis
- Thermodynamics
- Heat Transfer

5.1.4 Applied Engineering Sciences Courses

- Mechanical Design
- Fluid Power Systems
- Engineering Economy
- Industrial Electronics
- Casting, Forming and Welding
- Machining
- Turbo-machinery
- Robotics and Mechatronics
- Project Management

The curriculum gives the students the opportunity to select not only the major specialty but also several elective courses within the major. The student has more than 10% from the total credit hours in the bachelor degree chosen to his will. Students in the MDE program are also encouraged to participate in research through independent design and study projects. Moreover, the curriculum gives the students the opportunity to interact with industry and government agencies through two periods of industrial training internships. Students will be required to implement a major design project prior to their graduation. The following sections elaborate on the program requirements and present a sample study plan.

5.2 University Requirements

The main purpose of a university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills to develop a rational, well-rounded and successful personal identity. Moreover, Cairo University helps students to gain an appreciative understanding of the natural and cultural environments in which they live and their roles in the society and community services.

The university requirements of the CHS bachelor programs consist of 24 credits (13.3% of total 180 credits), which are satisfied by completing twelve (12) courses:

1. Nine (9) compulsory courses equivalent to 18 credits (10.0%), as listed in Table 1a.
2. Three (3) elective courses equivalent to 6 credits (13.3%), as listed in Table 1b.

Table 1a Compulsory Courses of University Requirements (18 credits, 10.0% of total 180 credits)

	Code	Course Title	Credits
1	GENN001	Humanities and Engineering	2
2	GENN002	English Language	2
3	GENN004	Computers for Engineers	2
4	GENN101	Technical Writing	2
5	GENN102	Fundamentals of Management	2
6	GENN201	Communication and Presentation Skills	2
7	GENN204	Accounting	2
8	GENN210	Risk Management and Environment	2
9	GENN221	Economics	2

Table 1b Elective Courses of University Requirements (6 credits, 3.3% of total 180 credits)

	Code	Course Title	Credits	Group
1	GENN301	Ethics and Legislation	2	E-1(1)
2	GENN310	Advanced Risk Management	2	
3	GENN311	Technical Writing in Arabic	2	
4	GENN321	Foreign Language	2	
5	GENN326	Marketing	2	
6	GENN327	Selections of Life-long Skills	2	
7	GENN331	Business Communication	2	
8	GENN332	Service Management	2	

Remarks:

(1) Student selects at least three (3) courses equivalent to 6 credits

5.3 College Requirements

College requirements provide students with the knowledge and skills that are essential to develop a successful engineer. A college core that is common to all credit hours programs is implemented. This unified college core contains two categories of courses. The first category of college core courses includes courses of basic knowledge essential to all engineering graduates such as Mathematics, Physics, Mechanics, Graphics and Design, Manufacturing, and Chemistry. The second category includes courses that all students are required to undertake in order to develop certain intended learning outcomes common to all engineering graduates, such as Seminar, Industrial Training, and Graduation Project courses.

The college requirements of the CHS bachelor programs consist of 45 credits (25.0% of total 180 credits), which are satisfied by completing nineteen (19) compulsory courses, as listed in Table 2.

Table 2 Compulsory Courses of College Requirements (45 credits, 25.0% of total 180 credits)

	Code	Course Title	Credits
1	CHEN001	Chemistry	3
2	GENN003	Basic Engineering Design	2
3	MDPN001	Engineering Graphics	3
4	MDPN002	Fundamentals of Manufacturing Engineering	3
5	MECN001	Mechanics-1	2
6	MECN002	Mechanics-2	2
7	MTHN001	Introduction to Linear Algebra and Analytic Geometry	3
8	MTHN002	Calculus I	3
9	MTHN003	Calculus II	3
10	MTHN102	Multivariable Calculus and Linear Algebra	3
11	MTHN203	Probability and Statistics	3
12	PHYN001	Mechanics, Oscillations, Waves and Thermodynamics	3
13	PHYN002	Electricity and Magnetism	3
14	MDEN280	Seminar-1	1
15	MDEN281	Industrial Training-1	1
16	MDEN380	Seminar-2	1
17	MDEN381	Industrial Training-2	2
18	MDEN480	Graduation Project-1	1
19	MDEN481	Graduation Project-2	3

5.4 Discipline Requirements

Graduates of MDE program should acquire the knowledge and skills of the Mechanical Engineering discipline at large. In addition to the typical "Mechanical Engineering" courses, the discipline requirements include topics from other inter-related disciplines that are very essential to the formation of a modern mechanical design-engineering curriculum. The discipline requirements comprise 45 credits (25.0% of total 180 credits), which are satisfied by completing sixteen (16) courses, as listed in Table 3.

Table 3 Compulsory Courses of Discipline Requirements: Mechanical Engineering (45 credits, 25.0% of total 180 credits)

	Code	Course Title	Credits
1	CVEN125	Civil Engineering	3
2	EPMN101	Electrical Engineering Fundamentals	3
3	EPMN202	Industrial Electronics	3
4	EPMN303	Industrial Instrumentation	2
5	EPMN404	Programmable Logic Controllers	2
6	MCNN101	Thermodynamics	3
7	MCNN202	Fluid Mechanics	3
8	MCNN326	Heat Transfer	3
9	MDPN131	Material Testing and Metrology	3
10	MDPN161	Stress Analysis	3
11	MDPN414	Experimentation	2
12	METN132	Materials Science	3
13	MEPN345	Turbo-machinery-I	3
14	MTHN103	Differential Equations	3
15	MTHN201	Numerical Analysis	3
16	PHYN104	Optics and Sound	3

5.5 Major Requirements

The major specialty requirements include courses in areas necessary in the formation of mechanical designers; such as design methodologies, materials engineering, control and automation engineering. Few specialty courses appear at early stages of the MDE program. The major requirements include compulsory courses and electives courses, which provide advanced knowledge and skills in areas of Mechanical Design, Solid Mechanics, Industrial Engineering, Energy Systems, and Mechatronics. A student who wishes to complete the specialty of Mechanical Design Engineering must complete the minimum major requirements of 66 credits (36.7% of total 180 credits), which are satisfied by completing twenty-four (24) courses as follows:

1. Seventeen (17) compulsory courses equivalent to 46 credits (25.6%), as listed in Table 4.
2. Seven (7) elective courses equivalent to 20 credits (11.1%), as listed in Table 5.

Table 4 Compulsory Courses of Major Requirements: Mechanical Design Engineering (46 credits, 25.6% of total 180 credits)

	Code	Course Title	Credits
1	MDPN117	Machine Drawing	3
2	MDPN141	Metal Cutting Processes	3
3	MDPN242	Casting, Forming, and Welding	3
4	MDPN251	Kinematics of Machine Components	3
5	MDPN252	Machine Design Ⅰ	3
6	MDPN253	Dynamics of Machine Components	2
7	MDPN262	Mechanics of Solids	3
8	MDPN313	Group Design Project	2
9	MDPN343	Sheet Metal Processing	3
10	MDPN353	Mechanism Design	2
11	MDPN354	Machine Design Ⅱ	3
12	MDPN363	Finite Element Analysis	2
13	MDPN422	Computer aided Manufacturing	2
14	MDPN457	Fluid Power Systems	3
15	MDPN464	Failure Analysis	3
16	MDPN471	Mechanical Vibrations	3
17	MDPN472	Automatic Control	3

Table 5 Elective Courses of Major Requirements: Mechanical Design Engineering (20 credits, 11.1% of total 180 credits)

