Sections 11 to 14

Mechanical Engineering Programs

11- Mechanical Design Engineering (MDE)
12- Mechatronics Engineering (MEE)
13- Industrial Engineering and Management (IEM)
14- Manufacturing Engineering and Materials (MEM)

Based on Credit Hours System (CHS)

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1. INTRODUCTION

The business environment in Egypt is expected to witness 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 chemical, processing, manufacturing, 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 Engineers" with knowledge and skills enabling utilization of modern tools of engineering analysis and design.

A bachelor's degree in mechanical 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 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. A Mechanical 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.

Mechanical Engineering graduates should 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 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.

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

To cope with the increasing need for development and improvement of technical skills for mechanical engineers, and to cope with the modern trends and developments in industry, the department has proposed four tracks that starts after the junior year. The tracks are as follows: 1) Mechanical Design (MDE), 2) Mechatronics (MEE) 3) Industrial Engineering and Management (IEM) and 4) Manufacturing Engineering and Materials (MEM). It proves inevitable that any emerging technologies will dictate the need for highly qualified and specialized engineers in the four aforementioned areas. The first three years are common among all students and are designed to give introductory knowledge to the four tracks. Twenty courses are then proposed in the last two years for each track. Group of electives courses that serve each track are compiled in four separate tables. The mechanical design and production department, based on its role in the country, has realized the need to prepare special programs aiming to provide engineers in the four areas.

2. PROGRAM MISSION

The mission of the Mechanical Engineering 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 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 tools 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 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 fields of: Mechanical Design, Mechatronics, Industrial Engineering & Management, and Manufacturing & Materials.
- To upgrade the skills of students in effective communication, logic thinking and creativity.

In addition to the general attributes of a mechanical 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 manufacturing.

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.

In addition to the general attributes of a mechanical engineer, the Mechatronics Engineer should be able to:

a) Use of mathematics, physical science and systems analysis tools in components and system design.
b) Students will learn engineering sciences and demonstrate the application of this knowledge to electro-mechanical systems.
c) Solve problems in the areas of integrated mechanics, electronics, computers and software systems.
d) Analyze and investigate the inter-disciplinary characteristics of mechanical, electrical and hydraulic systems.
e) Graduates should have wide choices leading to specialization in mechanics, electronics, design, computer software or other areas

In addition to the general attributes of a mechanical engineer, the Industrial Engineering & Management should be able to:

a) Demonstrate the ability to design, develop, implement, and improve integrated systems that include people, materials, information, equipment and energy.
b) Understand the engineering relationships between the management tasks of planning, organization, leadership, control, and the human elements in production, research and service organizations.
c) Comprehend and handle the integration of management systems into a series of different technological environments.
d) Provide strong ties and linkages between the local economic sectors and industrial communities with the department graduates in areas related to research, hands-on training, and field investigations.
e) Emphasizing risk assessment and the impact of uncertainties associated with economic and process decisions in industrial and service sectors.
f) Underlining the key roles of safety dimensions, sustainable technology, environmental friendliness, and cleaner production measures in manufacturing, materials, managerial and economic alternatives as reflected in the program course structure.

In addition to the general attributes of a mechanical engineer, the Manufacturing & Materials Engineer should be able to:

a) Handle professionally different engineering processes, including materials selection, design, analysis, synthesis, modern and classical fabrication techniques, nanotechnology and experimental techniques.

b) Continue their post-graduate studies and be able to enhance their capabilities in dealing with new technical problems and acquire new knowledge in CAD/CAM systems.
c) Conduct research and development of new materials and new technologies for potential breakthroughs in materials field products through understanding and developing novel fabrication techniques.
d) Create new and better materials, improve existing materials, and explore new ways to utilize and exploit the capabilities of both natural and synthesized materials.

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 Engineering program should be able to demonstrate.

4.1 Knowledge and Understanding

On successful completion of the program, Mechanical Design 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) The constraints within which an engineering judgment will have to be exercised;
c) The specifications, programming and range of application of CAD and CAD/CAM facilities
d) Relevant contemporary issues in mechanical engineering
e) Basic electrical, control and computer engineering subjects related to the discipline
f) The role of information technology in providing support for mechanical engineers
g) Engineering design principles and techniques
h) Management and business techniques and practices appropriate to the engineering industry.

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

a) Basic science and engineering fundamentals in mechanics, electronics and software in their interfacing;
b) Fundamentals of problem identification, formulation and solution in the inter-disciplinary fields of Mechatronics;
c) The principles of sustainable design and development;

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

a) The fundamental manufacturing processes and the most recent technologies that are used in that field. In addition to, the most important materials used in industry, their structure, and their modes of failure.
b) Basics of industrial engineering such as production planning and control, production scheduling, and inventory management.
c) Organisations, their internal structures and their management, including the management of human resources, financial resources and operations.
d) Globalization and its effect on the different operations of an organization and the importance of industrial data systems in that regard.
e) The key concepts of quality engineering and reliability and their importance in the production of goods and services.

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

a) Basic topics related to all materials including metals and alloys, polymers, ceramics and composites.
b) Concepts, principles and theories relevant to mechanical and manufacturing engineering.
c) Engineering principles relevant to materials selection to cover the needs in any application.
d) Processing and fabrication and post processing treatments (heat treatments, surface treatments, etc) of all materials categories.
e) Relevant properties of materials and the detailed experimental techniques to acquire such properties.
f) The specifications, programming and range of application of CAD and CAD/CAM facilities
g) The different aspects of technology within a global, societal and economic context.

4.2 Intellectual Skills

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

a) Apply the principles of mathematics, science and technology in problem solving scenarios in mechanical engineering;
b) Analyze and interpret numerical data, and design experiments to obtain primary data;
c) Design systems, components or processes to meet specific needs through the synthesis of ideas from a range of sources;
d) Evaluate and appraise designs, processes and products, and propose improvements;
e) Assess and manage risks during design process.
f) Use the principles of engineering science in developing solutions to practical mechanical engineering problems.
g) Interpret numerical data and apply analytical methods for engineering design purposes;

h) Select appropriate manufacturing method considering design requirements.

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

a) Identify at an appropriate level the design, production, interfacing and software needs of different parts of Mechatronics systems.
b) Create solutions to mechatronics systems especially to manufacturing, maintenance and interfacing problems in a creative way, taking account of industrial and commercial constraints.

On successful completion of the program, Industrial Engineering & Management graduates must be able to:

a) Solve a wide range of problems related to the analysis, design, and construction of production systems.
b) Identify a range of solutions and critically evaluate and justify proposed design solutions.
c) Analyse and solve the problems presented by industrial entities.

On successful completion of the program, Manufacturing & Materials graduates must be able to:

a) Select and identify an appropriate material and manufacturing route for the design of a component.
b) Select materials from an environmentally appreciative viewpoint.
c) Interpret numerical data and apply mathematical methods to the analysis of materials engineering, manufacturing and processing problems.
d) Propose and assess options for the improvement of operations.
e) Explain experimental results in terms of theoretical mechanisms and concepts.
f) Evaluate and present practical data in a suitable format.
g) Design systems, components or processes to meet specific needs through the synthesis of ideas from a range of sources;
h) Select appropriate manufacturing method considering design requirements.

4.3 Practical and Professional Skills

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

1. Prepare engineering drawings, computer graphics and specialized technical reports and communicate accordingly.
2. Employ modern CAD and CAD/CAM facilities in design and production processes
3. Use basic workshop equipment safely;
4. Analyze experimental results and determine their accuracy and validity;
5. Operate and maintain mechanical equipment.
6. Use laboratory equipment and related computer software.

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

a) Compete, in-depth, in at least one engineering discipline, namely mechanics, electronics or interfacing and software;
b) Manage field problem, identification, formulation and solution;
c) Utilize practical systems approach to design and performance evaluation;
d) Apply the principles of sustainable design and development;

On successful completion of the program, Industrial Engineering & Management graduates must be able to:

a) Use the scientific literature effectively and make discriminating use of Web resources.
b) Use appropriate computer-based support tools for problem-solving and analysis of results.
c) Apply the acquired skills in a commercial or industrial environment.

On successful completion of the program, Manufacturing & Materials graduates must be able to:

a) Employ modern CAD and CAD/CAM facilities in design and production processes
b) Use basic workshop equipment safely.
c) Analyze experimental results and determine their accuracy and validity;
d) Operate and maintain mechanical equipment.
e) Use laboratory equipment and related computer software.
f) Use appropriate mechanical testing, metallography and chemical analysis methods for characterization of any material category. .
g) Use appropriate computer software for design, simulation and modeling exercises.
h) Propose and assess options for the improvement of operations.
i) Utilize materials engineering principles to develop new materials/processing routes for improved performance of engineering systems

5. PROGRAM DESCRIPTION

The Mechanical Engineering Program offers instruction in numerous topics concerning mechanical design, control engineering, mechatronics, robotics, manufacturing technology, materials engineering, industrial engineering, and energy systems.

The program offers a Bachelor's Degree in Mechanical Engineering where students can choose one of four tracks to specialize in. The four tracks offered are Mechanical Design, Mechatronics, Industrial Engineering & Management, and Manufacturing & Materials.

