Section 15

Mechanical Engineering Programs

Sustainable Energy Engineering Program (SEE)

Based on Credit Hours System (CHS)

September 2019

1. INTRODUCTION

Egypt Vision 2030 aims at possessing a competitive, balanced and diversified economy, dependent on innovation and knowledge, based on justice, social integrity and participation, characterized by a balanced and diversified ecological collaboration system, investing the ingenuity of place and human resources to achieve sustainable development and to improve Egyptians' life quality.

Egyptian inhabitants crossing the barrier of 100 million in 2017 has positioned Egypt into a 9 digits population country. Population dimension together with the Global Warming factor are posing serious challenges into our development plans and methodologies. Obviously, a combination of different innovative approaches and techniques would be required to enable us to maintain and improve our efforts to climb the ladder of global competitiveness index, 100/137 on 2017/2018, up 16 countries from 2016, and aimed at being 50/137 in 2030*.

The MECHANICAL ENGINEERING - SUSTAIBALE ENERGY educational response to the contemporary challenges and objectives of the Egyptian National Vision 2030 is called upon in several parts of the document addressed directly and indirectly. See for example, in the 'The Economical Dimension', which allocated a separate chapter to 'Energy', the question of availability of energy and the necessity of expanding energy generation technologies both from conventional, new and renewable energy sources as well as nuclear power, energy conservation and optimization for different life application. The Environment dimension also mentioned explicit requirements for improving air and water quality, increasing restrictions on pollutants and finding out new sources of water by using different type's desalination methodology. Further, the last dimension of Egypt's Vision on Urban Development required higher living standards for tomorrow's buildings, including higher energy efficient buildings (Sustainable Buildings).

It is the mission of the MECHANICAL ENGINEERING - SUSTAIBALE ENERGY program of the Faculty of Engineering of Cairo University, the oldest and one of the best institutions in the country and the whole region to establish a program that incorporates means for achieving all those objectives.

A credit hours program amongst the department of Mechanical Power Department would provide the wagon for continuous development of modern courses specially tailored to meet job opportunities requirements, public challenges as well as the MENA region's sensitive needs in the field of Energy (conventional, new and renewable) regarding efficiency and operations. These include wind energy, solar energy, geothermal energy, bio-fuels, power plants for electricity generation, advanced gas turbines, turbomachines design and maintenance and quality control on products and processes, nuclear energy, desalination, Environment and HVAC Engineering. The importance and applications are further explained in appendix (1)

Although Cairo University's "Sustainable Energy Engineering" will not by any means be the first of its specialization whether internationally, Appendix (2), or even nationally,

Appendix (3), the competitive ingredients are represented by mechanical power department staff members who are the most prominent and influential figures of the field who are currently leading international and national committees in the fields of Energy, Environment and HVAC Engineering. They are without doubt the peers of the field. Our young staff members received their degrees from leading international institutions with up to date skills and knowledge in using latest Engineering and research techniques, and in directing the most sophisticated Engineering development programs. Furthermore, the established departments of Production and Mechanical Design, Civil, Electrical Power and Communications would enable unlimited graduates of this program to be the best candidates for leading positions in major engineering firms once they pass a number of years of practical experience.

This discipline is mainly concerned with thermo-fluid sciences that are the basis for energy conversion and power generation. In addition, (NARS, 2009), Energy engineers are concerned with other important issues like the pollution control, energy management, heating, ventilation and air-conditioning, transport phenomena, combustion, fluid flow,...etc.

The development of energy engineering has been fundamental to the advancement of civilization. Energy Engineering is the science and technology of energy and its conversion to mechanical and Electrical power. This includes the major flow and combustion processes occurring in different systems.

Energy takes a number of different forms, such as mechanical energy, electrical energy, nuclear energy, chemical energy, kinetic energy, and solar energy. Energy is used to do the work, and the relationship between work and energy (or heat) is called thermodynamics.

Applied thermodynamics deals with such special applications of energy transfer as power generation, refrigeration and gas compression. The energy transfers are made during processes which use certain fluid contained in or flowing through a system.

The techniques for calculating and evaluating heat engines performance, combustion, emissions processes and design features represent one subject of the energy engineering.

A basic knowledge of the principles of energy; its use, its transfer, and its conversion from one form to another is also one of the important subjects in energy engineering. It requires understanding of different subjects such as physics, chemistry, turbo-machinery, and mathematics.

As the population of the world grows and as fossil fuels become scarcer, it becomes more and more important for man to be able to control energy consumption; first, to obtain higher efficiencies from heat or power cycles; second, looking for alternative fuels (cheap, less polluting, high heat release); third, need to remove pollutants formed during processes of energy conversion; and forth, apply safety measures. Moreover, achieving high heat release, working with special materials and suppressing acoustic

interaction. It is a challenge now for energy engineers to search for alternative fuels as a new source for energy, to link between chemical, physical and thermo-fluid properties to energy transfer characteristics in different applications such as power stations, turbo-machinery, vehicles, boilers, gas and steam turbines. Moreover, it is very important to model energy transfer processes aiming at obtaining high efficiency and less pollutants.

It is thus mandatory to encourage a diversity of subjects' provision, to encourage institutions to explore new ways of enhancing knowledge and understanding of students, and to create a sense of excitement in their students.

Sustainable Energy Engineers may work in:
• Processing or user industries.
• Power stations and petrochemical plants.
• Management in industries.
• Establishments concerned with cars, ships, energy generation or aerospace and refrigeration and air conditioning.
• Safety and environmental concerns.
• Research

2. PROGRAM MISSION

The mission of the Sustainable Energy Engineering (SEE) Program is to develop scholar practitioners who would be the future leaders of their field driving profitability, avoiding unnecessary costs, achieving highest possible efficiencies through qualifying them with high skills based upon deep understanding of the physics and comprehending the human and economical dimensions. The program will provide the optimal learning environment with close exchange and continuous engagement with the ongoing mega projects taking place in the country to provide a generation of hands on engineers who are ready to embark into constructing activities once they graduate. The graduates would be of known attributes that are required by the business community in the field of (SEE).

3. EDUCATIONAL OBJECTIVES

The MESE program has the following set of educational objectives:

- To provide students with the understanding of fundamental knowledge prerequisite for the practice of, or for advanced studies in, Sustainable Energy Engineering, including its scientific principles, rigorous analysis, and creative design.
- To provide the students with broad based professional education that covers the important current and developing issues in Sustainable Energy Engineering, which is necessary for a productive career, and for being able to search and research in the spirit of continuing education in the field of SUSTAINABLE ENERGY and related areas.
- To enable graduates to work not only in local markets but also in regional (particularly, in the Arab and African regions) and international markets, acquiring logical thinking, and creativity.

- To provide an environment that enables students to pursue their goals in an innovative program that is rigorous and challenging, open and supportive.

In addition to the general attributes of engineer, the Sustainable Energy engineer should be able to:

1. Work with energy systems such as conventional energy generation systems, renewable and clean power generation systems, refrigeration, heating, ventilation, and air conditioning (HVAC) systems.
2. Cope with the state of art applications in the market nowadays such as green buildings and all types of renewable energies.
3. Perform an accurate performance analysis for the mentioned systems using mathematics, physical and engineering sciences.
4. 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.
5. Use and/or develop computer software, necessary for the proper designs of high performance systems.
6. Lead or supervise a group of designers or technicians and other work force.