	Code	Course Title	Credits	Group
1	MDPN331	Engineering Operations Research	3	E-2[(1)]
2	MDPN411	Computer Aided Design[(1)]	3	
3	MDPN413	Introduction to Mechatronics	3	
4	MDPN421	Tribology	3	
5	MDPN423	Robotics Engineering	3	
6	MDPN424	Project Management	3	
7	MDPN431	Sustainability and Design for Environment	3	
8	MDPN432	Pressure Vessels and Piping	3	
9	MDPN433	Hydraulic Servo Control	3	
10	MDPN434	Work Design and Ergonomics	3	
11	MDPN441	Design for Manufacturing	3	
12	MDPN442	Advanced Finite Element	3	
13	MDPN443	Special Topics in Mechanical Design	3	
14	MDPN451	Composite Materials: Design and Manufacturing	3	

	Code	Course Title	Credits	Group
15	MDPN452	Advanced Topics in Materials Engineering	3	E-2(1)
16	MDPN461	Computer Integrated Manufacturing CIM	3	
17	MEPN415	Power Generation	3	
18	MEPN425	Renewable Energy	3	
19	MEPN435	Internal Combustion Engines	3	
20	MEPN445	Turbo-machinery-II	3	
1	MDPN444	Quality Control	2	E-3(2)
2	MDPN456	Material Handling Equipments	2	

Remarks:

(1) Student selects at least six (6) courses from group E-2 equivalent to 18 credits, such that one of the six courses should be MDPN411

(2) Student selects at least one (1) course from group E-3 equivalent to 2 credits

5.6 Conformity to SCU Requirements

The classification and categorization of the courses offered by the Mechanical Design Engineering program follow the guidelines provided by the Supreme Council of Universities (SCU), as shown in Table 6. The classification is based upon the "Sample Study Plan and Course Sequence" described in Section 6. The categorization is given for the following five student levels according to the regulations of the credit hours system of education at the Faculty of Engineering, Cairo University:

- **Freshman**: a student who completed less than 36 credits
- **Sophomore**: a student who completed more than 35 credits but less than 72 credits
- **Junior**: a student who completed more than 71 credits but less than 108 credits
- **Senior-1**: a student who completed more than 107 credits but less than 144 credits
- **Senior-2**: a student who completed more than 143 credits

Table 6 Conformity to Supreme Council Criterion

Category	Freshman	Sophomore	Junior	Senior-1	Senior-2	Total Credits	%
Humanities and Social Sciences	6	4	7	5	2	24	13.3
Basic Sciences	22	15	6	2	0	45	25.0
Engineering Sciences	8	18	12	5	4	47	26.1
Applied Engineering Sciences	0	0	12	23	29	64	35.6
Total	36	37	37	35	35	180	100
University Requirements	6	4	6	6	2	24	13.3
College Requirements	30	3	5	3	4	45	25.0
Discipline Requirements	0	24	12	5	4	45	25.0
Major Requirements	0	6	14	21	25	66	36.7
Total	36	37	37	35	35	180	100

The MDE program consists of 71 courses: 61 compulsory courses (154 credits) and 10 elective courses (26 credits). The total 180 credits of the program are distributed between lectures (LEC) and tutorials (TUT), where a tutorial is classified as a problem solving session (PSS) and/or a practical work/laboratory session (PLS). The one credit of a tutorial corresponds to 2-3 hours to provide sufficient practical training for the students. Thus, the total contact hours of learning are around 300 hrs.

6. SAMPLE STUDY PLAN and COURSE SEQUENCE

A sample study plan for the MDE program is presented as one recommended sequence to complete the graduation requirements over 10 main semesters, the Fall and Spring semesters per academic year. Since the program is based on the credit hours system of education, the student does not have to take the courses during the semester indicated in the study plan as long as the course prerequisites are satisfied.

The MDE curriculum encourages students to interact with the industrial sector and government agencies by offering two industrial training courses in at least two summer sessions. Also, the Students will be trained on teamwork and exposed to large Mechanical Design Engineering projects during their practical training and graduation projects.

Freshman Year Course Schedule

	Semester-1: Fall		Semester-2: Spring	
	Course Code	CR	Course Code	CR
1.	MECN001	2	MECN002	2(1)
2.	MTHN001	3	CHEN001	3
3.	MTHN002	3	MTHN003	3(2)
4.	PHYN001	3	PHYN002	3
5.	MDPN001 OR MDPN002	3 OR 3	MDPN002 OR MDPN001	3 OR 3
6.	GENN001 OR GENN002	2 OR 2	GENN002 OR GENN001	2 OR 2
7.	GENN004 OR GENN003	2 OR 2	GENN003 OR GENN004	2 OR 2
Semester Credit Hrs		18		18

Remarks:

(1) Course MECN002 has a prerequisite course MECN001

(2) Course MTHN003 has a prerequisite course MTHN002

MDE Program Study Plan

	Semester-3: Fall		Semester-4: Spring		Semester-5: Fall		Semester-6: Spring	
	Course Code	CR	Course Code	CR	Course Code	CR	Course Code	CR
1.	GENN101	2	GENN102	2	GENN201	2	GENN210	2
2.	CVEN125	3	EPMN101	3	GENN204	2	EPMN202	3
3.	MDPN117	3	MDPN131	3	MDPN251	3	MDPN252	3
4.	METN132	3	MDPN141	3	MCNN202	3	MDPN253	2
5.	MDPN161	3	MTHN103	3	MDPN242	3	MDPN262	3
6.	MCNN101	3	PHYN104	3	MTHN201	3	MCNN326	3
7.	MTHN102	3	----------	------	MTHN203	3	MDEN280	1
8.		------	----------	------	----------	------	MDEN281(0)	1
Semester Credit Hrs		20		17		19		17+1(0)

	Semester-7: Fall		Semester-8: Spring		Semester-9: Fall		Semester-10: Spring	
	Course Code	CR	Course Code	CR	Course Code	CR	Course Code	CR
1.	GENN221	2	MEPN345	3	MDPN414	2	EPMN404	2
2.	EPMN303	2	MDPN354	3	MDPN422	2	MDPN464	3
3.	MDPN313	2	MDEN380	1	MDPN353	2	MDPN471	3
4.	MDPN343	3	GENN3XX(1)	2	MDPN457	3	MDEN481	3
5.	MDPN363	2	GENN3XX(1)	2	MDEN480	1	XXXN4XX(2)	3
6.	MDPN472	3	MDPN4XX(3)	2	GENN3XX(1)	2	XXXN4XX(2)	3
7.	XXXN4XX(2)	3	XXXN4XX(2)	3	MDPN411(2)	3	----------	------
8.	----------	-----	MDEN381(0)	2	XXXN4XX(2)	3	----------	------
Semester Credit Hrs		17		16+2(0)		18		17

Remarks:

(0) Industrial training courses to be completed in the summer sessions

(1) General elective course (group E-1, 2 credits per course): GENN301, GENN310, GENN311, GENN321, GENN326, GENN327, GENN331, GENN332

(2) Major elective course (group E-2, 3 credits per course): MDPN331, MDPN411, MDPN413, MDPN421, MDPN423, MDPN424, MDPN431, MDPN432, MDPN433, MDPN434, MDPN441, MDPN442, MDPN443, MDPN451, MDPN452, MDPN461, MEPN415, MEPN425, MEPN435, MEPN445

(MDE students are advised to study the course MDPN411 in the shown semester)