Graduates of Mechanical Design concentration are expected to gain the knowledge, understanding and comprehension of mechanical systems, design of components and equipment, control technology and automated machinery.

Graduates of Mechatronics concentration are expected to gain the knowledge, understanding and comprehension of the design, automation and operational performance of electro-mechanical systems. They typically use their skills and knowledge about mechanical and electronic processes as well as computers to develop new solutions to industrial problems. In addition, they often become involved in providing technical advice or assistance relating to the creation of new products.

Graduates of Industrial Engineering & Management concentration are expected to gain the knowledge, understanding and comprehension of the design, control and management of integrated systems and procedures for organizing the resources of production – people, materials, equipment, and information – to achieve specific objectives.

Graduates of Manufacturing and Material concentration are expected to work and manipulate the structure, processing and properties of materials to maximize the utilization of existing materials and innovate new materials and new technologies. The graduates are expected to be capable of working with classical and modern manufacturing processes and systems through solid knowledge and understanding of emerging technological trends such as "Nanotechnology" in terms of fabrication, characterization and applications, also with modern manufacturing techniques.

The Bachelor's Degree of the Mechanical Engineering program consists of a total of 175 credit hours offered over a period of 10 main semesters, the Fall and Spring semesters per academic year. The students are expected to complete the degree requirements in 10 main semesters.

5.1 Curriculum Overview

The curriculum of the Mechanical Engineering program consists of 175 credits spread over 66 courses plus industrial training 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). The engineering sciences courses are the same for the four tracks.

Sample courses in each category are presented as follows:

5.1.1 Humanities and Social Sciences Courses

- Ethics and Legislation
- Technical Writing
- Communication and Presentation Skills
- Risk Management and Environment
- Fundamentals of Management
- Critical Thinking
- Foreign Language
- Marketing
- Selections of Life-long Skills

5.1.2 Basic Sciences Courses

- Mathematics
- Physics
- Chemistry
- Mechanics
- Fun. of Economics and Accounting

5.1.3 Engineering Sciences Courses

- Electrical Engineering Fundamentals
- Computer Engineering
- Fluid Mechanics
- Stress Analysis
- Numerical Analysis
- Thermodynamics
- Heat Transfer

5.1.4 Applied Engineering Sciences Courses

- Mechanical Design
- Fluid Power Systems
- Manufacturing Processes I and II
- Turbo-machinery
- Dynamics of Machine Components
- Fundamentals of 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 courses related to the track represent about 30% of the total number of credits (175 Cr. Hours). The student has more than 10% from the total credit hours as electives. Students in the MEG 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 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 19 credits (10.9% of total 175 credits), which are satisfied by completing ten (10) courses:

1. Seven (7) compulsory courses equivalent to 13 credits (7.4%), as listed in Table 1a.
2. Three (3) elective courses equivalent to 6 credits (3.4%), as listed in Table 1b.

Table 1a Compulsory Courses of University Requirements (13 credits, 7.43% of total 175 credits)

	Code	Course Title	Credits
1	GENN001	History of Science and Engineering	1
2	GENN004	Computers for Engineers	2
3	GENN005	Technical Writing	2
4	GENN102	Fundamentals of Management	2
5	GENN201	Communication and Presentation Skills	2
6	GENN210	Risk Management and Environment	2
7	GENN224	Fun. of Economics and Accounting	2

Table 1b Elective Courses of University Requirements (6 credits, 3.43% of total 175 credits)

	Code	Course Title	Credits	Group
1	GENN301	Ethics and Legislation	2	E-1(1)
2	GENN303	Critical Thinking	2	
3	GENN305	Interdisciplinary Project	2	
4	GENN310	Advanced Risk Management	2	
5	GENN311	Technical Writing in Arabic	2	
6	GENN321	Foreign Language	2	
7	GENN326	Marketing	2	
8	GENN327	Selections of Life-long Skills	2	
9	GENN328	Research Methods for Engineering	2	
10	GENN331	Business Communication	2	
11	GENN332	Service Management	2	
12	GENN333	Creativity, Art & Design	2	Compulsory for AET

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 44 credits (25.14% of total 175 credits), which are satisfied by completing eighteen (18) compulsory courses, as listed in Table 2.

Table 2 Compulsory Courses of College Requirements (44 credits, 25.14% of total 175credits)

	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	MEGN280	Engineering Seminar	1
15	MEGN281	Industrial Training-1	1
16	MEGN381	Industrial Training-2	2
17	MEGN480	Graduation Project-1	1
18	MEGN481	Graduation Project-2	3

5.4 Mechanical Engineering Discipline Requirements

Graduates of Mechanical Engineering 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-engineering curriculum. The discipline requirements comprise 59 credits (33.7% of total 175 credits), which are satisfied by completing twenty (20) courses, as listed in Table 3.

Table 3 Compulsory Courses of Discipline Requirements: Mechanical Engineering (59 credits, 33.7% of total 175 credits)

	Code	Course Title	Credits
1	EPMN101	Electrical Engineering Fundamentals	3
2	MCNN101	Thermodynamics	3
3	MCNN202	Fluid Mechanics	3
4	MCNN326	Heat Transfer	3
5	MTHN103	Differential Equations	3
6	MTHN201	Numerical Analysis	3
7	PHYN104	Optics and Sound	3
8	MDPN117	Machine Drawing	3
9	MDPN131	Engineering Materials	3
10	MDPN132	Materials Science	3
11	MDPN141	Manufacturing Processes I	3
12	MDPN161	Stress Analysis	3
13	MDPN250	Fundamentals of Mechatronics	3
14	MDPN242	Manufacturing Processes II	3
15	MDPN260	Fundamentals of Industrial Engineering	3
16	MDPN251	Kinematics of Machine Components	3
17	MDPN252	Machine Design I	3
18	MDPN253	Dynamics of Machine Components	2
19	CVEN125	Civil Engineering	3
20	MDPN354	Machine Design II	3

5.5 Major Requirements

5.5.1 Mechanical Design Track (MDE)

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 Mechanical Engineering 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 53 credits (30.29% of total 175 credits), which are satisfied by completing twenty (20) courses as follows:

1. Sixteen (16) compulsory courses equivalent to 41 credits (23.43%), as listed in Table 4.
2. Four (4) elective courses equivalent to 12 credits (6.86%), as listed in Table 5.

Table 4.1 Compulsory Courses of Major Requirements: Mechanical Design track (41 credits, 23.43% of total 175 credits)

	Code	Course Title	Credits
1	EPMN202	Electric Drive Systems	3
2	MDPN262	Mechanics of Solids	3
3	MDPN332	Computer aided design and Manufacturing	2
4	MDPN363	Finite Element Analysis	2
5	EPMN303	Industrial Instrumentation	2
6	MDPN372	Control Systems Dynamics	3
7	MEPN345	Turbomachinery	3
8	MDPN313	Group Design Project	2
9	MDPN343	Sheet Metal Processing	3
10	EPMN404	Programmable Logic Controllers	2
11	MDPN473	Automatic Control I	2
12	MDPN457	Fluid Power Systems	3
13	MDPN468	Quality Engineering	3
14	MDPN464	Failure Analysis	3
15	MDPN471	Mechanical Vibrations	3
16	MDPN410	Mechanical Design Lab	2

Table 5.1 Elective Courses of Major Requirements: Mechanical Design track (12 credits, 6.86% of total 175 credits)

	Code	Course Title	Credits	Group
1	MDPN362	Operations Research I	3	E-2(1)
2	MDPN421	Tribology	3	
3	MDPN423	Robotics Engineering	3	
4	MDPN424	Project Management	3	
5	MDPN426	Engineering Economic Analysis	3	
6	MDPN431	Sustainability and Design for Environment	3	
7	MDPN432	Pressure Vessels and Piping	3	
8	MDPN433	Hydraulic Servo Control	3	
9	MDPN434	Work Design and Ergonomics	3	
10	MDPN441	Design for Manufacturing	3	
11	MDPN442	Advanced Finite Element	3	
12	MDPN443	Special Topics in Mechanical Design	3	
13	MDPN451	Composite Materials: Design and Manufacturing	3	
14	MDPN452	Advanced Topics in Materials Engineering	3	
15	MDPN461	Computer Integrated Manufacturing CIM	3	
16	MDPN456	Material Handling Equipment	3	
17	MDPN467	Production Management	3	
18	MEPN415	Power Generation	3	
19	MEPN425	Renewable Energy	3	
20	MEPN435	Internal Combustion Engines	3	
21	MEPN445	Turbomachinery-II	3	
22	MDPN353	Mechanism Design	3	
23	MDPN367	Safety Engineering	3	
24	MDPN368	Ergonomics and Human Factor	3	
25	MDPN369	Product Design and Development	3	
26	MDPN364	Facilities Planning and Design	3	
27	MDPN324	Materials Selection in Design	3	
28	MDPN439	Technology Based Entrepreneurship	3	
29	MDPN462	Design of Experiments	3	
30	MDPN463	Industrial Management	3	

Remarks:

(1) Student selects four (4) courses from group E-2 equivalent to 12 credits,

5.5.2 Mechatronics Track (MEE)

The major specialty requirements include courses in areas necessary in the formation of mechatronics engineers; such as mechanical engineering, electronics engineering, computer engineering, control and automation engineering. Few specialty courses appear at early stages of the Mechanical Engineering program. The major requirements include compulsory courses and electives courses, which provide advanced knowledge and skills in areas of System Dynamics and Control, Electrical and Electronics Engineering, Computer Engineering, Energy Systems, and Mechatronics. A student who wishes to complete the specialty of Mechatronics Engineering must complete the minimum major requirements of 53 credits (30.29% of total 175 credits), which are satisfied by completing twenty (20) courses as follows:

1. Sixteen (15) compulsory courses equivalent to 38 credits (21.71%), as listed in Table 4.
2. Five (5) elective course equivalent to 15 credits (8.6%), as listed in Table 5.