4. PROGRAM LEARNING OUTCOMES

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

4.1 Knowledge and Understanding

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

i) Essential facts, fundamentals, concepts, principles and theories relevant to Sustainable Energy Engineering;
j) The constraints which mechanical power and energy engineers have to judge to reach at an optimum solution.
k) Concepts and theories of basic sciences, mathematics and the technological base relevant to Mechanical Power and Energy Engineering.
l) The professional and ethical responsibilities of mechanical power and energy engineers.
m) The impact of mechanical power and energy engineering solutions in a global and societal context.
n) Mechanical power and energy engineering contemporary issues
o) Relevant mathematical and numerical methods and the principles of engineering and mechanical engineering sciences as applied to mechanical power and energy engineering systems.
p) The basic theories and principles of some other engineering and mechanical engineering disciplines providing support to mechanical power and energy disciplines.
q) The role of information technology in providing support for mechanical power and energy engineers.

r) Engineering design principles and techniques and their applications to mechanical power and energy engineering.

4.2 Intellectual Skills

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

i) Think in a creative and innovative environment, in solving problems;
j) Apply the principles of mathematics, science and technology in problem solving scenarios in energy engineering;
k) Run, analyze and interpret numerical data, and design experiments to obtain such data;
l) Design, develop, or evaluate energy-related projects or programs to reduce energy costs or improve energy efficiency during the designing, building, or remodeling stages of construction;
m) Appraise designs, processes and products, and propose improvements;
n) Assess risks, and take appropriate steps to manage those risks.
o) Use the principles of engineering science in developing solutions to practical energy engineering problems.

4.3 Practical and Professional Skills

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

1. Analyze experimental results and determine their accuracy and validity.
2. Use computational tools and packages and write computer programs pertaining to mechanical power and sustainable energy engineering.
3. Use a wide range of analytical and technical tools, and equipment, including pertinent software;
4. Prepare engineering drawings, computer graphics and specialized technical reports and communicate accordingly.
5. Understand, design and apply the principles of fire safety and fire-fighting systems;
6. Specify, install, operate and maintain energy generation equipment for conventional, new and renewable energy systems;
7. Operate and maintain energy equipment.
8. Use computational tools and software packages pertaining to the discipline and develop required computer programs.
9. Effectively access and reference to relevant technical literature.
10. Work in mechanical power and energy operations, maintenance and overhaul.

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

a) Concepts, principles and theories relevant to energy engineering;
b) Applied science and mathematics, and the technological base relevant to energy engineering;
c) The constraints within which an engineering judgment will have to be exercised;
d) The specifications, programming and range of application of CAD, HAP, ANSYS, SOLIDWORKS, MATLAB, REVITE and ELLITE
e) Relevant contemporary issues in energy engineering
f) Basic electrical, civil, control and computer engineering subjects related to the discipline

g) The role of information technology in providing support for energy engineers
h) Engineering energy principles and techniques
i) Characteristics of engineering materials and their selection criteria;
j) Management and business techniques and practices appropriate to the engineering industry.

5. PROGRAM DESCRIPTION

To prepare the student for the above targeted educational objectives, a set of program outcomes, describes what students are expected to know and are able to do by the time of graduation, have been adopted. Those outcomes are based on direct market needs and fall in line with the criteria forged by reputable international accrediting bodies, most notably ABET, USA. The students are expected to complete the degree requirements in 10 main semesters. High caliber students may finish in 9 main semesters.
The MESE program offers instruction in numerous topics concerning generation of energy from conventional sources (fossil fuels) as well as renewable and sustainable sources such as solar energy, wind energy, etc., design aspects of heat and energy machines, internal combustion engines, boilers, furnaces, and turbomachines. The program also offers insight knowledge and experience in refrigeration and heat, ventilation and air-conditioning, fire safety engineering, control engineering and energy systems. The MESE program accepts a maximum of 50 students at the sophomore level. This number may increase (within limits) in the years to come, as the program will have been proven and as the job market demands that increase.

5.1 Curriculum Overview

The curriculum of the MESE program consists of 175 credits. The courses offered are spread over 94 compulsory and elective courses covering topics in Humanities and Social Sciences (HSS), Basic Sciences (BS), Engineering Sciences (ES), and Applied Engineering Sciences (AS) as required by the Supreme Council of Universities (SCU). Sample courses in each category are presented as follows.

5.1.1 Humanities and Social Sciences Courses

- History of science and Engineering
- Ethics and Legislation
- Technical Writing
- Communication and Presentation Skills
- Risk Management
- Fundamentals of Management
- Foreign Language
- Marketing
- Selections of Life-long Skills
- Fundamentals of Economics and Accounting

5.1.2 Basic Sciences Courses

- Mathematics
- Physics
- Chemistry
- Mechanics

5.1.3 Engineering Sciences Courses

- Electrical Engineering
- Civil Engineering
- Industrial Electronics
- Manufacturing
- Fluid Mechanics
- Stress Analysis
- Numerical Analysis
- Thermodynamics
- Heat Transfer

5.1.4 Applied Engineering Sciences Courses

- Turbo-machinery
- Renewable Energy
- Internal Combustion Engines
- Computational Fluid Dynamics
- Power Generation
- Heat Exchanger Design
- Nuclear Energy
- Solar Energy

The curriculum gives the students the opportunity to select not only the major specialty but also several elective courses within the major. Students in the MESE 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 (10.85% of total 175 credits), which are satisfied by completing nine (9) 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, 7.4% 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	Fundamentals of Economics and Accounting	2

Table 1b Elective Courses of University Requirements (6 credits, 3.4% of total 175 credits)

	Code	Course Title	Credits	Group
1	GENN301	Ethics and Legislation	2	E-1(1)
2	GENN310	Advanced Risk Management	2	
3	GENN311	Technical Writing in Arabic	2	
4	GENN321	Foreign Language	2	
5	GENN326	Marketing	2	
6	GENN327	Selections of Life-long Skills	2	
7	GENN331	Business Communication	2	
8	GENN332	Service Management	2	
9	GENN333	Creativity Art and Design	2	
10	GENN255	Management of Engineering	2	
11	GENN328	Scientific Research Method	2	
12	GENN305	Interdisciplinary Project	2	
13	GENN303	Critical Thinking	2	

Remarks:

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

5.3 College Requirements

College requirements provide students with the knowledge and skills that are essential to develop a successful engineer. A college core that is common to all credit hours programs is implemented. This unified college core contains two categories of courses.

The first category of college core courses includes courses of basic knowledge essential to all engineering graduates such as Mathematics, Physics, Mechanics, Graphics and Design, Manufacturing, and Chemistry. The second category includes courses that all students are required to undertake in order to develop certain intended learning outcomes common to all engineering graduates, such as Seminar, Industrial Training, and Graduation Project courses.

The college requirements of the CHS bachelor programs consist of 45 credits (26.5% of total 175 credits), which are satisfied by completing nineteen (19) compulsory courses, as listed in Table 2.