(3) Major elective course (group E-2, 2 credits per course): MDPN444, MDPN456

7. COURSE CONTENTS

7.1 University-Core Courses

GENN001	**Humanities and Engineering** **Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s): none** History of Technology: Engineering and technology in a cultural, social, and historical context. Development of technology as a key to history of civilization in a comparative perspective - Exploring Humanities: Modes of thought found within humanities and social sciences. Humanities for Engineers: Humanities themes of increased complexity - Different work methodologies - Critical analysis of information & choice of argumentation - Work methodologies and pedagogical interest.
GENN002	**English Language** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): none** Writing clear topic sentences, well-developed supporting sentences, and concluding sentences. Editing paragraphs for punctuation & writing errors. Extracting meaning of words from reading texts. Making logical inferences from texts. Discussing opinions and thoughts about daily life topics. Planning, implementing and delivering group presentations. Skimming through and scanning text for details. Developing critical thinking skills.
GENN004	**Computers for Engineers** **Compulsory, Credits: 2 (1+0+2)** **Prerequisite(s): none** Developing basic concepts of algorithmic thinking to solve problems of relevance in engineering practice and implementing these algorithms using high-level computer language. Using data types, input/output commands, loops, control structures, functions, arrays, and other programming language constructs in a computer program. Evaluating and interpreting the results of programming work.
GENN101	**Technical Writing** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): GENN002 + 28 credits** Discovering and outlining ideas. Organizing outlines. Ways To begin the three parts of technical writing. Writing abstracts, summaries, and conclusions of long reports. The thesis statement. Forms: letters, memos, reports, scientific articles, job description, CV, references and footnotes. Selection of key words, titles, and subtitles. Editing, revising and proof-reading techniques. Electronic word processing and technical writing, vocabulary building, and basic types and patterns of argument.
GENN102	**Fundamentals of Management** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): 28 credits** Introduction to management, Historical view and evolution of concepts. Basic Managerial Functions: Planning, Strategies, Objectives, MBO;

	Organizing, Departmentation, Job Description; Elements of Human Resource Management: Staffing, Directing, Controlling. Total Quality Management, Continuous Improvement. Engineering Applications.
GENN201	**Communication and Presentation Skills** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): GENN101** Analyzing the audience. Selecting presentation topics and objectives. Recognizing different types of speeches and presentations. Overcoming nervousness and developing confidence while addressing an audience. Researching and generating information for informative presentations. Chucking presentation content. Designing effective visual aids. Using explicit and effective transitions throughout a presentation. Creating benefit statements for persuasive presentations. Using persuasive devices such as pathos and logos in speeches. Planning and delivering informative, persuasive, entertaining and inspiring presentations. Handling question and answer sessions effectively.
GENN204	**Accounting** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): 42 credits** Basic accounting concepts: Accounting terms and assumptions. Accounting Methodology: balance sheet, income statement, cash flow statement. Income Determination: Cash Effects, Basis of Accounting. Accounting ratio – measuring the performance – cost concepts – cost accumulation – cost allocation – cost/volume/profit analysis – budgets – forecasting. Cost Accounting.
GENN210	**Risk Management and Environment** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): GENN102** Risk Management: Introduction. Risk Definition. Basic Axioms Behind Risk Management. Systemic Approach to Handling Risk . Principle of Risk Management: Identification of Risks. Preliminary Risk Analysis (PRA). Risk Assessment. Risk Evaluation. Risk Control. Hierarchies of Control. Monitoring and Reviewing. Documentation. Study of a practical problem in which the student applies Basic Risk Management Environment: Environmental Systems: Local, Regional and Global. Influence of Air Pollutants on the, Environment, Water Pollutants, Industrial Waste, Hazardous Wastes, Management of Pollutant Releases, Pollution Prevention, Recycling of Waste Materials, Waste Treatment Technologies, Ultimate Disposal of Wastes, Water Treatment Technologies. Control of Air Pollution, Contaminated Land and Its Reclamation, Principals and Uses of the Environmental Risk Assessment, Environmental Risk Assessment Methodology, Environmental Impact Assessment Environmental Health Risk Assessment. National and International regulations**.**

GEN N221	**Economics** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): 42 credits** Economics as a Discipline: Economics as a Social Science, Micro-economics and Macroeconomics, Theories in Economics, Barriers to Clear Thinking in Economics. The Economic Problem: Scarcity, Resources and Production, Production Possibility Boundaries, Choices and Opportunity Costs, Resource Use (Fundamental Choices). Demand and Supply: The Mechanics of a Market. Demand and Supply, Consumers Behavior (Demand, Individual Demand and Market Demand), Properties of Demand Curves, Demand versus Quantity Demanded, Producers Behavior: Supply, Individual Supply and Market Supply, Properties of Supply Curves, Supply versus Quantity Supplied, Equilibrium of Demand and Supply, Adjustment in Market Equilibrium. Supply and Demand Analysis: Economic Analysis, Demand Shifts: Substitutes and Complements, Demand Shifts: Superior and Inferior Goods, Price Ceilings, Price Floor, Excise Taxes. Price Elasticity of Demand: Price Sensitivity, Price Elasticity of Demand, Measuring Price Elasticity of Demand with the Arc Formula, Price Elasticity of Demand and Slope, Price Elasticity of Demand and Total Revenue, Determinants of Price elasticity of Demand, Other Elasticities. Perfect Competition and Monopoly Production and Input Use: Production, Production Functions, Short-Run Functions, Long-Run Production, Choices of Inputs. Economic Costs: Economic Costs, Short-Run Costs, Short-Run Cost Curves, Long-Run Costs and Long-Run Cost Curves. Profits, Interests, and Rent. Interest Rates, Time Value of Money. Feasibility Studies. Project Economic Analysis. Depreciation. Factor Markets: Perfect and Imperfect Competition.
GENN301	**Ethics and Legislation** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): 80 credits** Engineering profession: Ethical issues in engineering practice. Conflicts between business demands and professional ideals. Social and ethical Responsibilities of Technologists. Codes of professional ethics. Case studies. Value Crisis in contemporary society. Nature of values: Psychological values, Societal values, Aesthetic values, Moral and ethical values. Work ethics and professional ethics. The legal rule: Mandatory and complementary. Sources of Law. Formal sources: Statutory Law, Custom, the Principles of natural Law and rules of justice. Informal sources: Jurisprudence, Doctrine. Application of Law. Holders of right; Natural persons, Juristic persons. Theory of Obligation; definition, forms. Sources of Obligations. Labor Law. Safety and Vocational Laws. The contract; Parties, Formation, Validity, Effect, Interpretation, Responsibilities, Dissolution, and compensation of Damage. Contracts.