Table 4.2 Compulsory Courses of Major Requirements: Mechatronics Engineering track (38 credits, 21.71 % of total 175 credits)

	Code	Course Title	Credits
1	CMPN101	Logic Design 1	3
2	CMPN201	Microprocessor Systems - 1	3
3	CMPN211	Microprocessor Systems - 2	2
4	EPMN202	Electric Drive Systems	3
5	EPMN303	Industrial Instrumentation	2
6	EPMN404	Programmable Logic Controllers	2
7	MEPN345	Turbomachinery	3
8	MDPN372	Control Systems Dynamics	3
9	MDPN332	Computer aided design and Manufacturing	2
10	MDPN423	Robotics Engineering	3
11	MDPN457	Fluid Power Systems	3
12	MDPN471	Mechanical Vibrations	3
13	MDPN473	Automatic Control I	2
14	MDPN474	Automatic Control II	2
15	MDPN470	Mechatronics Laboratory	2

Table 5.2 Elective Courses of Major Requirements: Mechatronics track (15 credits, 8.57% of total 175 credits)

	Code	Course Title	Credits	Group[(E)]
1	MDPN353	Mechanism Design	3	
2	MDPN433	Hydraulic Servo Control	3	
3	MDPN456	Material Handling Equipment	3	
4	MDPN476	Mobile Robots and Autonomous Systems	3	
5	MDPN477	Micro and Nano-Electromechanical Systems	3	
6	MDPN478	Vehicle System Dynamics and Control	3	
7	MDPN479	Special Topics in Mechatronics	3	
8	MEPN445	Turbomachinery-II	3	
9	MEPN435	Internal Combustion Engines	3	
10	MEPN415	Power Generation	3	
11	MEPN425	Renewable Energy	3	
12	ELCN203	Signal Analysis	3	
13	EPMN212	Electrical Measurements	3	
14	EPMN308	Digital Control Systems	3	
15	EPMN427	Intelligent Control	3	E-2
16	EPMN425	Process Control and Robotics	3	
17	CMPN103	Programming Techniques	3	
18	CMPN205	Computer Graphics and Man Machine	3	
19	CMPN444	Computer Interfacing	3	
20	CMPN445	Embedded Systems	3	
21	CMPN446	Image Processing and Computer Vision	3	
22	HEMN332	Biomechanics I	3	
23	HEMN432	Biomechanics II	3	
24	HEMN436	Medical Robotics I	3	
25	HEMN437	Medical Robotics II	3	
26	HEMN438	Rehabilitation Robotics	3	
27	MDPN362	Operations Research I	3	
28	MDPN424	Project Management	3	
29	MDPN426	Engineering Economic Analysis	3	

Remarks: Student selects five (5) courses from group E-2 equivalent to 15 credit hours.

5.5.3 Industrial Engineering and Management Track (IEM)

The major specialty requirements include courses in areas necessary in the formation of Industrial Engineering & Management engineers; such as mechanical engineering, electronics engineering, computer engineering, control and automation engineering. Few specialty courses appear at early stages of the MEG program. The major requirements include compulsory courses and electives courses, which provide advanced knowledge and skills in areas of Production/Operations Management, Operations Research, Systems Modeling and Simulation, Quality Engineering, and Maintenance Planning and Control. A student who wishes to complete the specialty of Industrial Engineering & Management must complete the minimum major requirements of 53 credits (30.29% of total 175 credits), which are satisfied by completing twenty (20) courses as follows:

1. Fifteen (15) compulsory courses equivalent to 38 credits (21.72%), as listed in Table 4.
2. Five (5) elective course equivalent to 15 credits (8.57%), as listed in Table 5.

Table 4.3 Compulsory Courses of Major Requirements: Industrial Engineering and Management track (38 credits, 21.71% of total 175 credits)

	Code	Course Title	Credits
1	EPMN202	Electric Drive System	3
2	MDPN361	Engineering Economy and Cost Accounting	2
3	MDPN332	Computer aided design and Manufacturing	2
4	MDPN362	Operations Research I	3
5	MDPN372	Control Systems Dynamics	3
6	MDPN364	Facilities Planning and Design	3
7	MDPN441	Design for Manufacturing	3
8	MDPN365	Reliability & Maintenance Eng.	2
9	MDPN366	Operations Research II	2
10	MDPN473	Automatic Control I	2
11	MDPN467	Production Management	3
12	MDPN468	Quality Engineering	3
13	MDPN469	Systems Modeling and Simulation	2
14	MDPN471	Mechanical Vibrations	3
15	MDPN460	Industrial Eng. Lab	2

Table 5.3 Elective Courses of Major Requirements: Industrial Engineering and Management track (15 credits, 8.57% of total 175 credits)

	Code	Course Title	Credits	Group[(E)]
1	MDPN367	Safety Engineering	3	E-2[(1)]
2	MDPN368	Ergonomics and Human Factor	3	
3	MDPN369	Product Design and Development	3	
4	MDPN431	Sustainability and Design for Environment	3	
5	MDPN461	Computer Integrated Manufacturing CIM	3	
6	MDPN424	Project Management	3	
7	MDPN462	Design of Experiments	3	
8	MDPN463	Industrial Management	3	
9	MDPN465	Industrial Information Systems	3	
10	MDPN466	Manufacturing Systems Design	3	
11	MDPN456	Material Handling Equipment	3	
12	MDPN458	Supply Chain Management	3	
13	EPMN425	Process Control and Robotics	3	
14	CMPN446	Image Processing and Computer Vision	3	
15	MDPN451	Composite Materials: Design and Manufacturing	3	
16	MDPN452	Advanced Topics in Materials Engineering	3	
17	MEPN345	Turbo-machinery-I	3	
18	MEPN415	Power Generation	3	
19	MEPN425	Renewable Energy	3	
20	MEPN435	Internal Combustion Engines	3	

Remarks:
Student selects five (5) courses from group E-2 equivalent to 15 credits.

5.5.4 Manufacturing Engineering and Materials Track (MEM)

The major specialty requirements include courses in areas necessary in the formation of Manufacturing and Materials engineers; such as mechanical engineering, manufacturing engineering, materials engineering, electronics engineering, computer engineering, control and automation engineering. Few specialty courses appear at early stages of the Mechanical Engineering program. The major requirements include compulsory courses and electives courses, which provide advanced knowledge and skills in areas of Production Operations, Manufacturing Systems, Materials Processing and Characterization, Design and Stress Analysis, Nanotechnology, Automatic Control and Dynamics. A student who wishes to complete the specialty of Manufacturing and Materials must complete the minimum major requirements of 53 credits (30.29% of total 175 credits), which are satisfied by completing twenty (20) courses as follows:

1. Sixteen (16) compulsory courses equivalent to 41 credits (23.42%), as listed in Table 4.
2. Four (4) elective course equivalent to 12 credits (6.86%), as listed in Table 5.

Table 4.4 Compulsory Courses of Major Requirements: Manufacturing Engineering and Materials track (41 credits, 23.42% of total 175 credits)

	Code	Course Title	Credits
1	MDPN313	Group Design Project	2
2	MDPN321	Fatigue, Creep and Fracture Mechanics	2
3	MDPN363	Finite Element Analysis	2
4	MDPN441	Design for Manufacturing	3
5	MDPN323	Modern Manufacturing Processes	3
6	MDPN332	Computer aided design and Manufacturing	2
7	MDPN324	Materials Selection in Design	3
8	MDPN464	Failure Analysis	3
9	MDPN471	Mechanical Vibrations	3
10	MDPN372	Control System Dynamics	3
11	EPMN202	Electric Drive Systems	3
12	MDPN427	Nanotechnology and Nanocrystalline Materials	3
13	MDPN333	Powder Metallurgy	2
14	MDPN426	Structure of Materials	3
15	MDPN473	Automatic Control I	2
16	MDPN430	Materials and Manufacturing Laboratory	2

Table 5.4 Elective Courses of Major Requirements: Manufacturing Engineering and Materials track (12 credits, 6.86% of total 175 credits)

	Code	Course Title	Credits	Group
1	MDPN329	Corrosion Engineering	3	
2	MDPN327	Modeling and Simulation of Materials	3	
3	MDPN328	Polymers Engineering	3	
4	MDPN322	Advanced Casting Processes	3	
5	MDPN326	Creep and High Temperature Materials	3	
6	MDPN451	Composite Materials: Design & Manufacturing	3	
7	MDPN425	Mechanical Behavior of Materials	3	
8	MDPN452	Advanced Topics in Materials Engineering	3	
9	MDPN438	Manufacturing Systems	3	
10	MDPN428	Advanced Topics in Manufacturing	3	
11	MDPN461	Computer Integrated Manufacturing CIM	3	
12	MDPN447	Advanced Welding Processes	3	
13	MDPN325	Sheet Metal Processing	3	E-2[(1)]
14	MDPN439	Technology Based Entrepreneurship	3	
15	MDPN456	Materials Handling Equipment	3	
16	MEPN345	Turbo-machinery-I	3	
17	MEPN445	Turbomachinery-II	3	
18	MEPN435	Internal Combustion Engines	3	
19	MEPN415	Power Generation	3	
20	MEPN425	Renewable Energy	3	
21	MDPN462	Design of Experiments	3	
22	MDPN463	Industrial Management	3	
23	MDPN465	Industrial Information Systems	3	
24	MDPN367	Safety Engineering	3	
25	MDPN368	Ergonomics and Human Factor	3	
26	MDPN362	Operations Research I	3	
27	MDPN424	Project Management	3	
28	MDPN426	Engineering Economic Analysis	3	

Remarks:
Student selects (4) courses from group E-2 equivalent to 12 credits.