Table 2 Compulsory Courses of College Requirements (44 credits, 26.5% of total 175 credits)

	Code	Course Title	Credits
1	CHEN001	Chemistry	3
2	GENN003	Basic Engineering Design	2
3	MDPN001	Engineering Graphics	3
4	MDPN002	Fundamentals of Manufacturing Engineering	3
5	MECN001	Mechanics-1	2
6	MECN002	Mechanics-2	2
7	MTHN001	Introduction to Linear Algebra and Analytic Geometry	3
8	MTHN002	Calculus I	3
9	MTHN003	Calculus II	3
10	MTHN102	Multivariable Calculus and Linear Algebra	3
11	MTHN203	Probability and Statistics	3
12	PHYN001	Mechanics, Oscillations, Waves and Thermodynamics	3
13	PHYN002	Electricity and Magnetism	3
14	MEPN280	Engineering Seminar	1
15	MEPN281	Industrial Training-1	1
16	MEPN293	Industrial Training-2	2
17	MEPN480	Graduation Project-1	1
18	MEPN481	Graduation Project-2	3

5.4 Discipline Requirements

Graduates of MESE program should acquire the knowledge and skills of the Mechanical Engineering - SUSTAIBALE ENERGY discipline at large. In addition to the typical "Mechanical Power Engineering" courses, the discipline requirements include topics from other inter-related disciplines that are very essential to the formation of a modern Energy-engineering curriculum. The discipline requirements comprise 72 credits (38.84% of total 175 credits), which are satisfied by completing twenty-three (23) courses, as compulsory as listed in Table 3a and 3 courses as elective as listed in Table 3b.

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

	Code	Course Title	Credits
1	EPMN101	Electrical Engineering Fundamentals	3
2	MCNN101	Thermodynamics	3
3	MEPN202	Fundamentals of Fluid Mechanics	2
4	MEPN224	Intermediate Fluid Mechanics	3
5	MEPN103	Engineering Thermodynamics	3
6	MCNN326	Heat Transfer	3
7	MEPN345	Turbo-machinery-I	3
8	MCNN327	Heat and Mass Transfer	3
9	MEPN203	Fundamentals of Combustion Systems	3
10	MEPN310	Mechanics of Machines and Vibration	3
11	MEPN309	Thermal Design of Energy Facilities	3
12	CVEN125	Civil Engineering	3
13	MDPN472	Automatic Control	3
14	MDPN161	Stress Analysis	3
15	MEPN406	Instrumentation and Computer Control (Application and Design)	3
16	MEPN301	Internal Combustion Engines (Theory and Development)	3
17	MDPN132	Material Science	3
18	MTHN103	Differential Equations	3
19	MTHN201	Numerical Analysis	3
20	MEPN331	Laboratory of Mechanical Engineering	3

Table 3b Elective Courses of Discipline Requirements: Energy Engineering (9 credits, 5.14% of total 175 credits)

	Code	Course Title	Credits	Group
1	EPMN202	Electric Drive Systems	3	E-2
2	MDPN431	Sustainability and Design for Environment	3	
3	MDPN424	Project Management	3	
4	MDPN250	Fundamentals of Mechatronics	3	
5	MDPN432	Pressure Vessels and Piping	3	
6	MEPN333	Automotive Systems	3	
7	MDPN321	Machine Design	3	
8	MEPN328	Fine Measurements and Laser Diagnostics in Energy System	3	
9	MEPN408	Mechanical Design of Energy Systems	3	

5.5 Major Requirements

The major requirements include compulsory courses which provide advanced knowledge and skills in areas of Power generation from fossil fuels as well as new and renewable energy sources including solar and wind energy. It also includes subjects related to Energy efficient buildings, refrigeration and air-conditioning. A student who wishes to complete the specialty of Energy Engineering must complete the minimum major requirements of 44 credits 25.41 % of total 175 credits), which are satisfied by completing eighteen (18) courses as follows:

1. Thirteen (13) compulsory courses equivalent to 34 credits (19.42 %), as listed in Table 4.
2. Five (5) elective courses equivalent to 10 credits (5.7%), as listed in Table 5.

Table 4 Compulsory Courses of Major Requirements: Energy Engineering (24 credits, 14% of total 175 credits)

	Code	Course Title	Credits
1	MEPN415	Power Generation	2
2	MEPN303	Heat Exchangers Design	2
3	MEPN416	Air and Water Quality Monitoring	2
4	MEPN430	Wind Energy Systems Design	2
5	MEPN420	Fundamentals of Energy in Buildings	2
6	MEPN404	Nuclear Energy	2
7	MEPN410	Fundamentals and Applications of Solar Energy	2
8	MEPN302	Applied Control Technologies for Energy System	2
9	MEPN425	Renewable Energy	2
10	MEPN402	Sea Water Desalination	2
11	MEPN415	Pollution Control Equipment Design	2
12	MEPN332	Laboratory of Energy Systems.	2

Table 5 Elective Courses of Major Requirements: Energy Engineering (10 credits, 5.7% of total 175 credits)

	Code	Course Title	Credits	Group
1	MEPN444	Energy Efficiency	3	E-3
2	MEPN422	Energy Auditing	2	
3	MEPN407	Fire Extinguishing Systems	2	
4	MEPN411	Concentrated Solar Power (CSP)	2	
5	MEPN412	Energy Storage	2	
6	MEPN413	Industrial Process Heating and Cooling	3	
7	MEPN414	Advanced CFD	2	
8	EPMN444	PV Technology and its applications	2	
9	MEPN432	Design of Renewable Energy Equipment	3	

	Code	Course Title	Credits	Group
10	MEPN475	Hydroelectric Power Plants	2	
11	MEPN417	Pollution control equipment design	2	

Remarks:
(1) Student selects at least Five (5) courses equivalent to 10 credits

5.6 Conformity to SCU Requirements

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

- **Freshman**: a student who completed less than 35 credits
- **Sophomore**: a student who completed more than 35 credits but less than 70 credits
- **Junior**: a student who completed more than 69 credits but less than 105 credits
- **Senior-1**: a student who completed more than 104 credits but less than 136 credits
- **Senior-2**: a student who completed more than 136 credits

Table 6 Conformity to Supreme Council Criterion

Category	Freshman	Sophomore	Junior	Senior-1	Senior-2	Total Credits	%
Humanities and Social Sciences	3	5	10	0	2	20	11.43
Basic Sciences	22	9	4	2	0	37	21.14
Engineering Sciences	5	15	13	10	0	43	24.57
Computer Application	3	2	4	5	3	17	9.71
Applied Engineering Sciences	0	0	0	16	25	41	23.43
Project and Practice	0	4	3	3	7	17	9.71
Total	33	35	34	36	37	175	100
University Requirements	5	4	6	2	0	17	9.71
College Requirements	28	9	6	0	4	47	26.85
Discipline Requirements	0	19	19	22	0	60	34.29
Major Requirements	0	3	3	12	33	51	29.14
Total	33	35	34	36	37	175	100

The MESE program consists of 69 courses: 58 compulsory courses (150 credits) and 11 elective courses (25 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 300 hrs.

6. SAMPLE STUDY PLAN and COURSE SEQUENCE

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

The SEE 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 ENERGY ENGINEERING projects during their practical training and graduation projects.