GENN310	**Advanced Risk Management** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN210 + MTHN203** Review of the Basic Risk Axioms and Concepts. Evolution of Risk Concepts and Terminology. Financial and Industrial Risk: Comparison and Contrast. Probabilistic Nature of Risk.. System Decomposition. Legal and Regulatory Risks. Tools for Risk Assessment: Probability and Consequences: Event Tree, Fault Tree, FMECA, FEMEA, MOSAR (The French Approach), Simulation, Optimization and Operations Research. HACCP: principles and applications. HAZOP.Qualitative and Quantitative Risk Assessments (QRA). Quantitative Risk Assessment: Qualitative Aspects of System Analysis (Quantification of Basic Events. Confidence Interval. Quantitative Aspects of System Analysis. System Quantification for Dependent Events. Human Reliability. Uncertainty Quantification). Operational Risk. Reporting Risk Operations. Sectoral Risk Management. Specific Risk Topics: Risk Specific to Confined Spaces. The Special Case of BLEVE and Explosive Mixtures. Social and Psychological Risk. Social Risk Management and Social Protection. Disaster Risk Management and Vulnerability Reduction. Can Risk be a Management Style?
GENN311	**Technical Writing in Arabic** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN101 + 80 credits** Review of the Basics of Arabic Grammar and Mechanics. Writing Effective Sentences and Paragraphs Using Arabic Language. Discovering and Outlining Ideas. Writing Abstracts, Summaries, and Conclusions of Long Reports. The thesis Statement. Writing Technical Forms Using Arabic Language: Letters, Memos, Reports, Scientific Articles, Job Description, CV. Writing References and Footnotes. Selection of Key Words, Titles and Subtitles. Editing, Revising and Proofreading Techniques. Electronic Word Processing and Technical Writing. Integrating Graphs, Tables and Charts in Technical Documents. Vocabulary Building. Basic Types and Patterns of Argument: Terminology, Building Sub-Arguments of Fact and Policy. مراجعة أسس القواعد النحوية و ميكانيكيات اللغة العربية - الأخطاء الشائعة فى استخدامات اللغة العربية - كتابة جمل وفقرات صحيحة وفعالة باستخدام اللغة العربية - خلق الأفكار (التفاكر) - كتابة مقدمات، ملخصات و خاتمات التقارير - كتابة الأبحاث - أشكال الكتابة باللغة العربية: الرسائل، المذكرات، التقارير، المقالات العلمية، الوصف الوظيفي، كتابة السيرة الذاتية وتوثيق المراجع - اختيار الكلمات المفتاحية و كذلك العناوين الرئيسية والفرعية - التعرف على تقنيات التحرير و المراجعة و القراءة الاحترافية - إمكانية معالجة النصوص والكتابة الإليكترونية - الرسوم و الجداول و المخططات البيانية في الوثائق الفنية - بناء حصيلة لغوية من الكلمات والمفردات - تعلم الانماط و الأساليب الأساسية والمبدئية للنقاش من حيث الهنهجية والهناء.
GENN321	**Foreign Language** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN201** Emphasizing the development of student's communicative skills to speak, listen, read and write in languages other than Arabic and English, such as

	French, German, Spanish, Italian, Japanese, Chinese, etc, and to study cultural characteristics of such foreign languages from historical, geographical, literature, economic, and social viewpoints. Topics include, but not limited to, the basics of language grammar and mechanics, writing effective sentences and paragraphs, vocabulary building, writing technical engineering documents and writing technical forms: letters, memos, reports, scientific articles, job description, resumes and curriculum vitas.
GENN326	**Marketing** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN102 + 80 credits** Introduction. The Field of Sales; Strategic Sales Force Management. The Personal Selling Process and Sales Force Organization. Profiling and Recruiting Salespeople; Selecting and Hiring Applicants, Developing the Sales Program, Sales Force Motivation, Sales Force Compensation, Expenses and Transportation; Leadership of a Sales Force, Forecasting Sales and Developing Budgets; Sales Territories, Analysis of Sales Volume, Marketing Cost & Profitability Analysis, Performance Evaluation; Ethical and Legal Responsibilities tender writing.
GENN327	**Selections of Life-Long Skills** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN201** Communicating Clearly - Managing Time and Resources - Making Decisions - Delegating Successfully - Motivating People - Managing Teams - Negotiating Successfully - Minimizing Stress - Getting Organized - Managing Changes - Interviewing People - Managing Your Career - Balancing Work and Life - Thinking Creativity and Innovation - Influencing People – Systems Thinking – Interpersonal Management Skills – Entrepreneurial Skills.
GENN331	**Business Communication** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN201** Skills for effective communication in the workplace; constructing and delivering persuasive business presentations; theoretical and experiential knowledge of argumentation and debate for informal and formal presentations; style, layout, and convention of business writing; writing business proposals, progress reports, and feasibility reports; common areas of miscommunication.
GENN332	**Service Management** **Elective (group E-1), Credits: 2 (1+1+0)** **Prerequisite(s): GENN102 + 80 credits** Role of services in the economy, The nature of services, Service quality, Service Strategy, Developing new services, The role of technology in supporting service delivery, Design of services, Capacity planning and managing queues, Quantitative methods for service management.

7.2 College-Core Courses

CHEN001	**Chemistry** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Gases; Applications to gaseous law; Mass balance and heat balance in combustion processes of fuels; Solutions & separation techniques; Applications to electrochemistry; Corrosion; Water treatment; Building materials; Environmental Engineering; Selected chemical industries: fertilizers, dyes, polymers, sugar, petro-chemicals, semi-conductors, oil and fats, industrial systems; Chemical Vapor deposition.
GENN003	**Basic Engineering Design** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): none** Introduction to Design: Problem description and Introduction to Internet communication - Project Management: Project Management Application, Problem Solving Techniques: Problem Definition, Design Constraints - Creative Thinking and Problem Solving: Introduction to critical and creative thinking, nature of design problems - Brainstorming seminar, list of possible and impossible solutions and generating Ideas - Creative Thinking and Decision making: Product life cycles , Selection of idea (s), Final decision matrix, Justify decision - The Design Matrix: Context, purpose and requirements of engineering design - Analyze selected solution/preliminary design - Automated Design & the Positive Attitudes for Creativity - Systematic generation and evaluation of ideas.
MDPN001	**Engineering Graphics** **Compulsory, Credits: 3 (1+0+5)** **Prerequisite(s): none** Techniques and skills of engineering drawing, normal and auxiliary projections. Solid geometry. Intersections between planes and solids. Development, sectioning. Drawing and joining of steel frames. Assembly drawing of some mechanical parts.
MDPN002	**Fundamentals of Manufacturing Engineering** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): none** Engineering Materials - Elements of Manufacturing Processes, material flow, energy flow and information flow - Forming in the liquid state, Casting and molding processes - Forming in the solid state, metal forming, forming of plastics and powder metallurgy - Material Joining processes, welding, soldering and brazing, riveting, joining by mechanical elements, assembly processes - Material removal processes, metal cutting and finishing processes - Computer applications in manufacturing - Term mini-project.
MECN001	**Mechanics-1 (Statics)** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): none** Statics of particles, forces in three-dimensions, vector algebra; equivalent systems of forces, resultant of a group of forces, moments of forces,