5.6 Conformity to SCU Requirements

The classification and categorization of the courses offered by the Mechanical 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 five student levels according to the regulations of the credit hours system of education at the Faculty of Engineering, Cairo University.

Table 6 Conformity to Supreme Council Criterion

Category	MDE		MEE		IEM		MEM	
	Total Credits	%	Total Credits	%	Total Credits	%	Total Credits	%
Humanities and Social Sciences	17	9.7	17	9.7	17	9.7	18	10.2
Basic Sciences	46	26.3	45	25.7	45	25.7	46	26.3
Engineering Sciences	40	22.9	40	22.9	41	23.5	42	24
Computer Application	17	9.7	19	10.9	18	10.3	15	8.6
Applied Engineering Sciences	38	21.7	37	21.1	37	21.1	39	22.3
Project and Practice	17	9.7	17	9.7	17	9.7	15	8.6
Total	175	100	175	100	175	100	175	100
University Requirements	19	10.9	19	10.9	19	10.9	19	10.9
College Requirements	44	25.1	44	25.1	44	25.1	44	25.1
Discipline Requirements	59	33.7	59	33.7	59	33.7	59	33.7
Major Requirements	53	30.3	53	30.3	53	30.3	53	30.3
Total	175	100	175	100	175	100	175	100

Remarks:

MDE: Mechanical Engineering – Mechanical Design Engineering Track
MEE: Mechanical Engineering – Mechatronics Engineering Track
MEM: Mechanical Engineering – Manufacturing Engineering and Materials Track
IEM: Mechanical Engineering – Industrial Engineering & Management Track

The Mechanical Engineering program consists of 68 courses: 58 compulsory courses (151 credits), two industrial training courses (3 credits) and 8 elective courses (21 credits). The total 175 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 280 hrs.

6. SAMPLE STUDY PLAN and COURSE SEQUENCE

A sample study plan for the Mechanical Engineering program is presented as one recommended sequence to complete the graduation requirements over 10 main semesters, 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 Mechanical Engineering program 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
2.	MTHN001	3	CHEN001	3
3.	MTHN002	3	MTHN003	3
4.	PHYN001	3	PHYN002	3
5.	MDPN001	3	MDPN002	3
6.	GENN005	2	GENN001	1
7.	GENN004	2	GENN003	2
Semester Credit Hrs		18		17

Program Study Plan (Sophomore and Junior)

	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.	MTHN102	3	MTHN103	3	MTHN201	3	MTHN203	3
2.	MCNN101	3	PHYN104	3	MCNN202	3	MDPN260	3
3.	MDPN132	3	MDPN131	3	MDPN242	3	MDPN250	3
4.	MDPN171	3	MDPN141	3	MDPN251	3	MDPN252	3
5.	MDPN161	3	EPMN101	3	EPMN202	3	MDPN253	2
6.	GENN102	2	CVEN125	3	MEGN280	1	GENN224	2
7.	----------	-----	----------	----	GENN210	2	GENN201	2
8.	----------	-----	----------	-----	----------	-----	MEGN281$^{(0)}$	1
Semester Credit Hrs		17		18		18		18+1$^{(0)}$

Remark: Industrial training courses to be completed in the summer sessions. A detailed Manual for Industrial training is given in a separate Chapter of this Book.

Mechanical Design Engineering (MDE) Track Study Plan (Senior I and Senior II)

	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.	MCNN326	3	MDPN372	3	MEGN480	1	MEGN481	3
2.	MDPN262	3	MEPN345	3	MDPN473	2	MDPN471	3
3.	MDPN354	3	MDPN313	2	MDPN457	3	MDPN410	2
4.	MDPN332	2	MDPN343	3	MDPN468	3	XXXNXXX(2)	3
5.	MDPN363	2	EPMN404	2	MDPN464	3	XXXNXXX(2)	3
6.	EPMN303	2	XXXNXXX(2)	3	XXXNXXX(2)	3	---	---
7.	GENN3XX(1)	2	GENN3XX(1)	2	GENN3XX(1)	2	---	---
8.		---	MEGN381(0)	2	---	---	---	---
Semester Credit Hrs		17		18+2(0)		17		14

Mechatronics Engineering (MEE) Track Study Plan (Senior I and Senior II)

	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.	MCNN326	3	MDPN372	3	MEGN480	1	MEGN481	3
2.	CMPN101	3	CMPN201	3	MDPN473	2	MDPN471	3
3.	MDPN354	3	MEPN345	3	MDPN457	3	MDPN474	2
4.	MDPN332	2	MDPN423	3	CMPN211	2	XXXNXXX(2)	3
5.	EPMN303	2	EPMN404	2	MDPN470	2	XXXNXXX(2)	3
6.	XXXNXXX(2)	3	XXXNXXX(2)	3	XXXNXXX(2)	3	---	---
7.	GENN3XX(1)	2	GENN3XX(1)	2	GENN3XX(1)	2	---	---
8.		---	MEGN381(0)	2	---	---	---	---
Semester Credit Hrs		18		19+2(0)		15		14

Industrial Engineering & Management (IEM) Track Study Plan (Senior I and Senior II)

	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.	MCNN326	3	MDPN372	3	MEGN480	1	MEGN481	3
2.	MDPN361	2	MDPN364	3	MDPN473	2	MDPN471	3
3.	MDPN354	3	MDPN441	3	MDPN467	3	MDPN460	2
4.	MDPN332	2	MDPN365	2	MDPN468	3	XXXNXXX(2)	3
5.	MDPN362	3	MDPN366	2	MDPN469	2	XXXNXXX(2)	3
6.	XXXNXXX(2)	3	XXXNXXX(2)	3	XXXNXXX(2)	3	---	---
7.	GENN3XX(1)	2	GENN3XX(1)	2	GENN3XX(1)	2	---	---
8.		---	MEGN381(0)	2	---	---	---	---
Semester Credit Hrs		18		18+2(0)		16		14

Manufacturing Engineering & Materials (MEM) Track Study Plan (Senior I and Senior II)

	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.	MCNN326	3	MDPN441	3	MEGN480	1	MEGN481	3
2.	MDPN332	2	MDPN372	3	MDPN324	3	MDPN427	3
3.	MDPN354	3	MDPN313	2	MDPN430	2	MDPN471	3
4.	MDPN363	2	MDPN321	2	MDPN473	2	XXXNXXX(2)	3
5.	MDPN323	3	MDPN333	2	MDPN464	3	XXXNXXX(2)	3
6.	XXXNXXX(2)	3	XXXNXXX(2)	3	MDPN426	3	---------	----
7.	GENN3XX(1)	2	GENN3XX(1)	2	GENN3XX(1)	2	----------	------
8.		----	MEGN381(0)	2	----------	------	----------	------
Semester Credit Hrs		18		17+2(0)		16		15

7. COURSE CONTENTS
7.1 University-Core Courses

GENN001	**History of Science and Engineering** **Compulsory, Credits: 1 (1+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.
GENN004	**Computers for Engineers** **Compulsory, Credits: 2 (1+0+3)** **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.
GENN005	**Technical Writing** **Compulsory, Credits: 2 (2+0+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 (2+0+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 (2+0+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.
GENN210	**Risk Management and Environment** **Compulsory, Credits: 2 (2+0+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**.**
GENN224	**Principles of Economics and Accounting** **Compulsory, Credits: 2(2+0+0)** **Prerequisites (s): 42** The main objective of this course is to provide engineers with the basic concepts of Economics and Accounting where the engineer has to be able of conceiving a business' vision from financial & strategic dimensions alongside to his/her technical skills. The course includes introduction to financial accounting, overview of managerial accounting, and economic concepts. The financial accounting includes the accounting cycle and financial statements. It also includes financial ratios for measuring the organization's performance. The Managerial accounting and behavior of cost includes the cost volume relationships and its further use in Budgeting & Forecasting. Economic concepts are addressed in microeconomics & macroeconomics where microeconomics includes the basic principles of economics, theory, assumptions, and models of economics as a social science, it also includes market forces of supply and demand, and elasticity & its applications. Another important topic addressed in this part is the competitive markets where decisions regarding maximizing profit, shutting down or exiting the market are discussed through computational methods & formulas. Macroeconomics includes measuring the nation's income where it explains the gross domestic product (GDP), its components & types.