Freshman Year Course Schedule & Study Plan

	Semester-1: Fall		Semester-2: Spring	
	Course Code	CR	Course Code	CR
1.	MECN001	2	MECN002	2(1)
2.	MTHN001	3	CHEN001	3
3.	MTHN002	3	MTHN003	3(2)
4.	PHYN001	3	PHYN002	3
5.	MDPN001 OR MDPN002	3 OR 3	MDPN002 OR MDPN001	3 OR 3
6.	GENN005	2	GENN001	1
7.	GENN004	2	GENN003	2
Semester Credit Hrs		18		17

Remarks:

(1) Course MECN002 has a prerequisite course MECN001

(2) Course MTHN003 has a prerequisite course MTHN002

SEE Study Plan

	Sophomore				*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	MEPN103	3	MEPN203	3	MEPN309	3
3.	MDPN132	3	CVEN125	3	GENN224	2	MEPN310	3
4.	MEPN202	2	MEPN224	3	MEPN301	3	MEPN406	3
5.	MDPN161	3	EPMN101	3	MEPN405	3	MEPN331	3
6.	GENN102	2	GENN210	2	MEPN281	1	MEPN293	2
7.	GENN201	2	MEPN280	1	MCNN326	3		
Semester Credit Hrs		18		18		18		17

	Senior-1				*Senior-2*			
	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.	MEPN404	3	MEPN345	3	MEPN480	1	MEPN481	3
2.	MCNN327	3	GENNXXX	2	MEPN445	3	MEPN402	2
3.	MEPN433	2	MEPN420	2	MDPN472	3	GENNXXX	2
4.	MEPN416	3	MEPN410	3	MEPN415	3	MEPN425	3
5.	Discipline	3	Discipline	3	MEPNXXX	2	MEPNXXX	2
6.	GENNXXX	2	Discipline	3	MEPNXXX	2	MEPNXXX	2
7.	MEPN403	2	MEPN430	2	MEPN421	3	MEPNXXX	2
Semester Credit Hrs		18		18		17		16

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): Passing required exam held in the University** 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 statements. 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): GENN005** 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	**Fundamentals 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.
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 thought are 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): GENN005 + 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+2+1)** **Prerequisite(s): none** Gases; Applications to gaseous law; Mass balance and heat balance in combustion processes of fuels; Solutions & separation techniques; Applications to electrochemistry; Corrosion; Water treatment; Building materials; Environmental Engineering; Selected chemical industries: fertilizers, dyes, polymers, sugar, petro-chemicals, semi-conductors, oil and fats, industrial systems; Chemical Vapor deposition.
GENN003	**Basic Engineering Design** **Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s): none** Introduction to Design: Problem description and Introduction to Internet communication - Project Management: Project Management Application, Problem Solving Techniques: Problem Definition, Design Constraints - Creative Thinking and Problem Solving: Introduction to critical and creative thinking, nature of design problems - Brainstorming seminar, list

	of possible and impossible solutions and generating Ideas - Creative Thinking and Decision making: Product life cycles , Selection of idea (s), Final decision matrix, Justify decision - The Design Matrix: Context, purpose and requirements of engineering design - Analyze selected solution/preliminary design - Automated Design & the Positive Attitudes for Creativity - Systematic generation and evaluation of ideas.
MDPN001	**Engineering Graphics** **Compulsory, Credits: 3 (1+0+4)** **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+1+2)** **Prerequisite(s): none** Engineering Materials - Elements of Manufacturing Processes, material flow, energy flow and information flow - Forming in the liquid state, Casting and molding processes - Forming in the solid state, metal forming, forming of plastics and powder metallurgy - Material Joining processes, welding, soldering and brazing, riveting, joining by mechanical elements, assembly processes - Material removal processes, metal cutting and finishing processes - Computer applications in manufacturing - Term mini-project.
MECN001	**Mechanics-1 (Statics)** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): none** Statics of particles, forces in three-dimensions, vector algebra; equivalent systems of forces, resultant of a group of forces, moments of forces, moment of a couple, reduction of a system of forces, wrench; equilibrium of rigid bodies in two dimensions, reactions at supports and connections for a 2D structure, 2D trusses, equilibrium of rigid bodies in three dimensions, reactions at supports and connections for a three dimensional structure; centroids and centers of gravity, center of gravity of 2D bodies, centroids of areas and lines, first moments of areas and lines, composite plates and wires; moments of inertia, moments of inertia of areas, second moment, or moment of inertia of an area, polar moment of inertia, radius of gyration of an area, parallel-axis theorem, moments of inertia of composite areas, product of inertia, principal axes and principal moments of inertia, moments of inertia of masses, moment of inertia of a mass, parallel axis theorem, moments of inertia of thin plates, moments of inertia of composite bodies, mass product of inertia, principal axes and principal moments of inertia.

MECN002	**Mechanics-2 (Dynamics)** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): MECN001** Kinematics of particles: rectilinear motion of particles, position, velocity and acceleration, uniform rectilinear motion, uniformly accelerated rectilinear motion, curvilinear motion, derivatives of vector functions, rectangular components of velocity and acceleration, relative motion, tangential and normal components of acceleration, motion of a particle in a circular path, velocity and acceleration of a particle in polar coordinates. Kinetics of particles: Newton's second law, linear momentum of a particle, equations of motion with applications in Cartesian coordinates, tangential and normal directions, polar coordinates, free vibrations of particles, simple harmonic motion; energy & momentum methods, work of a force, kinetic energy of a particle, principle of work and energy, applications, power and efficiency, potential energy, conservation of energy, principle of impulse and momentum, impulsive motion, impact, direct central impact and coefficient of restitution, oblique central impact.
MTHN001	**Introduction to Linear Algebra and Analytic Geometry** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): none** Matrix algebra, determinants, inverse of a matrix, row equivalence, elementary matrices, solutions of linear systems of equations; parabola, ellipse and hyperbola, eccentricity and conic sections; quadratic equations; solid geometry, line, plane, quadratic surfaces.
MTHN002	**Calculus I** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): none** Functions, graphing of functions, combining functions, trigonometric functions; limits and continuity; differentiation; inverse functions; exponential and logarithmic functions; inverse trigonometric functions; hyperbolic and inverse hyperbolic functions; indeterminate forms and L'Hopital's rule; Taylor and Maclaurin expansions.
MTHN003	**Calculus II** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN002** Anti-derivatives; indefinite integrals; techniques of integration; definite integrals, applications of definite integrals; functions of several variables; partial derivatives, applications for partial derivatives.
MTHN102	**Multivariable Calculus and Linear Algebra** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN001 + MTHN003** Double integrals, double integrals in polar coordinates; triple integrals, triple integrals in spherical and cylindrical coordinates; applications of double and triple integrals; line and surface integrals; vector analysis, gradient of a scalar function, divergence of a vector, curl of a vector, divergence and Stokes' theorems, vector identities; LU-factorization;

	vector spaces; inner product spaces; eigenvalues and eigenvectors; diagonalization of matrices; functions of matrices.
MTHN203	**Probability and Statistics** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN102** Probability axioms; probability laws; conditional probability; random variables; discrete and continuous distributions; joint distribution; computer simulation; sampling; measures of location and variability; parameter estimation, testing of hypothesis.
PHYN001	**Mechanics, Oscillations, Waves and Thermodynamics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Physics and measurements; elastic properties of solids; universal gravitation and motion of planets; fluid mechanics (statics and dynamics); oscillatory motion; wave motion, sound waves; thermo-dynamics, temperature, heat and the first law of thermodynamics, the kinetic theory of gases, heat engines, entropy and the second law of thermodynamics. Laboratory experiments on course topics.
PHYN002	**Electricity and Magnetism** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Electric field; Gauss' law; electrostatic potential; capacitance and dielectrics; current and resistance; direct current circuits; magnetic fields, sources of magnetic field; Faraday's law; Maxwell's equations; inductances; magnetic properties of matter. Laboratory experiments on the course topics.
MEPN280	**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.*
MEPN281	**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.*