	moment of a couple, reduction of a system of forces, wrench; equilibrium of rigid bodies in two dimensions, reactions at supports and connections for a 2D structure, 2D trusses, equilibrium of rigid bodies in three dimensions, reactions at supports and connections for a three dimensional structure; centroids and centers of gravity, center of gravity of 2D bodies, centroids of areas and lines, first moments of areas and lines, composite plates and wires; moments of inertia, moments of inertia of areas, second moment, or moment of inertia of an area, polar moment of inertia, radius of gyration of an area, parallel-axis theorem, moments of inertia of composite areas, product of inertia, principal axes and principal moments of inertia, moments of inertia of masses, moment of inertia of a mass, parallel axis theorem, moments of inertia of thin plates, moments of inertia of composite bodies, mass product of inertia, principal axes and principal moments of inertia.
MECN002	**Mechanics-2 (Dynamics)** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MECN001** Kinematics of particles: rectilinear motion of particles, position, velocity and acceleration, uniform rectilinear motion, uniformly accelerated rectilinear motion, curvilinear motion, derivatives of vector functions, rectangular components of velocity and acceleration, relative motion, tangential and normal components of acceleration, motion of a particle in a circular path, velocity and acceleration of a particle in polar coordinates. Kinetics of particles: Newton's second law, linear momentum of a particle, equations of motion with applications in Cartesian coordinates, tangential and normal directions, polar coordinates, free vibrations of particles, simple harmonic motion; energy & momentum methods, work of a force, kinetic energy of a particle, principle of work and energy, applications, power and efficiency, potential energy, conservation of energy, principle of impulse and momentum, impulsive motion, impact, direct central impact and coefficient of restitution, oblique central impact.
MTHN001	**Introduction to Linear Algebra and Analytic Geometry** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): none** Matrix algebra, determinants, inverse of a matrix, row equivalence, elementary matrices, solutions of linear systems of equations; parabola, ellipse and hyperbola, eccentricity and conic sections; quadratic equations; solid geometry, line, plane, quadratic surfaces.
MTHN002	**Calculus I** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): none** Functions, graphing of functions, combining functions, trigonometric functions; limits and continuity; differentiation; inverse functions; exponential and logarithmic functions; inverse trigonometric functions; hyperbolic and inverse hyperbolic functions; indeterminate forms and L'Hopital's rule; Taylor and Maclaurin expansions.

MTHN003	**Calculus II** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN002** Anti-derivatives; indefinite integrals; techniques of integration; definite integrals, applications of definite integrals; functions of several variables; partial derivatives, applications for partial derivatives.
MTHN102	**Multivariable Calculus and Linear Algebra** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN001 + MTHN003** Double integrals, double integrals in polar coordinates; triple integrals, triple integrals in spherical and cylindrical coordinates; applications of double and triple integrals; line and surface integrals; vector analysis, gradient of a scalar function, divergence of a vector, curl of a vector, divergence and Stokes' theorems, vector identities; LU-factorization; vector spaces; inner product spaces; eigenvalues and eigenvectors; diagonalization of matrices; functions of matrices.
MTHN203	**Probability and Statistics** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN102** Probability axioms; probability laws; conditional probability; random variables; discrete and continuous distributions; joint distribution; computer simulation; sampling; measures of location and variability; parameter estimation, testing of hypothesis.
PHYN001	**Mechanics, Oscillations, Waves and Thermodynamics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Physics and measurements; elastic properties of solids; universal gravitation and motion of planets; fluid mechanics (statics and dynamics); oscillatory motion; wave motion, sound waves; thermo-dynamics, temperature, heat and the first law of thermodynamics, the kinetic theory of gases, heat engines, entropy and the second law of thermodynamics. Laboratory experiments on course topics.
PHYN002	**Electricity and Magnetism** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Electric field; Gauss' law; electrostatic potential; capacitance and dielectrics; current and resistance; direct current circuits; magnetic fields, sources of magnetic field; Faraday's law; Maxwell's equations; inductances; magnetic properties of matter. Laboratory experiments on the course topics.
MDEN280	**Seminar-1** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): 72 credits + AA Approval** Talks and presentations are invited from industrial establishments relevant to the program. The guest speaker should discuss the organization, management, and recent technologies implemented in his/her industrial establishment. Students exercise writing brief technical

	reports on the guest presentation and deliver their own presentation about the topic. *The course is graded as Pass/Fail grade-system.*
MDEN380	**Seminar-2** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): MDEN280 + GENN201** Students will be required to present seminars on a subject assigned to (or chosen by) them about the latest technology relevant to the program. The grade depends on organization, quality, and content of both the presentation and the report prepared by the student. *The course is graded as Pass/Fail grade-system.*
MDEN281	**Industrial Training-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 72 credits + AA Approval** Training on industrial establishments relevant to the program. Training lasts for total of 90 hours, during a period about three weeks. The program training advisor schedules at least one follow up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. *The course is graded as Pass/Fail grade-system.*
MDEN381	**Industrial Training-2** **Compulsory, Credits: 2 (0+0+6)** **Prerequisite(s): MDEN281 + AA Approval** Training on industrial establishments relevant to the program. Training lasts for total of 180 hours, during a minimum period of six weeks. The program training advisor schedules at least two follow-up visits to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. *The course is graded as Pass/Fail grade-system.*
MDEN480	**Graduation Project-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 130 credits + AA Approval** Students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement appropriate concepts and techniques to a particular design. Students are required to select and research the expected project to be designed and implemented in the following course Graduation Project-2. The student should give an oral presentation to be approved. *The course is graded as Pass/Fail grade-system.*

MDEN481	**Graduation Project-2** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): MDEN480 + AA Approval** All students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement the appropriate concepts and techniques to a particular design. A dissertation on the project is submitted on which the student is examined orally.

7.3 Discipline Courses

CVEN125	**Civil Engineering** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MECN001** Buildings: types of buildings, items within a building, types of foundations, building materials with emphasis on concrete and testing, insulation against heat moisture, noise and pollution, Principles of fire protection, tender document. Surveying: Principles & applications of surveying sciences with emphasis on plane surveying, Popular techniques and engineering uses of distance, angles and height difference measurements. Applications of mapping, earthwork computations, setting out engineering structures, Integrated digital surveying and mapping using total station, Internet resources. Structures: Types of structures, loads, supports, reactions, internal forces, analysis of beams, frames, trusses. Beams subjected to moving loads.
EPMN101	**Electrical Engineering Fundamentals** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PHYN002** Analysis of DC and AC circuits, branch currents and node voltages. Transient analysis. Single-phase transformers and circuits thereof. Basic DC motors: series shunt and compound. Induction motors. Predicting motor performance. Logic gates, circuit design with logic gates.
EPMN202	**Industrial Electronics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): EPMN101** Analyzing and characterizing the basic power electronic circuits. Diodes and rectifier circuits. Transistors: DC bias, power transistors. Thyristors: operation, rectifier circuits. Design of digital and analogue firing circuits needed to operate the power electronic circuits. Operational amplifier circuits and applications. Digital electronics. Course project.
EPMN303	**Industrial Instrumentation** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): EPMN202** Performance of analogue and digital transducers; selecting a proper

	transducer for a given application. Analogue transducers: solenoids, thermocouples, pressure transducers. Digital transducers: optical encoders, ultrasonic sensors. Signal conditioning: signal analysis, frequency response, filter design, op-amp circuits. Data acquisition systems (A/D and D/A converters). Stepper motors: microprocessors: structure, programming, applications. Course project.
EPMN404	**Programmable Logic Controllers** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): EPMN202** Selecting a proper PLC configuration for a given application. Hardware structure and wiring techniques. Basics of programming (bit and word programming, analogue values processing). Programming sequential control tasks. Structured programming techniques. Networking. Building simple supervisory control and data acquisition (SCADA) system integrated with a PLC for sequential control problems. Course project.
MCNN101	**Thermodynamics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PHYN001** Basic concepts. Pure substances - First law of thermodynamics and applications – second law of thermodynamics and corollaries – entropy. May include a visit to a power plant, course project
MCNN202	**Fluid Mechanics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MTHN003 + PHYN001** Fluid kinematics. flow types. Integral analysis of flow: Continuity, Linear momentum, Angular momentum and Energy equations, Applications. Similitude and dimensional analysis and modeling, Viscous flow in pipes and ducts. Flow measurement. General applications. Course project computer oriented.
MCNN326	**Heat Transfer** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCNN101** Conduction: General equation of conduction, one dimensional steady-state conduction, steady-state conduction with internal heat generation, steady conduction with variable thermal conductivity, fins and extended surfaces, unsteady conduction. Convection: fundamentals of convection, dimensionless groups, natural and forced convection, use of empirical correlations. Radiation: Fundamentals of heat transfer by radiation. Case studies and computer applications.
MDPN131	**Material Testing and Metrology** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PHYN001** **Part I:** An introduction to the properties and applications of a wide variety of materials: metals, polymers, ceramics, and composites. Considerations include availability and cost, formability, rigidity, strength, and toughness. Mechanical testing of metals: tension, compression, bending, torsion,