7.1b University-Elective Courses

GENN301	**Ethics and Legislation** **Elective (group E-1), Credits: 2 (2+0+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.
GENN303	**Critical Thinking** **Elective (group E-1), Credits: 2 (2+0+0)** **Prerequisite(s): GENN003** The aim of the course is to apply critical thinking in the context of problem solving in the engineering field. Critical thinking and abstract thoughtare invaluable tools, which complement an engineer's technical expertise. Critical Thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. The following terms and applications are also discussed: Analysis, breaking down the problem into parts and finding the relationships between them; Synthesis, thinking about other ways to solve the problem either by incorporating new information or combining the parts in a different way; and finally, Evaluation is making a judgment about the results using the evidence at hand.
GEN N305	**Interdisciplinary Project** **Elective (group E-1), Credits: 2 (2+0+0)** **Prerequisite(s): 108 credits** The course aims to give students more space for creativity, out of box thinking, collaboration and involvement in team work. It's a free specialization course where the subject is to be determined by the student team. The team consists of up to 6 students and minimum of 4 students. A maximum of two students of the same credit hour program can be members of the same student team. The team shall register the topic of the project with the course coordinator and follow up with him/her at least 3 times during the semester. No mid-term Exam for the course and the final Exam jury will be nominated by the course coordinator depending on the project subject, but not necessarily on the student(s) cr. Hr. program. The course is graded as a normal graded course. Final grade consists of: 20% for Semester work + 80% for Final Exam.

GENN310	**Advanced Risk Management** **Elective (group E-1), Credits: 2 (2+0+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 (2+0+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 المنهجية والبناء.
GENN321	**Foreign Language** **Elective (group E-1), Credits: 2 (2+0+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 (2+0+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 (2+0+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.
GENN328	**Scientific Research Methods** **Elective (group E-1), Credits: 2 (2+0+0)** **Prerequisite(s): 108 credits** Course covers the process of scientific knowledge and practical implementation, underlying research methodology issues. To develop a critical and questioning mindset, critical understanding of issues related to research questions, literature review, methodological design, data collection, analysis and conclusion. Moving you toward fulfillment of the publication and dissertation requirements, perhaps will turn you into a 'Researcher'. All of which to use content to solve technical, practical, and life problems.
GENN331	**Business Communication** **Elective (group E-1), Credits: 2 (2+0+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 (2+0+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.
GENN333	**Creativity, Art & Design** **Elective (group E-1), Credits: 2 (1+0+3)-Compulsory for AET** **Prerequisite(s): AA approval** This course will provide entry level visualization, communication and design

	skills for a wide variety of fields including: mechanical engineering, architecture, interior and furniture design, graphic design, package design, marketing, visual arts, …etc. It will help produce innovative creative and artistic projects. To develop basic thinking, visualizing and problem-solving skills , in order to apply these skills to a realistic simple creative project ex. exhibit design, landscape design, furniture design, … etc

7.2 College-Core Courses

CHEN001	**Chemistry** **Compulsory, Credits: 3 (2+0+3)** **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+4+0)** **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. Drawing of Architectural projections and reading of blueprints.
MDPN002	**Fundamentals of Manufacturing Engineering** **Compulsory, Credits: 3 (2+0+3)** **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+0+3)** **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+0+3)** **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+0+3)** **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+0+3)** **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.
MEGN280	**Engineering Seminar** **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.*

MEGN281	**Industrial Training-1** **Compulsory, Credits: 1** **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.*
MEGN381	**Industrial Training-2** **Compulsory, Credits: 2** **Prerequisite(s): MEGN281 + 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.*
MEGN480	**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.*
MEGN481	**Graduation Project-2** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): MEGN480 + 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

EPMN101	**Electrical Engineering Fundamentals** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PHYN002** Electrical elements and electrical quantities. Basic electrical laws (voltage and current divider rules, star-delta transformation). Analysis of DC circuits (branch currents, node voltages and Thevenin's theorem). First order capacitive transients. Time varying signals (average and RMS values, voltage and current waveforms). Analysis of AC circuits (vector and complex representations of sine waves, concept of impedance, power analysis, power factor correction). Three phase circuits (line and phase voltages, star and delta connected balanced loads, three phase power). Transformers circuits. 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.
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.
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.
MDPN131	**Engineering Materials** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN132** Heat treatments of steel, Classification of Alloy steels, Non- ferrous metals and alloys: copper and its alloys and aluminum and its alloys, Age hardening, Introduction to Polymers, Introduction to Composites, Introduction to Ceramics.
MDPN132	**Materials Science** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN002 + PHYN001** Introduction to materials engineering, Atomic structure and interatomic bonding, Crystal structures, crystal imperfections, Diffusion, Mechanical properties, Strengthening mechanisms and plastic deformation, phase diagrams, Iron carbon phase diagram, Types of cast iron, Phase transformations and isothermal heat treatments (TTT), Classification of Metals. Mechanical testing of metals: tension, compression, bending, torsion, hardness

MDPN141	**Manufacturing Processes I** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN002 + MDPN132** Examination of metal cutting processes including turning, shaping, drilling and milling. Mechanics of cutting, chip formation, shear plane, velocity relations, merchant circle, tool material, tool wear, tool life, economy in metal cutting. Introduction and definitions of metrology – Gauges – Errors in measurement – Linear and angle measuring instruments test of geometrical shape: straightness and flatness.
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.
MDPN250	**Fundamentals of Mechatronics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): EPMN101** Mechatronics fundamentals, Design of Mechatronics systems, System performance, System Interfacing, Instrumentation, and Control Systems, Microcontrollers, Sensors, Actuators, Computer simulation and Practical training, Case studies and Applications, Course projects.
MDPN242	**Manufacturing Processes II** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN002 + MDPN132** 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.
MDPN260	**Fundamentals of Industrial Engineering** **Compulsory, Credits: 3 (2+1+2)** **Pre-requisites: none** This course is designed to introduce the fundamental concepts of Industrial Engineering and give answers to the first questions that are usually asked by the prospective Industrial Engineering students. The course surveys both the traditional and modern topics of Industrial Engineering, providing a historical as

	well as an academic perspective of the whole profession. Related software applications, together with fundamentals of modeling & optimization, and production system design and control (methods engineering, work measurement, ergonomics, facilities planning and design, production planning, inventory control and quality control) will also be covered in the course.
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, 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, 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.
MDPN354	**Machine Design II** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN252** 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.
MDPN253	**Dynamics of Machine Components** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MDPN251** Dynamics fundamentals and basic concepts, Plane Kinetics of Rigid bodies: force-mass-acceleration, work and energy, virtual work, 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
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.

7.4 Major Courses

7.4.1 Major Compulsory Courses

CMPN101	**Logic Design I** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): PHYN002** Number systems and data representation - Boolean algebra - simplification of Boolean functions - logic gates - combinational and sequential logic circuits – Registers, counters, and adders – Memory
CMPN201	**Microprocessor Systems-1** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): CMPN101** Computer architecture - CPU architecture - fetch-decode-execute cycle - addressing modes - instruction set - memories (RAM-ROM-Cache-Flash) - memory interfacing - timing diagrams - assembly language - instruction formats - data representation - arithmetic operations
CMPN211	**Microprocessor Systems-2** **Compulsory, Credits: 2 (1+1+2)** **Prerequisite(s): CMPN201** Program controlled and interrupt driven I/O - I/O interfacing - connection of terminals, discs and I/O ports - assembly language - macros and kernels - introduction to embedded systems.
EPMN202	**Electric Drive System** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): EPMN101** Power Electronic Converters for Motor Drives: Controlled Rectifiers, DC Choppers, Inverters. DC Motor Drives: Structure and Operation of DC Motors, Types of DC Motors, Thyristor and Chopper DC Drives. Induction Motor Drives: Motor Structure and Operation, Speed Control, Inverter-fed Drives. Stepper Motor Drives: Principle of Operation, Motor Characteristics, Drive Circuits. Course Project.
EPMN303	**Industrial Instrumentation** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): EPMN202** Logic gates, circuit design with logic gates. Operational amplifier circuits and applications. Digital electronics. 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.
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 (1+0+3)** **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
MDPN321	**Fatigue, Creep and Fracture Mechanics** **Compulsory, Credits: 2 (2+1+0)** **Prerequisite(s): MDPN131 + MDPN161** Basic fracture mechanisms as applied to engineering materials, S-N curves, Goodman diagram, stress concentrations, residual stress effects, effect of material properties on mechanisms of crack propagation, high temperature deformation mechanisms (dislocation based creep, diffusion creep, grain boundary sliding), stress rupture, superplasticity, deformation mechanism map, fracture toughness, crack growth rate.
MDPN323	**Modern Manufacturing Processes** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN141 + MDPN242** Gear and thread manufacturing; Non-conventional metal cutting; Electro-chemical machining; Electro discharge machining; Laser beam machining; Electron beam machining; Water jet machining; Rapid Prototyping; micro system product; micro fabrication processes; Property enhancing of metals; cleaning and surface treatment; Coating and deposition processes; Thermal and mechanical coating; Processing of integrated circuit.