MEPN293	**Industrial Training-2** **Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s): MEPN281 + + 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.
MEPN480	**Graduation Project (I)** **Compulsory, Credits: 1(0+0+2)** **Prerequisites: Completion of 150 credit hours.** The Department announces, at the beginning of the First Term, a list containing the Titles of Projects available in different areas of Mechanical Power Engineering. That list also includes an abstract, an objective a work-plane and the optimum number of students suggested for Each Project. The students (in small groups) select and register in one of the projects. The projects allow the students to apply the engineering concepts, skills, and techniques acquired during their study. After the end of the second term exams, four weeks are given for the students to finish their projects. The students must then submit a project report and present an oral presentation after which an oral exam is performed.
MEPN481	**Graduation Project (II)** **Compulsory, Credits: 3(1+2+3)** **Prerequisites: MEPN480** The Department announces, at the beginning of the First Term, a list containing the Titles of Projects available in different areas of Mechanical Power Engineering. That list also includes an abstract, an objective a work-plane and the optimum number of students suggested for Each Project. The students (in small groups) select and register in one of the projects. The projects allow the students to apply the engineering concepts, skills, and techniques acquired during their study. After the end of the second term exams, four weeks are given for the students to finish their projects. The students must then submit a project report and present an oral presentation after which an oral exam is performed.

7.3 Discipline Courses

EPMN101	**Electrical Engineering Fundamentals** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PHYN002** Analysis of DC and AC circuits, branch currents and node voltages. Transient analysis. Single-phase transformers and circuits thereof. Basic DC motors: series shunt and compound. Induction motors. Predicting motor performance. Logic gates, circuit design with logic gates.
MEPN333	**Automotive Systems** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MEPN301** ICE Driven systems, Electrical driven systems – Automatic control – Autonomous Automotives – Emissions and environmental impact – Automotive Economics – Advances in Automotive systems.
MCNN101	**Thermodynamics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisites: PHY N001** 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.
MEPN202	**Fundamentals of Fluid Mechanics** **Compulsory, Credits: 2 (2+1+0)** **Prerequisites: PHYN001 and MTHN003** Fundamentals - statics of fluids- characterization of fluid flows- conservation equations of mass, momentum and energy – Bernoulli's equation and its applications – flow in pipes and ducts – dynamic similarity in fluid flow.
MEPN224	**Intermediate Fluid Mechanics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MEPN202** Introduction to the Navier-Stokes equations; Incompressible viscous and inviscid potential flows; Laminar and turbulent boundary layers: Growth, shear relations and total drag; Flow around a body: Lift, drag, and separation; 1-D compressible flow and shock waves; Water Hammer; Open-channel flow: Specific energy critical depth, gradually-varying flow and hydraulic jump
MEPN103	**ENGINEERING THERMODYNAMICS** **Compulsory, Credits: 3 (2+1+1)** **Prerequisite(s): MCNN101** Vapor Power Cycles – Gas Power Cycles – Refrigeration Cycles – Exergy – Non- reacting Gas Mixtures – Psychometry – Combustion chemical reactions – First Law Analysis of Combustion Processes

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.
MEPN345	**Turbo-machinary-I** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MEPN202** Basic concepts and laws of fluid mechanics – Similarity of fluid machines – One-dimensional flow in turbomachines: Euler equation, The Degree of reaction & Stage and components efficiency – Two-dimensional flow through cascade of blades: Blade cascade terminology, Energy transfer in terms of lift and drag & Analytical methods for solution of two-dimensional cascade flow – Three-dimensional flow in axial turbomachines: Radial equilibrium theory, Compressor and pump design & Turbine design including free vortex design, forced vortex design and general vortex design.
MCNN327	**Heat and Mass Transfer** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCNN326** Mass Transfer – Diffusion – Mass Transfer in Cooling, Heating and Power Systems – Heat transfer in solar energy systems – Waste Heat Harvesting -
MEPN203	**Fundamentals of Combustion Systems** **Compulsory, Credits: 3 (2+2+1)** **Prerequisites: MEP N101, MEP N103** Fuel types and properties; chemically reacting systems; mass conservation; chemical kinetics; chemical equilibrium and dissociation; introduction to flame types and theory; burner types and design; combustion system efficiency and tune-up; stability and elements of combustion control, Premixed and Non-Premixed Combustion, Laminar and Turbulent Combustion.
MEPN310	**Mechanics of Machines and Vibration** **Compulsory, Credits: 3 (3+2+0)** **Prerequisite(s): MCNN101, MEPN224, MCNN326.** Kinematic fundamentals: geometry of motion, machine components; Dynamics basic concepts: work and energy, balancing of Machines; Introduction and basic concepts of mechanical vibrations: sources and causes of vibration, basic theoretical concepts of acoustical vibrating systems in thermo-fluid systems; plane linear wave propagation and transmission, fluid-structure interaction.

MEPN309	**Thermal Design of Energy Facilities** **Compulsory, Credits: 2 (2+1+2)** **Prerequisite(s): MEPN202, MCNN326** - Introduction and overview - Energy system components and configuration - Thermal performance evaluation - Physical modeling of transport qualities and governing equations - Modeling methods and algorithms - Thermal design of: • Heat exchangers • Compressors • Turbines • Pumps • Facilities phase change • Computer-aided design software with application of energy facilities
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.
MDPN472	**Automatic Control** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MEPN224** Introduction, definitions and classification of control systems, Mathematical modeling of control system components, Application to mechanical and electrical systems, Fluid power systems, and thermal systems – Signal flow graph – Stability of linear systems – Analysis of systems in state space – controllability – observability – pole placement – Feedback control system – Control system characteristics – Error analysis – Steady state error for the test input signal using static error coefficients – Dynamic error coefficient and error series – Transient response characteristics – Approximation of higher order systems to second order systems. MATLAB computer simulation and case studies. Course project.

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.
MDPN321	**Machine Design** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): MDPN161** Design of Power Transmission Elements: Shafts, Couplings, Clutches, Brakes, Belts, Ropes, Chains, and Gears - Design and Selection of Rolling element Bearing - Hydrodynamic and Hydrostatic Bearings - Gear Boxes - Flywheels - Machine Structure - Computer Applications.
MEPN406	**Instrumentation & Computer Control (Applicatons & Design)** **Compulsory, Credits: 3(2+2+1)** - Types of applications of measurement instrumentation - Generalized configuration of measuring and control systems - Generalized performance characteristics - Measuring devices for engineering quantities and parameters - Manipulation transmission and recording of data - Data acquisition and processing systems - Computer-aided experimentations - Practicing and laboratory sessions
MEPN328	**Fine Measurements and Laser Diagnostics in Energy System** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCNN101, MEPN202** Transducers - Pressure measurements instruments – Velocity and flow measurements techniques – Introduction to laser – Types of lasers – LDV and PIV technique for flow field – Rayleigh – Raman – LIF for radicals – Imaging techniques for 2-D and 3-D measurements – Test cases.
MEPN408	**Mechanical Design of Energy Systems** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): MDPN321** Principles of machine design – Design basis for Material Handling and Transport Facilities – Reverse Engineering Concepts and Application in Facility Design – Smart Fluids and Materials – Case Study: Mechanical Design of Heat Exchanger and energy system components.
MEPN301	**Internal Combustion Engines (Theory and Development)** **Compulsory, Credits: 3(2+1+2)** **Prerequisites: MEPN103** Gases Flow and Exchange in Internal Combustion Engines - Flow Inside Combustion Chamber - Charge Movement Inside the Cylinder - Modeling