	hardness, fatigue, impact. **Part II:** Introduction and definitions of metrology – Gauges – Errors in measurement – Linear measuring instruments – Angle measuring instruments – Tests of straightness and flatness – Surface roughness – Comparators – Screw thread measurements and gear measurements.
MDPN161	**Stress Analysis** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MTHN003 + MECN001** Equilibrium, continuity, material mechanical behavior. Normal force, shearing force, bending and twisting moment diagrams. Stresses in simply loaded elastic bars: axial loading, bending and torsion, deformation, stiffness, strain energy. Stresses in elastic and elasto-plastic bars, residual stresses. Combined loading, eccentric normal load, oblique bending, combined bending and torsion. Two-dimensional stresses, principal stresses, maximum shear stress, allowable stresses, Mohr's circle representation. Application to simple frames, thin-walled vessels, springs, load and displacement measurement. Course project computer oriented.
MDPN414	**Experimentation** **Compulsory, Credits: 2 (1+0+3)** **Prerequisite(s): 108 credits** Introduction to experimentation, Endurance test setups for mechanical components, acquisition, adjusting, plotting and interpretation of test results, extraction of reliability data. Experiments are oriented to four disciplines: Design and Tribology; Solid Mechanics; Metallurgy and Microstructure; Dynamics. The evaluation of students will be upon reports submitted by students, a written exam in Mid-Term and an Oral Exam by a panel of beer examiners.
MEPN345	**Turbo-machinery-I** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCNN202** Fans, Compressors, Pumps and Turbines: Terminology - Basic concepts and laws - Similarity – Turbo-machinery Classifications - Axial flow fans and compressors – Centrifugal pumps, fans and compressors - Axial and radial flow hydraulic turbines – Sizing in Various Applications (steam and gas power plants, compressed air system, chilled water system, AC air distribution system, pneumatic control system, etc.), Course Project
METN132	**Materials Science** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN002 + PHYN001** Nature and properties of materials: Crystal structures and lattices, crystal imperfections, slip and dislocations, plastic deformation, phase diagrams, binary phase equilibrium characteristics of alloy solidification and structure of metals and alloys, Iron carbon diagram, various types of bonds, Hot and cold working of metals, recovery, recrystalization and grain growth. Metallography: Study of microstructure.

MTHN103	**Differential Equations** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN003** First-order differential equations, separable, exact, linear, homogeneous and Bernoulli equations; modeling with first order differential equations; higher-order differential equations; method of undetermined coefficients; variation of parameters; modeling with higher order differential equations; series solutions; Laplace transform; properties and applications, shifting theorems, convolution theorem; solutions of differential equations using Laplace transform; Fourier series; Fourier transform.
MTHN201	**Numerical Analysis** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MTHN102 + MTHN103** Basic concepts of floating- point arithmetic- Conditioning of a problem- Numerical stability of an algorithm – Linear systems: direct methods (Gauss elimination , LU factorization, Choleski) – Iterative methods (Jacobi –Gauss-Seidle – SOR). Approximation of Functions: polynomials and piecewise polynomial interpolation, splines, discrete least squares. Nonlinear equations: Newton's method and its discrete variants, fixed point iteration. Numerical integration: Newton- Cotes formulas, Gaussian quadrature rules, composite rules. Initial value problems for ordinary differential equation: one-step methods (Runge-Kutta methods) and multistep (Adams) methods. Stiff problems
PHYN104	**Optics and Sound** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PHYN001 + PHYN002** Principles of optics: electromagnetic wave phenomena; dispersion; prisms and lenses, the optical path; interference; diffraction; polarization. Fundamentals of acoustics: sound generation, transmission, reflection and reception; noise perception and measurement; principles of ultrasound, non-destructive testing of materials.

7.4 Major Courses:

MDPN117	**Machine Drawing** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): MDPN001** Sketching and drafting of actual Mechanical components and Assemblies - Assembly drawing, working drawing, dimensioning, limits, fits, Geometrical and dimensional tolerances, surface roughness. Standard machine elements (threads, fasteners, locking devices, keys, splines, gears, pulleys, bearings, pipe connections, etc.) - Welding and riveting conventions. Standardization and designation of machine elements. Computer aided graphics application.

MDPN141	**Metal Cutting Processes** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN002 + METN132** Examination of metal cutting processes including turning, shaping, drilling, grinding. Mechanics of two and three-dimensional cutting. Principles and mechanisms of wear. Tool materials. Theoretical prediction of surface finish. Chemistry of cutting fluids. Laboratory period includes operation of machine tools. Experimental determination of cutting energy, forces, stresses and strains. The interrelationship between these and practical metal cutting conditions. Course project.
MDPN242	**Casting, Forming and Welding** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN002 + METN132** Casting: Types of foundries, steps in making a casting; cast metals; types, materials and allowances of patterns; moulding processes and materials; gating and risering; casting defects. Forming: Metal forming process classification, basic metal working concepts and plasticity; yield criterion; slip line fields; estimation of force and energy requirements; technology of bulk and sheet metal forming processes; precision forming processes; features of different types of metal forming dies; principles of powder forming. Welding: Welding processes; welding energy sources and their characteristics; fluxes and coatings; weldability and welding of various metals and alloys; metallurgical characteristics of welded joints; weld testing and inspection. Course project.
MDPN251	**Kinematics of Machine Components** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN117 + MECN002** Kinematics fundamentals: geometry of motion and mechanism topology, Machine components, Indexing mechanisms, Rolling bearings, Kinematics of rigid bodies: rotation, absolute motion, relative velocity, instantaneous center of zero velocity, relative acceleration, motion relative to rotating axes, linkage mechanisms and planar robots: (position, velocity and acceleration), Cam-follower mechanisms: design and analysis, standard cams and equivalent mechanisms, Gear trains (simple, compound and planetary): Kinematics, geometry and assembly conditions, Belts and chain Drives, Screw Mechanisms, Simulation using Computer Graphics and Matlab Software and case studies, Course project
MDPN252	**Machine Design I** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): MDPN161 + MDPN251** Design procedures – Factors affecting design details – Selection of materials – Modes of loading – Safety factors and allowable stresses – Design variants and inversions. The various design calculations. Interpretation and usage of component data sheets. .Design of