MDPN324	**Materials Selection in Design** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s):MDPN131** Classification of all engineering material; Materials properties; Performance indices; Materials selection charts; Performance indices with geometry factors; Case studies.
MDPN332	**Computer Aided Design and Manufacturing CAD/CAM** **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.
MDPN333	**Powder Metallurgy** **Compulsory, Credits: 2 (2+1+0)** **Prerequisite(s): MDPN131** Powder preparation, rapid-solidification processing principles, powder characterization, theory of compaction, sintering, full-density processing, powder metallurgy component design, compact characterization, application of powder metallurgy processing to structural, electrical, magnetic, and biomedical components.
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
MDPN361	**Engineering Economy and Cost Accounting** **Elective (group E-2), Credits: 2 (1+3+0)** **Prerequisite(s): GENN224** Break-even analysis, time value of money, interest factors, equivalent present cost, equivalent uniform annual cost, rate of return, payback period, analysis of alternatives, present worth, annual worth, depreciation, sensitivity and risk analysis, replacement analysis, Benefit / cost Ratio. Elements of product cost: Material cost, labor cost, overhead costs and overhead application rates, Job costing and Process costing.

MDPN362	**Operations Research I** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s):** Introduction to Operations Research. Formulation of linear programming problems. Graphical solution. The Simplex algorithm. Duality and sensitivity analysis. Transportation and assignment problems. Integer and Goal programming.
MDPN363	**Finite Element Analysis** **Compulsory, Credits: 2 (1+1+2)** **Prerequisite(s): MDPN262 (MDE) OR MDPN161 (MEM)** 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.
MDPN364	**Facilities Planning and Design** **Compulsory, Credits: 3 (2+1+2)** **Pre-requisites: MDPN260** Fundamentals of facilities planning. Facilities design. Flow, space, and activity relationships. Material handling systems. Layout planning models. Warehouse operations. Quantitative facilities planning models. Preparing, presenting, implementing and maintaining facilities plan.
MDPN365	**Reliability and Maintenance Engineering** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MTHN203** Maintenance systems. Maintenance operation and control. Preventive Maintenance: concepts, modeling, and analysis. Maintenance planning and scheduling. Maintenance material control. Computerized Maintenance Management Systems. Replacement studies. Case studies.
MDPN366	**Operations Research II** **Compulsory, Credits: 2 (1+1+2)** **Prerequisite(s): MDPN362** Non-linear programming. Dynamic programming. Inventory models. Waiting line models. Markov analysis. Introduction to Game theory. Applications in industrial, service and public systems.
MDPN372	**Control Systems Dynamics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN253** Introduction to system dynamics; Mathematical modeling of dynamic systems (mechanical, electrical, electronic, hydraulic, pneumatic, and thermal); Transfer-function approach; State-space approach; Time-domain analysis – Block diagrams - Transient response – Stability analysis – Root locus; Frequency-domain analysis– Bode diagrams – Nyquist plots. Computer simulation and case studies. Course project.

MDPN410	**Mechanical Design Lab** **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.
MDPN423	**Robotics Engineering** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN251** 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
MDPN426	**Structure of Materials** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN131** Atomic arrangements in crystalline and non-crystalline materials. Crystallography, kinematic, and dynamical theories of diffraction, applications to x-rays, electrons and neutrons. Interpretation of diffraction patterns and intensity distributions, application to scattering in perfect and imperfect crystals, and amorphous materials. Continuum description of structure emphasizing the tensor analysis of distortions in solids.
MDPN427	**Nanotechnology and Nanocrystalline Materials** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): MDPN131 + MDPN323** Introduction to concepts of nanotechnology in view of the construction and utilization of functional structures designed from atomic or molecular scale. Introduction to quantum mechanics. Phenomenal at nanoscale. Introduction to Nanomaterials. Overview of general synthesis and processing strategies and requirements: CVD, MOCVD, soft lithography, dip-pen lithography and self-assembly. Overview of some nanomaterials which have been synthesized for certain applications in nanotechnology: Nano catalysis, electronic materials, electro catalysis and fuel cells, carbon Nano tubes and other applications in polymers and biotechnology fields. Nano- technology, Nano-crystalline materials. Synthesis of 0-dimensional nanoparticles, 1-dimensional nanotubes, nanowires, and nanorods; 2-dimensional nanoribbons and nanofilms, and specialized Nano-features on substrates. Characterization of nanomaterials. Processing into higher order dimensions. Chemical, physical, mechanical, and electrical properties of nanomaterials. Application of nanomaterials
MDPN430	**Materials and Manufacturing lab** **Compulsory, Credits: 2 (1+0+3)** Fatigue, notch sensitivity, strain rate sensitivity, plane strain fracture toughness KIC, grain size and/or phase fraction measurement using optical microscope, 3D printing, heat treatment or cold work hardening followed by microstructure examination and/or hardness testing.

MDPN441	**Design for Manufacturing** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): MDPN141 + MDPN242** 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
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.
MDPN460	**Industrial Engineering Lab** **Compulsory, Credits: 2 (1+0+3)** **Prerequisite(s): 140 Credit Hours** Introduction to Work Study (WS). Productivity and WS. WS approaches. Basic procedure of method study involving job selection, recording facts, critical examination etc. String diagram, Multiple activity chart, Travel chart. Principles of motion economy. Two-handed chart. Fundamental hand motions. Micro-motion and Memo-motion studies. Cycle-graph and Chrono-cycle-graph. Work Measurement (WM). Work sampling. Time study. Computerized WM. PMTS: MTM, Work factor and Standard data.
MDPN464	**Failure Analysis** **Compulsory, Credits: 3 (2+1+1)** **Prerequisite(s): MDPN262 (MDE) OR MDPN161 + MDPN321 (MEM)** 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.
MDPN467	**Production Management** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): MDPN364** Basic concepts of Production and Operations Management (POM). Design of products and services. Processes and technologies, Inventory management. Forecasting. Material Requirements Planning (MRP). Scheduling. Supply-Chain management. Just-in-time and lean production. Introduction to Enterprise Requirement Planning (ERP). Capacity and Aggregate planning.
MDPN468	**Quality Engineering** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN203** Introduction to quality systems. Cost of quality. Total quality management. Quality

	systems and standards: six sigma and ISO. Reengineering. Statistical quality control: control charts for variables and attributes, process capability analysis, acceptance-sampling plans. Quality function deployment. Quality circles. Quality loss functions.
MDPN469	**Systems Modeling and Simulation** **Elective, Credits: 2 (1+1+2)** **Prerequisite(s): MDPN366** Basic theory of industrial simulation. Building simulation models. Organization of simulation studies. Simulation modeling and application to medium and large-scale production and service system problems. Output analysis. Variance reduction and optimization. Use of software such as ARENA for discrete and continuous system simulation.
MDPN470	**Mechatronics Laboratory:** **Compulsory, Credits: 2 (1+0+3)** **Prerequisite(s): 140 credits** Practical laboratory using prototyping equipment for Mechatronics applications; Implementation of Mechatronics system design principles; Experimental evaluation of Mechatronics systems; Hands-on laboratory projects using electric, mechanical, electronic components.
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
MDPN473	**Automatic Control I:** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MDPN372** Introduction to feedback control systems; Control system characteristics; Control Design by the Root locus method; Control Design by the Frequency-response method; PID Controllers and Tuning. Computer simulation and case studies. Course project.
MDPN474	**Automatic Control II:** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MDPN473** Linear control systems analysis in State Space – State-Transition Matrix - Controllability – Observability; Linear control systems design in State Space – Pole placement – State Observers – Linear quadratic regulators. Computer simulation and case studies. Course project.
MEPN345	**Turbomachinery** **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

7.4.2 Major Elective Courses

CMPN103	**Programming Techniques** **Elective, Credits: 3 (2+1+2)** **Pre-requisites: MTHN003 + GENN004** Introduction to software design - evolution and comparison of programming languages - types and characteristics of translators - structured programming - function versus object-oriented programming- introduction to parallel programming- program maintenance & testing - documentation - numerical and non-numerical examples-programming project.
CMPN205	**Computer Graphics and Man Machine Interfacing** **Elective, Credits: 3 (2+1+2)** **Prerequisite(s): CMPN103** Fundamentals of computer graphics - display devices - fundamentals of graphic algorithms - two-dimensional graphics - polygon representation - polygon filling - polygon clipping - three dimensional graphics - back face removal - scan line and ray tracing - illumination and shading models - programming projects
CMPN444	**Computer Interfacing** **Elective, Credits: 3 (2+1+2)** **Prerequisite(s): CMPN201 + CMPN205** Basic interfacing hardware - buses and memory/peripheral connections - interrupts - synchronous and asynchronous connections - serial and parallel interfaces - analog interfaces – Analog to Digital – Digital to Analog Converters – USB- Wireless interface- special interfaces.
CMPN445	**Embedded Systems** **Elective, Credits: 3 (2+1+2)** **Prerequisite(s): CMPN201** Embedded system design process - embedded computing platform- program design and analysis- Hardware accelerators - distributed embedded architectures- system analysis and architecture design- Design example – Programming project.
CMPN446	**Image Processing and Computer Vision** **Elective, Credits: 3 (2+1+2)** **Prerequisite(s): MTHN203** Image representation - methods of image processing - enhancement - data compression - reconstruction from projection - features extraction - image analysis - pattern recognition - computer vision
ELCN203	**Signal Analysis** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): EPMN101 + MTHN102** Continuous time and discrete time signals and systems - basic system properties - Linear Time Invariant Systems – The C.T and D.T. convolution - Properties of LTI systems - Fourier Series Representation of C.T. and D.T. Periodic Signals - Parseval's relation - The C.T. Fourier Transform for periodic and aperiodic signals - Properties of continuous time F.T. – The D.T. Fourier Transform – Properties of D.T. Fourier Transform - Complex exponential and sinusoidal Amplitude Modulation-Demodulation for Sinusoidal AM - Frequency Division Multiplexing - Representation of continuous time signal by its samples - The sampling Theorem - The effect of under-sampling or aliasing - sampling with zero order hold - The Z Transform