	of Combustion and Flow inside Combustion Chamber - Adjusting and Controlling Engine Performance -Increasing Engine Power (Supercharging, Fuel Injection, Fuel/Air Mixture Control, etc..) - Examples for Advanced Technologies in Internal Combustion Engines (Gas Engine, Fuel Cells, Electric Cells, etc.).
MDPN132	**Material Science** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MDPN002 + PHYN001** Nature and properties of materials : Crystal structures and lattices, crystal imperfections, slip and dislocations, plastic deformation, phase diagrams, binary phase equilibrium characteristics of alloy solidification and structure of metals and alloys, Iron carbon diagram, various types of bonds, Hot and cold working of metals, recovery, re-crystalization and grain growth. Metallography: Study of microstructure
MTHN103	**Differential Equations** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN003** First-order differential equations, separable, exact, linear, homogeneous and Bernoulli equations; modeling with first order differential equations; higher-order differential equations; method of undetermined coefficients; variation of parameters; modeling with higher order differential equations; series solutions; Laplace transform; properties and applications, shifting theorems, convolution theorem; solutions of differential equations using Laplace transform; Fourier series; Fourier transform.
MTHN201	**Numerical Analysis** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MTHN102 + MTHN103** Basic concepts of floating- point arithmetic- Conditioning of a problem- Numerical stability of an algorithm – Linear systems: direct methods (Gauss elimination , LU factorization, Choleski) – Iterative methods (Jacobi –Gauss-Seidle – SOR). Approximation of Functions: polynomials and piecewise polynomial interpolation, splines, discrete least squares. Nonlinear equations: Newton's method and its discrete variants, fixed point iteration. Numerical integration: Newton- Cotes formulas, Gaussian quadrature rules, composite rules. Initial value problems for ordinary differential equation: one-step methods (Runge-Kutta methods) and multistep (Adams) methods. Stiff problems
MEPN331	**Laboratory of Mechanical Engineering** **Compulsory, Credits: 3(2+0+2)** **Prerequisite(s): MEPN202** Pressure measurements – manometers – Pitot tube – pressure gauges – flow meters – Venturimeter – Temperature measurements – Thermometers – Thermocouples – Flux-meters – Viscometers – Heat release rate measurements – conductivity measurements – forced convection measurements – radiation measurements – Measurements of flow around immersed bodies

EPMN202	**Electric Drive System** **Elective, 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.
MDPN431	**Sustainability and Design for Environment** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): 108 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
MDPN424	**Project Management** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): GENN102 + 102 credits** Phases of project planning and monitoring, Work breakdown and coding, Time and resource estimation, project planning and network representation, project scheduling, budgeting and cash flow, project control and reporting, Industrial case studies and use of computer S/W packages Project team management, Project bidding, contracting, and commissioning cycles. Course project.
MDPN250	**Fundamentals of Mechatronics** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Mechatronics fundamentals, linear components, semi-conductors, IC's , Circuits, Sequential control, Logic gates and Boolean algebra, Electric and electronic power components, actuators, sensors and interfacing, design of Mechatronics systems, system performance, computer simulation and practical training, case studies and applications, Course project.
MDPN432	**Pressure Vessels and Piping** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): 102 credits + AA Approval** Introduction to ASME Boiler, Pressure Vessels, and Piping Codes. Section VIII Divs. 1 and 2. B31 code series. Material selection. Basic principles in design. Types of loads. Failure theories. Design for internal

	and external pressure. Design of end closures with various geometries. Design of openings and nozzles. Fabrication requirements. Non-destructive examination and testing. Piping stress and flexibility analyses, design and selection of piping supports. Computer implementation of general-purpose software packages. course project

7.4 Major Courses:

MEPN415	**Power Generation** **Compulsory, Credits: 3 (2+1+1)** **Prerequisites: MEPN203, MEPN103** Review Of Thermodynamics Principles of Power Cycles, Steam Power Plants, Steam Turbine Components, Steam Turbine Maintenance, Power Station Performance, The Turbine Governing Systems, Steam Chests and Valves, Turbine Protective Devices, Turbine Instrumentation, Turbine Governing System, Gas Turbine Fundamentals, Design & Calculations, Gas Turbine Compressors, Combustors, Axial-Flow Turbines, Gas Turbine Materials, Lubrication and Fuel Systems, Gas Turbine Combustion Chamber Design, Gas Turbine Instrumentation and Control Systems, Gas Turbine Performance Characteristics, Gas Turbine Operating and Maintenance Considerations, Gas Turbine Emission Guidelines and Control Methods, Single-Shaft Combined-Cycle Power generation Plants, Selection Considerations of Combined Cycles and Co-Generation Plants, Applications of Co-Generation and Combined Cycle Plants, Cogeneration Application Considerations, Economic and Technical Considerations for Combined Cycle Performance – Enhancement Options, Economics of Combined Cycles Co- Generation Plants, Power Plant Accessories, Draft system , etc..
MEPN403	**Heat Exchangers Design** **Compulsory, Credits: 2 (2+0+1)** **Prerequisite(s): MCNN326** Computer aided engineering; design optimization; Matlab programming; optimization module; one dimensional system flow analysis; general applications; fluid mechanics review; pipe and tubing standards; hydraulic resistance – wall friction and minor losses; system behavior & flow networks; pump types & applications; heat transfer review; extended surface heat transfer; longitudinal fins; spines; fin performance; heat exchanger types; basic design method of heat exchangers : effectiveness – NTU analysis, log mean temperature method; forced convection correlations for heat exchangers; heat exchanger pressure drop and pumping power; fouling of heat exchangers; double pipe heat exchangers; shell & tube heat exchangers; compact heat exchangers; plate & shell heat exchangers; applications of heat exchanger design to boilers and evaporators; air cooled radiators, air cooled or water cooled condensers, and wet cooling towers; compact heat exchangers; examples of waste heat recovery

MEPN416	**Air and Water Pollution and Quality Monitoring** **Compulsory, Credits: 3(2+2+1)** **Prerequisites: MEPN202, MEPN203, MEPN406** Fundamentals of gas and aerosol measurements with emphasis on major pollutants in the country; theory of operation of measuring instruments; detection and sampling techniques; and calibration techniques; air and water quality pollution control. Air and water quality monitoring. Monitoring stations and Facilities in Egypt and worldwide. Environmental impact assessment.
MEPN430	**Wind Energy System Design** **Compulsory, Credits: 2(2+0+1)** **Prerequisite (s): MEPN224** Geophysics of wind resources; aerodynamics of horizontal-axis wind turbines; wind turbine performance; design loads; conceptual design of horizontal-axis wind turbines; blade design and its optimization; materials properties and materials selection; mechanical design and safety factors; wind turbine control; installation; wind farms; electrical systems for wind turbines.
MEPN420	**Fundamentals of Energy in Buildings** **Compulsory, Credits: 2(2+0+1)** **Prerequisites: MCNN326, MEPN103, MEPN224** Energy, ventilation, air conditioning and comfort in buildings. Energy consumption in buildings. One design project is required. Students will use the principles and information given in the course to solve a particular problem. The students will be asked to propose and assess innovative building designs, technologies and operating schemes that will yield an outstanding sustainable building.
MEPN404	**Nuclear Energy** **Compulsory, Credits: 3(2+1+0)** **Prerequisites: MEPN103** Introduction and principles of nuclear engineering; generation, transport and transfer of energy in nuclear reactor core; nuclear power plants; pressurized water reactors (PWR), boiling water reactors (BWR); gas-cooled reactors (GCR); fast breeder reactors (FBR); the future of nuclear fusion; reactor safety; power plant site selection; fundamentals of risk assessment and risk mitigation in nuclear engineering
MEPN410	**Fundamentals and Applications of Solar Energy** **Compulsory, Credits: 3(2+1+2)** **Prerequisites: MCNN326** Solar energy potential in Egypt- resource assessment measurements - solar geometry-solar thermal applications- flat plate collectors(water-air)- efficiency and Sankey diagram-assessment of yield and solar fraction- evacuated tube collectors- medium temperature concentration of solar energy- high temperature concentration application-solar cooling- solar desalination- poly-generation applications-certification.