	detachable joints: (threaded joints , keys and splines) – Design of permanent joints: (welding, interference fitting, riveting, riveting, adhesion) – Design of some machine elements: springs, power screws. Applications to small-scale mechanical systems. Course project.
MDPN253	**Dynamics of Machine Components** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MDPN251 + MDPN117** Dynamics fundamentals and basic concepts, Plane Kinetics of Rigid bodies: force-mass-acceleration, work and energy, virtual work, impulse & momentum, Newton's laws of motion, Static force analysis, Dynamic force analysis: application to linkage mechanisms; gear trains, cam-follower mechanism, Balancing of machinery: rotating elements, 4-bar linkage, reciprocating elements, Engine dynamics, Balancing of single cylinder engine, Flywheel design and turning moment diagram, Multi-cylinder engines: Line engines, V-engines, W-engines, Simulation using Computer Graphics and Matlab Software and case studies, Course project
MDPN262	**Mechanics of Solids** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN161** Energy methods, Curved bars, Thin-walled pressure vessels, Shear stresses in non-circular sections, Introduction to Theory of Elasticity, States of stress and Strain, Stress-strain Relations, Application to problems in polar coordinates such as: Thick- walled spheres and cylinders, Inelastic material behavior: introduction to theory of plasticity, Yield and flow criterion, applications to beams, shafts and cylinders, Computer applications and case studies, Course project.
MDPN313	**Group Design Project** **Compulsory, Credits: 2 (0+0+6)** **Prerequisite(s): MDPN252** Students in small groups will apply the knowledge acquired on the mechanics of machines and components and on mechanical design to handle the design of some mechanical modules. These will be selected such as to be of educational value and of an accuracy level commensurate with their functional requirements. The designs will be constructed and assessed as to the extent of verifying and coping with their requirements. The exam will be in form of a presentation by each group before their fellow students and peer examiners
MDPN343	**Sheet Metal Processing** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN242** Review of Sheet metal industry applications, Sheet Metal Properties, Deformation of sheet metals, Simple Stamping Analysis, Deep Drawing Die design, Sheet metal shearing and bending, Non-Conventional Sheet metal processes. Die design: Standard parts, progressive and compound dies, Mechanical and Hydraulic Presses selection-CNC punch presses. Course project

MDPN353	**Mechanism Design** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MDPN251 + AA Approval** Introduction and basic concepts, Mechanisms and structures, Number synthesis, Paradoxes, Isomers, Linkage transformation, Intermittent motion, Inversion, Function path and motion generation Graphical synthesis of planar mechanisms: Two-position synthesis, Three-position synthesis, Quick-return mechanisms, Coupler curves, Analytical synthesis of planar mechanisms, Optimal planar mechanism synthesis, Analytical synthesis of simple toggles, Introduction to spatial mechanism synthesis, simulation using Computer Graphics and Matlab Software and case studies. Course project
MDPN354	**Machine Design II** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN252 + MDPN253** Design of Power transmission elements, Shaft design, Bearing design and Selection, Gear design (spur, helical and bevel gears), Sprocket and chain design, Belts and Pulley, Brake Design, Clutch design, Course Project.
MDPN363	**Finite Element Analysis** **Compulsory, Credits: 2 (1+1+2)** **Prerequisite(s): MDPN262** Basic principles of continuum mechanics and finite element methods, modern application to solution of practical problems in solid, structural, and fluid mechanics, heat and mass transfer, other field problems. Kinematics of deformation, strain and stress measures, constitutive relations, conservation laws, virtual work, and variational principles. Discretization of governing equations using finite element methods. Solution of central problems using an existing general-purpose finite element analysis program, Course project.
MDPN422	**Computer Aided Manufacturing** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MDPN141** Product Cycle and CAD/CAM, Automation and CAD/CAM, Programming for lathe, drilling and milling machines, canned cycles, subroutines, Do Loops, Computer assisted part programming, DNC, CNC, Adaptive control. Industrial robotics: Robot physical configurations, robot motions, accuracy, repeatability, end effecter, sensors, robot programming, robot languages. Group Technology: part families, part classifications and coding systems, group technology machine, cell, concepts of composite part, benefits and limitations. Computer aided process planning: Retrieval type process planning systems, generative process planning systems, machinability data systems, computer generated time standard. Computer Integrated Manufacturing: Types of manufacturing systems, types of CIMS, special manufacturing systems, Flexible Manufacturing Systems FMS, Manufacturing Cells, Course project.

MDPN457	**Fluid Power Systems** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCNN202 + MDPN253** Fluid power transmission; actuation and control – Properties of hydraulic fluids – Positive displacement pumps and motors; types, static characteristics of constant and variable geometric volume units, flow rate, torque and power – Cylinders – Pressure, flow, and directional control valves; direct and pilot operated, static flow forces acting on poppets and spools, static characteristics of valves – Accumulators – Accessories – Throttling and non-throttling systems –Basics of design of fluid power systems and examples from industrial and mobile applications – Course project.
MDPN464	**Failure Analysis** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN262** Functional and structural failures. Tribological surface failure, abrasive, adhesive, fatigue wear, fretting and corrosive wear. Design against wear. Modes of bulk failures, excessive deformation, buckling, yielding, plastic instability, creep and creep rupture. Incremental collapse, fracture mechanics and crack propagation. Damage-tolerant design. Identification and detection of failures. Applications to some mechanical components. Case studies. Course project.
MDPN471	**Mechanical Vibrations** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN253** Introduction and basic concepts, sources and causes of vibrations, free and forced vibrations of SDOF systems, vibration transmissibility, vibration control, free and forced vibrations of 2DOF systems, vibration absorber, MDOF systems: (natural frequencies and normal modes, forced vibrations), vibration measurement methods, computer-aided simulation and case studies, course project
MDPN472	**Automatic Control:** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN253** Introduction, definitions and classification of control systems, Mathematical modeling of control system components, Application to mechanical and electrical systems, Fluid power systems, and thermal systems – Signal flow graph – Stability of linear systems – Analysis of systems in state space – controllability – observability – pole placement – Feedback control system – Control system characteristics – Error analysis – Steady state error for the test input signal using static error coefficients – Dynamic error coefficient and error series – Transient response characteristics – Approximation of higher order systems to second order systems. Matlab computer simulation and case studies. Course project.

MDPN331	**Engineering Operations Research** **Elective (group E-2), Credits: 3 (2+3+0)** **Prerequisite(s): MTHN102 + 102 credits** Optimization and mathematical models in Engineering, Linear Programming (LP) models; model formulations and applications, solutions using computer software, post optimality analysis, transportation and transshipment models, assignment problems. Maximal flow, shortest route, minimum spanning tree, and integer programming applications. Case studies. Course project.
MDPN411	**Computer Aided Design** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): MDPN252 + MDPN363** ***(MDE students should study this course)*** The objective of the course is to have each student, as a member of a team, fully develop and document a capstone design project through the concept phase. During the course work, students will understand the role of computer aided engineering and apply CAD tools in solving engineering problems in a creative and efficient manner. Projects involving design, analysis, and simulation and testing will be used to achieve the course objectives. Course project and case studies
MDPN413	**Introduction to Mechatronics** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Mechatronics fundamentals, linear components, semi conductors, IC's , Circuits, Sequential control, Logic gates and Boolean algebra, Electric and electronic power components, actuators, sensors and interfacing, design of Mechatronics systems, system performance, computer simulation and practical training, case studies and applications, Course project.
MDPN421	**Tribology** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Surface topography, Nature of surface and contacts, Viscosity and Rheology, Methods of fluid-film formation, Friction mechanism, Mechanisms of wear, Plain bearing materials, Bearing surface coatings and treatments, Wear resistant materials, Rolling bearing materials, Gear materials, Friction materials, Properties of friction materials, Mineral oils, Synthetic oils, Greases, Solid lubricants and coatings, Selection of lubricant types, Plain bearing lubrication, Rolling bearing lubrication, Gear and chain lubrication, Selection of bearing type and form, Selection of journal bearing, Selection of thrust bearing, Pressure-fed fluid film bearings, Grease, wick, and drip-fed lubricated journal bearings, Dry rubbing bearings, Plain-thrust bearings, Profiled-pad thrust bearings, Tilting-pad thrust bearing, Plain bearings form and installation, Mechanical seals, Selection of seals, Wear-resistant parts, (material selection), course project and computer applications