EPMN212	**Electrical Measurements** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): EPMN303** Errors in measurements - Electronic measurement, Oscilloscopes - Signal generators - Noise sources and reduction techniques - Troubleshooting with instruments - Analog to digital converter, Electronic digital counters, Digital multi-meter - Temperature transducers, Mechanical Transducers, Optical transducers - Analog and Digital Signal Conditioning - Fiber optic in instrumentation, acoustic detectors – Partial discharge detection – High voltage measurements – High current measurements - Electromagnetic field meters. Laboratory experiments on the course topics.
EPMN308	**Digital Control Systems** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): ELCN203 + MDPN473** By completing this course, students should be able to convert linear time invariant systems from continuous-time to discrete-time. Identification of unknown systems is also considered. Students should be able to design digital controllers and filters. The course syllabus includes: sampling continuous-time systems, time-delay systems, transfer functions in z-domain, block diagram simplification, stability analysis, transformation techniques, compensator designs, PID controllers, digital filters, state space models, controllability, observability, state feedback, output feedback, and introduction to system identification. Laboratory experiments on the course topics.
EPMN425	**Process Control and Robotics** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): EPMN308 + AA approval** This is an industrially oriented course. It demonstrates to students what they are likely to see in real life if they work in the instrumentation and control field. By the end of this course, students should be able to read P&I diagrams, identify control loops, and tune industrial controllers including robot arms. The course syllabus includes: Piping and instrumentation diagrams, cascade controllers, feed forward controllers, control design of time-delay processes, internal model control, two-degree of freedom controllers, hybrid controllers, introduction to model predictive control, Smith predictor, implementation of industrial controllers, introduction to nonlinear controllers, robots kinematics, robots inverse kinematics, path planning, joint control of robotic arms.
EPMN427	**Intelligent Control** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): CMPN201 + MDPN473** This course introduces the basics of intelligent control. Many commercial products use intelligent control. For example: washing machines use it to determine the amount of detergent and cameras use it to counteract vibrations. This course helps students to understand and design simple intelligent controllers. The syllabus includes the following: Artificial intelligence basics, fuzzy set theory, fuzzy logic, Fuzzy reasoning, Fuzzy controllers, Fuzzy PID control, Neural networks introduction, perception model, classification problem, multilayer networks, Feed forward networks, back propagation learning algorithms, recurrent networks, radial basis networks, neural network control. Neuro-fuzzy systems, introduction to optimization methods such as swarm optimizations and ants colony, application examples.

HEMN332	**Biomechanics I** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): None** Relationship between forces, moments, mass, and acceleration for human body and body segment motions. Centroids, center of mass, mass moment of inertia, and relative motion, mechanics of tissues, joints, and human movement. Basic anatomy and physiology of limb and joint defects, biomechanics, motion analysis, and current device designs. Application of mechanical engineering and biomaterial selection principles in the design of artificial limbs and joints
HEMN432	**Biomechanics II** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): HEMN332** Biomechanics for the design and evaluation of artificial devices intended to restore or improve movement lost due to injury or disease. Measurement technique in movement biomechanics, including motion analysis, electromyography, and gait analysis. Design and use of upper and lower limb prostheses. Principle of neuro-prostheses with applications to paralyzed upper and lower extremities.
HEMN436	**Medical Robotics I** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN203** Robot's applications, Introductory concepts, Kinematics: forward and inverse kinematics, instantaneous kinematics, Rotation, Homogeneous transformation, Differential motion & the Jacobbian, Denavit Hartenberg foundational convention, Screw Motion: Plücker coordinates, Motion invariants, Pose, Instantaneous Screw axis (Screw Velocity): screw, twist, Acceleration, Dynamics: wrench, wrench axis, mass, center of mass, 1st moment of mass, Inertia, Kinetic energy, Newton Euler equations, Dynamics canonical equation.
HEMN437	**Medical Robotics II** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): HEMN436** Motion Planning: Workspace vs joint space planning, Slew, interpolated, & linear motions, Path Planning, Trajectory Planning: Point-to-point, splines, Motion Control: General Control Approach: Joint Space vs Operational (work) space control, Independent joint control, Multi-joint control, Joint Space. Control (PD position Control, PD position Control with gravity Compensation, Inverse dynamics Control), External Space Control, (Transposed Jacobian matrix-based Control, Inverse Jacobian matrix-based Control, PD position control with gravity compensation in external coordinates, Inverse dynamics Control in external space, Inverse dynamics control with contact, Force Control). Physical human robot interaction (HRI), HRI and safety, human machine interface (HMI), human computer interface (HCI), brain computer interface (BCI), cognitive HRI, HRI necessary design fundamentals, examples and case studies: surgical robots, upper and lower limb prostheses (hand, arm, leg, knee, and ankle), upper and lower limb exoskeletons, wheelchairs, Advanced Topics
HEMN438	**Rehabilitation Robotics** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): HEMN436** Revision of robotic kinematics, dynamics, motion planning, and control, physiological and biological concepts, impairment and rehabilitation, prosthetics and orthotics, rehabilitation and disability management of patients with: motor

	disorders, pathological tremor, amputation & paralysis , needs advantages and challenges of rehabilitation robotics, The role of robotics in rehabilitation, physical human robot interaction (HRI), HRI and safety, human machine interface (HMI), human computer interface (HCI), brain computer interface (BCI), cognitive HRI, HRI necessary design fundamentals, examples and case studies: upper and lower limb prostheses (hand, arm, leg, knee, and ankle), upper and lower limb exoskeletons, wheelchairs, Advanced Topics
MDPN322	**Advanced Casting processes** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + MDPN242 + AA Approval** Casting processes: Classification, Metal mould casting processes, advanced casting processes, investment casting, Rheocasting, mould and core making materials and their characteristics. Technology of Selected casting Processes: Clay bonded, synthetic resin bonded, inorganic material bonded mould and core making, sand additives, mould coating, continuous casting process, centrifugal casting process. Casting defects, inspection, diagnosis and rectification, mechanization and automation in foundries, use of robots, casting design, near net shape casting, pollution control, energy and waste management in foundries
MDPN325	**Sheet Metal Processing** **Elective, Credits: 3(2+1+1)** **Prerequisite(s): 102 credits + MDPN242 + AA Approval** 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
MDPN326	**Creep and high temperature materials** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + MDPN132 + AA Approval** Mathematical description of creep process. Mathematical methods of extrapolation of creep data. Micro mechanisms of creep deformation, including dislocation gild and grain boundary sliding. Study of various high temperature materials, including iron, nickel, and cobalt base alloys and refractory metals, and ceramics. Emphasis on phase transformations and microstructure-property relationships.
MDPN327	**Modeling and Simulation of Materials Processing** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + MDPN132 + MDPN242 + AA Approval** Overview and hand-on practice for programs used to simulate metal casting, bulk metal forming, sheet metal forming, polymer injection, etc. summary of numerical methods before going to each technique, insight to the underlying numerical methods for each software.
MDPN328	**Polymers Engineering** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + AA Approval** This course offers engineering analysis and design techniques for synthetic polymers. Treatment of materials properties selection, mechanical

	characterization and processing in design of load-bearing and environment-compatible structures are covered.
MDPN329	**Corrosion Engineering** **Elective, Credits: 3 (2+1+1)** **Prerequisite(s): 102 credits + AA Approval** Basics of electrochemistry. Advanced topics in corrosion engineering. Case studies and industrial applications. Special forms of corrosion. Advanced measurement techniques.
MDPN353	**Mechanism Design** **Elective, Credits: 3 (2+2+0)** **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
MDPN362	**Operations Research I** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): None** Introduction to Operations Research. Formulation of linear programming problems. Graphical solution. The Simplex algorithm. Duality and sensitivity analysis. Transportation and assignment problems. Integer and Goal programming.
MDPN367	**Safety Engineering** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + AA Approval** 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. Personal protection. First aid. Planning for emergencies.
MDPN368	**Ergonomics and Human Factor** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + AA Approval** Introduction to Occupational Biomechanics. Review of kinematics and kinetics. Anthropometry. Mechanical work-capacity evaluation. Bioinstrumentation for Occupational Biomechanics. Biomechanical models. Methods of classifying and evaluating manual work. Manual material handling limits. Biomechanical considerations in machine control and workplace design. Hand tool design guidelines. Guidelines for seated work. **I**ntroduction to human factors engineering. Muscular work. Nervous control. Work efficiency. Body size and anthropometrics. Work station design. Heavy work. Handling loads. Man-machine systems. Mental activity. Fatigue. Stress and boredom. Vision and lighting. Noise and vibration.