MEPN405	**Applied Control Technologies for Energy Systems** **Compulsory, Credits: 3 (2+1+1)** **Prerequisites: MTHN003 , MEPN224** Power systems: Basic principles, system, modeling, design, simulation, analysis. Control systems – transfer functions – closed loop – reduction, response, classical methods – transitional and steady state – stability – Bode diagram – frequency response. Automatic control: Hydraulic control, Hydraulic pumps and motors – Control valves – Transmission components of power control – pressure and flow valves – Applications.
MEPN425	**Renewable Energy** **Compulsory, Credits: 3(2+1+2)** **Prerequisite(s): MEPN103, MCNN326** Introduction. Different Sources of Energy - Solar Energy. Availability of Solar Energy Collection of Solar Energy. Solar Energy Systems. Wind Energy. Characteristics of Wind. Wind Turbine Theory. Wind Energy Conversion Systems. Biomass Energy. Production of Biomass Gases. Systems and Tools for Energy Production from Biomass - Small Hydraulic Turbines and Hydraulic Power - Systems Design of Energy Saving systems.
MEPN402	**Sea Water Desalination** **Compulsory, Credits: 2 (2+0+1)** **Prerequisite(s): MCNN326** Introduction - Basics of Desalination Technologies: Thermal. Membrane, Electrical, and Chemical - Co-Generation Systems - Desalination Using New and Renewable Energy Sources - Economics of Desalination.
MEPN417	**Pollution Control Equipment Design** **Elective, Credits: 2(2+0+1)** **Prerequisites: MEPN202, MEPN203** Review of fluid mechanics; particle dynamics; design of dust removal equipment: settling chambers, cyclones, baghouse filters, electrostatic precipitators; treatment of sulfur oxides; treatment of nitrogen oxides; pollution control cost estimation.
MEPN433	**Laboratory of Energy Systems** **Compulsory, Credits: 2 (2+0+2)** **Prerequisite(s): MEPN202, MCNN326, MEPN301** Engines Performance testing – Spark Ignition Engine -Pressure Ignition Engine – Reciprocating Compressor – Flame Tube Boiler – Centrifugal Pumps – Axial Pumps – Positive displacement pump – Pelton turbine – Kaplan turbine – steam turbine – gas turbine – testing of industrial cooling unit – testing of central air conditioning unit – testing of heat pump

MEPN421	**Air Conditioning Design, Selection, Operation and Troubleshooting** **Compulsory, Credits: 3(2+1+1)** **Prerequisites: MEPN420** Introduction to air conditioning and ventilation systems. Fundamentals of HVAC design calculations. Detailed HVAC computer load estimation tips Factor governing commercial air conditioning applications designs Airflow pattern in different applications. Detailed review of ventilation system selection. Worked examples and discussions. Special HVAC design applications to hospitals. Indoor Air Quality (IAQ) at workplace. HVAC plant selection and chilled water piping calculations. Electrical power requirements in HVAC systems. Refrigerants environmental regulations, compliance, and methods and equipment used for pollution control. Overview of HVAC system controls and selection. Worked examples and discussions II Instruments used for flow and temperature measurements. Chillers selection, operation and Trouble shooting Air Handling units selection, operation and trouble Shooting Remedial procedures checklist for operational emergencies air conditioning plant components inspection details for air and water cooled chillers Air conditioning plant operation – start up, normal operation, coming off line, provisions for short shutdown, provision for long shutdown. HVAC maintenance checklist and particularly for products used in Arab world HVAC life cycle cost analyses Codes and standards Introduction and overview of ASHRAE Energy Code 90.1 and DOE Teaching materials include power point lectures, solved examples, design of projects, movies and hands on exercises
MEPN445	**Turbo-machinery-II** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MEPN345 + 102 credits** Fans, Compressors, Pumps and Turbines: General selection criteria and charts - Machines in series, Machines in parallel – Selection & Installation requirements as per Manufacturer's Catalogues (air compressors, domestic water pumps, chilled water pumps, centrifugal fans, axial fans, etc.) - Vibration and Noise problems and solutions – control of turbomachinery in various application - Best practices in operation - Maintenance – Troubleshooting., Course project
MEPN444	**Energy Efficiency** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): MEPN103, MCNN327** Energy Resources, energy efficiency technologies, integration of renewable Energy with energy efficiency measures. Supply and demand side management. Industrial energy efficiency. Energy efficiency in residential, commercial, tourist and transport sectors.

	Energy efficiency policies, standards, codes and benchmarking. Energy auditing and accounting, life cycle Assessment, Economics and financing of Energy Efficiency options. Environmental impact of energy efficiency.
MEPN422	**Energy Auditing** **Elective, Credits: 2(2+0+1)** **Prerequisites: MEPN420** Introduction; quick review of energy-related measurements; the energy audit process; energy bills; financial analysis of energy conservation/energy efficiency opportunities;; improving energy efficiency through: high-efficiency lighting, improvement and tune-up of combustion systems (boilers and furnaces), HVAC, combined heat and power generation, energy management systems, controls, efficient insulation and refractories, switching to other fuel types; the audit report. The course contains at least one site visit for practice on energy auditing. Group reports will be presented
MEPN407	**Fire Extinguishing Systems** **Elective, Credits: 2 (2+0+1)** **Prerequisite(s): MEPN224, MEPN203** Fundamental of Fire Science - Explosions - Fire Models - Fire and Smoke Spread - Fire Safety Equipment-Design of hydrants – Fire Pumps – Sprinkler Systems Design – Inert Gas Systems – Foam Systems – Fire Codes
MEPN411	**Concentrated Solar Power (CSP)** **Elective, Credits: 2(2+0+1)** **Prerequisites: MEPN410** Low, medium and high temperature applications- parabolic trough concentrator-linear Fresnel concentrator- Sterling Dish concentrator-heliostats/Solar tower-heat transfer fluid-use of CSP with Rankine, combined, Gas Turbine and Sterling cycles- thermal storage strategies-Operation and Maintenance practices-project planning-Economics.
MEPN412	**Energy Storage** **Elective, Credits: 2(2+0+1)** **Prerequisites: MEPN410** Introduction to the need for storage- storage efficiency- storage density-thermal energy storage technology- sensible heat storage- latent heat storage- phase change materials-thermal mass storage-chilled water/ice storage-thermochemical storage- compressed air storage-hydroelectric storage-batteries- super conducting magnetic storage- super capacitors-hydrogen as a storage medium-comparison of storage technologies.
MEPN413	**Industrial Process Heating and Cooling** **Elective, Credits: 3(2+1+2)** **Prerequisites: MEPN410** Assessment of process heat temperature and demand- technology selection- estimation of area requirements-hybridization with conventional steam generators and systems- thermal storage-