MDPN423	**Robotics Engineering** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Introduction to Robotics Technology, Robot structures and components, Kinematics and dynamics of planar robots, Kinematics of 3-D robots and homogeneous transformation, Trajectory planning and robot control methods, computer simulation and practical training. course project
MDPN424	**Project Management** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): GENN102 + 102 credits** Phases of project planning and monitoring, Work breakdown and coding, Time and resource estimation, project planning and network representation, project scheduling, budgeting and cash flow, project control and reporting, Industrial case studies and use of computer S/W packages Project team management, Project bidding, contracting, and commissioning cycles. Course project.
MDPN431	**Sustainability and Design for Environment** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Analysis and design of technology systems within the context of the environment, economy, and society. Applies the concepts of resource conservation, pollution prevention, life cycle assessment, and extended product responsibility. Examines the practice, opportunities, and role of engineering, management, and public policy. Presents and discusses the computation structure and data sources for environmental Life Cycle Assessment. Uses Life Cycle Assessment to analyze materials, products, and services. The analysis either identifies opportunities for improvements or selects a superior alternative on the basis of pollution prevention and resource conservation
MDPN432	**Pressure Vessels and Piping** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Introduction to ASME Boiler, Pressure Vessels, and Piping Codes. Section VIII Divs. 1 and 2. B31 code series. Material selection. Basic principles in design. Types of loads. Failure theories. Design for internal and external pressure. Design of end closures with various geometries. Design of openings and nozzles. Fabrication requirements. Non-destructive examination and testing. Piping stress and flexibility analyses, design and selection of piping supports. Computer implementation of general-purpose software packages. course project
MDPN433	**Hydraulic Servo Control** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): MDPN457 + MDPN472** Fields of applications of hydraulic servo systems –Hydraulic servo systems versus proportional systems and electric servo systems – Hydraulic servo valves; types, static characteristics, valves coefficients,

	lapping conditions – Transient and steady state flow forces acting on spools and flappers – Pilot operated servo valves and types of feedback – Dynamic characteristics of servo valves and fluid lines – Hydro mechanical and electro-hydraulic servo systems; loop gain, stability, dynamics – Course project.
MDPN434	**Work Design and Ergonomics** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Productivity, and human performance, Recording and Analysis of methods of work, Operation analysis and improvement, Principles of Motion economy and Manual Work Design, Ergonomics Considerations of Work place, tools, and equipment design, Work Environment Design, Performance Rating and Work Allowances systems, Predetermined Time Systems, case studies. Course project.
MDPN441	**Design for Manufacturing** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Review of manufacturing processes. Categorization of bought-out and made-in components. Lot size effect on the selection of the design variant for rational manufacture. The design principles and design details for ease of parts manufacture and assembly. Introduction to the principles of design for maintainability. course project and computer applications
MDPN442	**Advanced Finite Element Analysis** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Basic principles of continuum mechanics and finite element methods. Kinematics of deformation, strain and stress measures, constitutive relations, conservation laws, virtual work, and variational principles. Modern application to solution of practical problems in solid mechanics, heat transfer, and dynamic problems. Multiphysics problems with emphasis on thermo-mechanics and elasto-dynamic applications. Solution of fundamental problems using an existing general-purpose finite element analysis program. course project
MDPN443	**Special Topics in Mechanical Design** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Students study one or more topics in Mechanical Design Engineering that are not covered by other program courses and/or that present recent or advanced development of interest to mechanical engineers. Course project.
MDPN451	**Composite Materials: Design and Manufacturing** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Stress and strain analysis of continuous fiber composite materials. Orthotropic elasticity, lamination theory, failure criterion, fiber-matrix interfacial features and interactions. Manufacturing and processing

	techniques of metal-, polymer-, and ceramic-matrix composites; Design philosophies, as applied to structural polymeric composites. Design considerations related to manufacturing techniques; non-destructive testing of composite structures.
MDPN452	**Advanced Topics in Materials Engineering** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** The course covers advanced topics in materials engineering of relevance to emerging technologies. The topics may include: nanomaterials and their physical and electrical properties, Applications of nanomaterials, Concepts and working principles of devices such as nanosensors and nanotransistors, Device performance as related to microstructural characteristics of their materials. The course includes independent research project on new materials. course project
MDPN461	**Computer Integrated Manufacturing CIM** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): MDPN411 + MDPN422** This course is designed to address the key integration issues in manufacturing with the goal of providing the future engineers with a thorough understanding of computer integrated manufacturing (CIM). An in-depth and integrated coverage of computer aided design, computer aided process planning, computer aided manufacturing, production planning and scheduling, manufacturing system control, and shop floor control topics, as well as integration among them, are presented. The laboratory work includes product design, machining code generation, computer numerical control (CNC) machining, robot programming, programmable logic controller (PLC) programming, PC-based control, human machine interface (HMI) design, and radio frequency identification (RFID) systems. The labs will provide hands-on experience, which is the basis for understanding the topics conceptually covered in class.
MEPN415	**Power Generation** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** The course covers several topics associated with power generation from first and second law perspectives. Steam power generation (Rankin cycles with reheat and regeneration). Gas power generation (Gas turbines without and with regeneration). Course project.
MEPN425	**Renewable Energy** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** General review of thermodynamics; solar power systems for heat and electric power; electric power generation from solar energy; hydroelectric power generation; geothermal and ocean thermal energy recovery systems; tidal and wave power; economics and system integrations. Course project.

MEPN435	**Internal Combustion Engines** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Introduction to engine design with topics that include: air capacity, engine vibration, kinematics and dynamics of the crank mechanism, air cycles, combustion, petroleum and alternative fuels, engine electronics and fuel cells. Automotive emissions, government standards, test procedures, instrumentation, and laboratory reports. course project
MEPN445	**Turbo-machinery-II** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): MEPN345 + 102 credits** Fans, Compressors, Pumps and Turbines: General selection criteria and charts - Machines in series, Machines in parallel – Selection & Installation requirements as per Manufacturer's Catalogues (air compressors, domestic water pumps, chilled water pumps, centrifugal fans, axial fans, etc.) - Vibration and Noise problems and solutions – control of turbomachinery in various application - Best practices in operation - Maintenance – Troubleshooting., Course project
MDPN444	**Quality Control** **Elective (group E-3), Credits: 2 (1+3+0)** **Prerequisite(s): 102 credits + AA Approval** Quality concepts and definitions, quality characteristics, sources of variations, Theory of control charts, Control charts for attributes, defectives, U-charts, Engineering process control, Process capability analysis, Single and double inspection sampling plans, Standard sampling systems. Applications. Course project.
MDPN456	**Material Handling Equipments** **Elective (group E-3), Credits: 2 (1+3+0)** **Prerequisite(s): MDPN252** Analysis of Materials Handling Problems, General Types of Materials Handling Equipment: Conveyors, Monorails, hoists, and cranes, Industrial trucks, Containers and supports, Auxiliary and other equipment, Factors Affecting the selection of Materials Handling Equipment, Accounting for Materials Handling Costs, Relation of Materials Handling to Flow of Material and Plant Layout: storage, packing. Design of belt conveyors: Roller Conveyors, Flat Belt Conveyors, Troughed Belt Conveyors Pneumatic Conveyors: Dust Collection Systems, Screw Conveyors. Design of Cranes: Jib Cranes, Bridge Cranes. Design of Positioning Equipment: Dock Leveler. Developing and conducting a preventive maintenance program for materials handling equipment, Course project.