MDPN369	**Product Design and Development** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): MDPN252** Product development and design processes and methods, including product specifications, concept development, engineering drawings, design for prototyping, and manufacturing.
MDPN421	**Tribology** **Elective, Credits: 3 (2+2+0)** **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, Credits: 3 (2+2+0)** **Prerequisite(s): MDPN251 + 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, Credits: 3 (2+2+0)** **Prerequisite(s):** Introduction to Project planning and scheduling, Project charter, Scope statement, Work Breakdown Structure, Responsibility Chart. Network diagram, Schedule analysis and possibilities using the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT). Resource leveling and allocation, Time-cost trade off (Crashing a schedule), Gantt Chart, Time overlaps, Time and cost control, Risk monitoring and control, Computer applications.
MDPN425	**Mechanical Behavior of Materials** **Elective, Credits:3 (2+2+0)** **Prerequisite(s): 102 credits + MDPN161 + MDPN132 + AA Approval** Advanced studies of deformation and failure in materials. Macroscopic and microscopic aspects of deformation. Elasticity and plasticity theories and problems in deformation processing. Fracture mechanics and composite toughening mechanisms. Mechanisms of creep deformation.
MDPN426	**Engineering Economic Analysis** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + AA Approval** Elements of product cost: Material cost, labor cost, overhead costs and overhead application rates - Job costing - Process costing - Cost accumulation systems -

	Cost reduction in mechanical system designs - Economic comparison of alternative mechanical system design projects: break-even analysis, time value of money, interest factors, equivalent present cost, equivalent uniform annual cost, rate of return, payback period, present worth, annual worth – depreciation – sensitivity and risk analysis. . Applications. Course project.
MDPN428	**Advanced Topics in Manufacturing Processes** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + AA Approval** The course covers advanced topics in manufacturing of relevance to emerging technologies. The topic may include: flexible manufacturing systems, reverse engineering and prototyping, integrated manufacturing, manufacturing intelligence, 3-D printing, Additive manufacturing, The course includes independent research project on advanced manufacturing processes.
MDPN431	**Sustainability and Design for Environment** **Elective, Credits: 3 (2+2+0)** **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, Credits: 3 (2+2+0)** **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, Credits: 3 (2+2+0)** **Prerequisite(s): MDPN457 + MDPN473** 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, Credits: 3 (2+2+0)** **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.
MDPN438	**Manufacturing Systems** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + MDPN141 + MDPN242 + MDPN323 + AA Approval** NC machines, basic principles; Numerical control and industrial robotics; Group technology and flexible manufacturing systems; Production lines; Machining centers; High speed machining; Manufacturing engineering: Process planning; Problem solving and continuous improvement; Concurrent engineering design for manufacturability; Production planning and control; Quality control.
MDPN439	**Technology-Based Entrepreneurship** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): MDPN 131 + MDPN141 + MDPN242** Concentrates on hands-on aspects of innovation and entrepreneurial enterprise development. Examines relationships between innovation, iterative prototyping, and marketing testing. Students identify market opportunities, create new technology-based products and services to satisfy customer needs, and construct and test prototypes.
MDPN441	**Design for Manufacturing** **Elective, Credits: 3 (2+2+0)** **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, Credits: 3 (2+1+1)** **Prerequisite(s): 102 credits + MDPN363** 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, Credits: 3 (2+1+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.

MDPN447	**Advanced Welding processes** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + MDPN242 + AA Approval** Physics of welding arc, characteristics of arc, modes of metal transfer, welding fluxes, electrode coating, classification of electrode, characteristics of welding power source, pulsed and inverter type power source, power source for resistance welding, weldability, weldability tests, Weldability of cast iron, Plain carbon steel, Determination of preheating temperature, Stainless steel, use of Scheffler' s diagram. Heat flow in welding, significance, theory of heat flow, cooling rate determination, selection of welding parameters based on heat flow analysis, residual stress and its measurement, types and control of distortion. Analysis of fatigue of welded joint, fracture and toughness testing and its application on welded joint, automated welded joint, microprocessor based of control resistance and arc welding, quality assurance in welding, effects of welding fumes on environment.
MDPN451	**Composite Materials: Design and Manufacturing** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + MDPN131 + 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, Credits: 3 (2+2+0)** **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
MDPN456	**Material Handling Equipments** **Elective, Credits: 3 (2+0+2)** **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.

MDPN458	**Supply Chain Management** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): MDPN467 or its equivalent** This course focuses on management and improvement of supply chain processes and performance. It will be valuable for students who would like to pursue a career in consulting or take a position in operations, marketing or finance functions in a manufacturing or distribution firm. It explores important supply chain metrics, primary tradeoffs in making supply chain decisions, and basic tools for effective and efficient supply chain management, production planning and inventory control, order fulfillment and supply chain coordination. It will also investigate topics such as global supply chain design, logistics, and outsourcing, several other recent supply chain innovations.
MDPN461	**Computer Integrated Manufacturing CIM** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 102 credits + AA Approval** CIM introduces the basic concepts and procedures of CIM production as well as the main components and devices in a CIM cell. Students learn about all the aspects of a CIM production cycle, from customer order and inventory control, through automated manufacturing of materials into finished parts, to quality inspection and final delivery. It covers the integration of: Computer Aided Design (CAD), Computer Aided Process Planning (CAPP), and Computer Aided Manufacturing (CAM); Integrating robotic systems such as Automated Guided Vehicles (AGV) and robotic arms into manufacturing systems and use of Flexible Manufacturing Systems (FMS). Use of CIM software.
MDPN462	**Design of Experiments** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): MTHN203** Principles of experimental design. Randomized complete block designs. Latin square and Greco-Latin square designs. General factorial designs. 2k Factorial designs. Response surface methodology and robust design. Planning, performing and analyzing industrial experiments.
MDPN463	**Industrial Management** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s):** Introduction to industrial management. Economic concepts in industry. Organizational structure and design. Human resource management. Motivating the work force. Managing information technology. Financial management. Engineers in marketing and services. Job analysis, job description, and job specification. Preparation of business plan.
MDPN465	**Industrial Information Systems** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s):** General concepts. Values and attributes of information. Different types of information systems. Concepts of managerial information systems. Emphasis on analysis, design, and development of industrial information systems. Developing information systems by using microcomputers.

MDPN466	**Manufacturing Systems Design** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s):** Study of recent developments in manufacturing, Japanese manufacturing techniques, hybrid manufacturing management system, supply chain management, total quality management, design for manufacturing and assembly. Manufacturing automation fundamentals and strategies; High volume manufacturing systems; Automated handling and storage systems; Automated inspection systems; Flexible manufacturing systems; Modeling of manufacturing systems.
MDPN467	**Production Management** **Elective, Credits: 3 (2+1+2)** **Prerequisite(s): MDPN364** Basic concepts of Production and Operations Management (POM). Design of products and services. Processes and technologies, Inventory management. Forecasting. Material Requirements Planning (MRP). Scheduling. Supply-Chain management. Just-in-time and lean production. Introduction to Enterprise Requirement Planning (ERP). Capacity and Aggregate planning.
MDPN476	**Mobile Robots and Autonomous Systems** **Elective, Credits: 3 (2+1+1)** **Prerequisite(s): MDPN423** Introduction to Mobile Robots Locomotion; Kinematics of Mobile Robots: Maneuverability – Workspace; Mobile Robots Perception: Sensors – Computer Vision – Image Processing – Place Recognition; Mobile Robot Localization; Planning and Navigation: Path Planning – Obstacle Avoidance. Computer Simulations and Course Project.
MDPN477	**Micro and Nano-Electromechanical Systems** **Elective, Credits: 3 (2+1+1)** **Prerequisite(s): MDPN372** Introduction to Micro and Nano-Electromechanical Systems (MEMS/NEMS); Design of MEMS/NEMS; Fabrication of MEMS/NEMS; Principles of sensing and actuation in MEMS/NEMS: Electrostatic – Piezoresistive - Magnetic; Applications of MEMS/NEMS; Computer Simulations and Course Project.
MDPN478	**Vehicle System Dynamics and Control** **Elective, Credits: 3 (2+1+1)** **Prerequisite(s): MDPN372** Introduction – vehicle body motion – Tires – Suspension systems – Equations of motion of passenger cars – vehicle stability - Simulation of motion of passenger cars - Fundamentals of Hybrid Electric Vehicles and Electric Vehicles, Course Project.
MDPN479	**Special Topics in Mechatronics** **Elective, Credits: 3 (2+1+1)** **Prerequisite(s): 102 credits + AA Approval** Students study one or more topics in Mechatronics Engineering that are not covered by other program courses and/or that present recent or advanced development of interest to mechatronics engineers. Course project.

MEPN345	**Turbo-machinery-I** **Elective, Credits: 3 (2+2+0)** **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
MEPN415	**Power Generation** **Elective, Credits: 3 (2+2+0)** **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, Credits: 3 (2+2+0)** **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, Credits: 3 (2+2+0)** **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, Credits: 3 (2+2+0)** **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