	economics of industrial process heat- component testing and certification-absorption cooling driven by solar energy-economics of Solar process heating and cooling.
MEPN414	**ADVANCED CFD** **Elective, Credits: 2 (2+1+1)** **Prerequisite(s): MEPN202, MEPN310** Turbulence models – Combustion models – Buoyant flows and flows inside buildings – body fitted coordinate system in CFD – Flow in sudden pipe contraction – modeling of a fire in a test room – prediction of flow and heat transfer in a complex flow tube – Laminar flow in a circular pipe driven by periodic pressure variations
EPMN444	**PV Technology and its applications** **Elective, Credits: 2 (2+1+1)** **Prerequisites: MEPN410, EPMN202** Introduction to power generation from solar energy - Fundamentals of solar cell operation – electrical and optical properties of solar cells – Installation and operation of solar cells – Equivalent electrical circuits – crystal cells – Fine membrane cells – Cells matrices formation – Calibration and testing of solar cells – connection to the grid and operation without grid.
MEPN432	**Design of Renewable Energy Equipment** **Elective, Credits: 3 (2+1+2)** **Prerequisites: MEPN425** General overview of electricity demand, supply, industry structure, interconnected system operations and state of technology; hydro, geothermal, closed system fuel cells; role of power electronic circuits in renewable technologies; economics of various technologies; environmental attributes; engineering principles of electrical storage technologies: electrical vs. chemical energy storage; batteries; double-layer capacitors; superconducting magnetic energy storage; flywheels; demand-side issues: electrical load curve; periodicity; electricity tariff structure and time-of-use tariff; fundamentals of demand-side management; efficiency improvements; load management; electricity market basics; integration of renewable generation into the grid; regulatory policy aspects.
MEPN475	**Hydroelectric Power Plants** **Elective, Credits: 2(2+1+1)** **Prerequisites: MEPN345, MEPN224** Fundamentals of Hydraulic Power Stations Engineering- Evaluation of Hydraulic Power Resources - Generation Equipment - Structures of Hydraulic Power Stations -Saving of Hydraulic Power - Water Hammer - Spreading and Operation of Hydraulic Power Stations.

List of Non-Engineering Electives (Reading Courses)	
GENN141	**Basic French** **Elective, Credits: 1 (2 +1+0)** Study of the basic sounds and structures of the French language; formulation of complex sentences; improving composition and conversational skills; enhancing vocabulary with emphasis on scientific and technical terminology.
GENN142	**Basic German** **Elective, Credits: 1(2 +1+0)** Study of the basic sounds and structures of the German language; formulation of complex sentences; improving composition and conversational skills; enhancing vocabulary with emphasis on scientific and technical terminology.
GENN143	**Advanced English** **Elective, Credits: 1 (2 +1+0)** **Pre-requisites: College English** Practice in writing moderately complex texts and essays in English language based in literary readings.
MEPN251	**Environmental Laws and Regulations** **Elective, Credits: 1(1+1+0)** An overview of Egyptian environmental statutes and regulations. Statutory/regulatory scheme and its application to current environmental problems. Specific regulations pertaining to air, water, toxic substances and pesticides, and solid and hazardous wastes, as well as related regulatory programs. Historical and philosophical basis of environmental regulation.
GENN252	**Environmental Sociology** **Elective, Credits: 1(2+1+0)** Social processes by which environmental conditions are transformed into environmental problems; scientific claims, popularization of science, issue framing, problem-amplification, economic opportunism, and institutional sponsorship. Examination of social constructs such as ecosystem, community, and free-market economy. Use of human ecology to assess whether the current framing of environmental problems promotes ecological adaptability.
MEPN253	**Evolution of Energy and Environment Engineering** **Elective, Credits: 1 (1+1+0)** Historical Development – Areas of energy and environmental Engineering – Examples of the evolution (especially the effects of computers and information technology – Relationship between advances in Energy and environmental engineering and social and economic advances of society.

GENN254	**Environmental Policy Analysis** **Elective, Credits: 1(1+1+0)** Approaching environmental policy as argument, we will analyze its fundamental assumptions, principles, and methodology, and synthesize alternatives, using three paradigms: efficiency, utility, and autonomy.
GENN256	**Organizational Behavior for the Engineering Manager** **Elective, Credits: 1(1+1+0)** Behavior at the engineering organization level. Emphasis on changing engineering organizations and their cultures and on increasing their effectiveness. Includes evaluating and selecting engineering organization structures, considering influences on their design, and reviewing work design and encouraging innovation
GENN257	**Program and Project Management** **Elective, Credits: 1(2+1+0)** Problems in managing projects; project management as planning, organizing, directing, and monitoring; project and corporate organizations; duties and responsibilities; the project plan; schedule, cost, earned-value and situation analysis; leadership; team building; conflict management; meetings, presentations, and proposals.
GENN258	**Crisis and Emergency Management** **Elective, Credits: 1 (1+1+0)** Concepts and problems of crisis and emergency management. Defining crises, emergencies, and disasters. Developing crisis and contingency plans. The Federal Response Plan and National Contingency Plan, organizing for response, managing the response organization, managing in a turbulent environment, crisis decision making and communication.
GENN259	**Business Management** **Elective, Credits: 1(2+1+0)** Introduction to Execution and Management of Engineering Projects - Management Schools - Quality and Quantity Management - Characteristics of a Successful Manager - Decision Making and Organization Process - Types of Task Distribution Conceptions and Criteria of Evaluation - Relative Weighting - Evaluation Nets Utilization - Management of Human Resources - Direct and Indirect Supervision Methods - Development of Work Relations and Resources - Principles and Applications of Operation Research and Other Techniques -Case Studies for Mechanical Power Engineering.
GENN333	**Statistics and Marketing** **Elective, Credits: 1(1+1+0)** Introduction to Applied Statistics– Reviewing of Methods of Data Presentation and Analysis and the Important Statistical Measures – Probability Distributions and Their Applications (especially in Mechanical Power Engineering) – Sampling Methods – Sample and Population Measures (point estimate) – Tests of Hypothesis and Confidence Limits – Correlation and Regression Analysis – Fundamentals of Marketing –

	Market Surveying Studies –Economic and Visibility Studies of Projects – Applications and Case Studies in Mechanical Power Engineering.
GENN334	**Applied Psychology** **Elective, Credits: 1(1+1+0)** Definition of Psychology - Introduction to Applied Psychology - Physiological Bases of Human Behavior - Attention and Perception - Learning Processes - Application of Psychology in Management of Industrial and Engineering Projects (Importance of Management for Engineers, Characteristics of a Successful Manager - Decision Making and Organization - Task Distribution - Conceptions and Criteria of Evaluation - Management of Human Resources - Direct and Indirect Supervision Methods -Development of Work Relations and Resources) - Case Studies for Mechanical Power Engineering.
MEPN335	**Energy Service Companies** **Elective, Credits: 1(2+1+0)** Basic concepts and definitions; identifying and evaluating energy-saving opportunities; designing energy efficiency programs to meet customer needs; energy efficiency project management; financing arrangements for energy efficiency projects; training aspects; performance contracting; energy savings guarantees; financial analysis; case studies for energy service company activities. This course includes visits and discussions with energy service company owners and personnel. It also includes reports from individual students and/or groups of students.