ملحق (2)

اللائحة الدراسية لبرنامج هندسة الميكاترونيات بنظام الساعات المعتمدة

B.Sc.inMechatronicsEngineering(MCE-C)

BasedonCreditHours System

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1. INTRODUCTION

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

Mechatronics is an interdisciplinary field aims at the synergistic integration of mechanics, electronics, control theory, and computer science within product design and manufacturing, in order to improve and/or optimize its functionality.

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

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

expert opinion before acquiring such equipment.
A mechatronics engineer unites the principles of mechanics, electronics, and computing to generate a simpler, more economical and reliable system. Mechatronics 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. "Mechatronics Engineers" are expected to be at the forefront of the national Egyptian effort to localize technology development and hence increase the national share in production of global industrial knowledge.

As the country is embarking on ambitious plans of industrial development, it is natural that, a common effort is initiated by universities and government authoritiesto develop human resources in the field of engineering design. Incentives should be devised to attract students of high caliber, who could be promising in acquiring innovative and creative capabilities in such difficult engineering studies. This can be achieved by providing study grants that are linked to student performance during the course of his/her study.

The foregoing brief should highlight the expected growth in the job market need for mechatronics engineers–of caliber. Therefore, the Faculty of Engineering at Fayoum University is proposing the

establishment of a new MechatronicsEngineering (MCE-C) program at the Bachelor level. Theexisting departments of Industrial Engineering, Electrical Engineering, and Applied Mathematics and Physics will have a share in the teaching load of the new "MCE-C" program.

2. PROGRAM MISSION

The mission of the Mechatronics Engineering (MCE-C) 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 MCE-C program will also contribute to achieving this goal. Providing the students with carefully designed curricula and good educational experience and resources supports the program mission. The program emphasizes hands-on practice, it is application oriented, it acquaints the student with the relevant design codes and standards necessary for his/her future work, and it builds students capabilities on utilization of computer based analysis and design tools.

3. EDUCATIONAL OBJECTIVES

The mechatronics 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

mechatronics engineering, which is necessary for a productive career, and for being able to search and research in the spirit of continuing education.
To upgrade the skills of students in effective communication, logic thinking, and creativity.

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

4. PROGRAM LEARNING OUTCOMES

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

4.1Knowledge and Understanding

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

a) Concepts, principles and theories relevant to mechanical, electrical and manufacturing engineering;

b) Applied science and mathematics, and the technological base relevant to mechatronicsengineering;

c) The constraints within which an engineering judgment will have to be exercised;

d) Relevant contemporary issues in mechatronics engineering;

e) Basic electrical, control and computer engineering subjects related to the discipline;

f) The role of information technology in providing support for mechatronicsengineers;

g) Engineering design principles and techniques;

h) Management and business techniques and practices appropriate to the engineering industry.

4.2 Intellectual Skills

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

a) Think in a creative and innovative environment, in solving problems, and in designing products, systems, components and processes;

b) Apply the principles of mathematics, science and technology in problem solving scenarios in mechatronicsengineering;

c) Analyze and interpret numerical data, and design experiments to obtain such data;

d) Design systems, components or processes to meet specific needs through the synthesis of ideas from a range of sources;

e) Evaluate and appraise designs, processes and products, and propose improvements;

f) Assess risks, and take appropriate steps to manage those risks;
g) Use the principles of engineering science in developing solutions to practical mechatronicsengineering problems.

4.3 Practical and Professional Skills

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

5. PROGRAM DESCRIPTION

The MCE-C program offers instruction in numerous topics concerning mechatronics, electrical engineering, mechanical design, control engineering, robotics, manufacturing technology, materials engineering, industrial engineering, and energy systems. At the end of these courses, graduates are expected to gain the knowledge, understanding and comprehension of mechatronics systems, design of components and equipment, control

technologyand automated machinery. The MCE-C 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 B.Sc. degree is in Mechatronics Engineering consists of 180 credit hours; spread typically over 10 main semesters. High caliber students may finish the requirements of the degree in nine main semesters. These 180 Hours are realized through 308 actual contact hours, during which instructors mentor the students in tutorials, and laboratory sessions; in addition to the lecture form of instruction. The curriculum consists of courses In Humanities, Basic Sciences, Engineering Science, and Applied Engineering. Sample courses, in each category, are presented as follows:

5.1.1 Humanities and Social Sciences

- English language
- Humanities and Engineering
- Ethics and Legislation
- Technical Writing
- Communication and Presentation Skills
- Risk Management
- Marketing

5.1.2 Basic Sciences

- Mathematics
- Physics
- Chemistry
- Mechanics

5.1.3 Engineering Sciences

- Mechanics of Machines
- Computer Engineering
- Fluid Mechanics
- Systems Models
- Numerical Analysis
- Thermodynamics
- Automatic Control

5.1.4 Applied Engineering Sciences

- Robotics and Mechatronics
- Mechatronics Engineering Design
- Kinematics and Dynamics of Electromechanical Machines
- Systems modeling and control
- Mechanical Design
- Industrial Electronics
- Thermodynamics
- Pneumatic and Hydraulic Control

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

5.2 University Requirements

The main purpose of a university education is not only to prepare students for successful careers but also to provide them with the knowledge and skills to develop a rational, well-rounded and successful personal identity. Moreover, Fayoum 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.

A university requirement of 24 credits (13.3% of total 180 credits) spread over 12 courses is common to all credit hours programs. This common university core consists of 18 compulsory credits (10% of total 180 credits) and 6 elective credits (3.3% of total 180 credits). Table 1a lists the nine (9) university core compulsory courses, which represent 18 credits.

Table 1b lists the university electives, where students should select only three (3) courses, which represent 6 credits.

Table 1a. Compulsory Courses of University Requirements(18 Credits, 10% of total 180 Credits)

No	Code	Course title	Credits
1	GEN-C001	Humanities and Engineering	2
2	GEN-C002	English Language	2
3	ENG-C001	Computers for Engineers	2
4	GEN-C103	Technical Writing	2
5	GEN-C005	Fundamentals of Management	2
6	GEN-C206	Communication and Presentation skills	2
7	GEN-C007	Accounting	2
8	GEN-C108	Risk Management and Environment	2
9	GEN-C409	Economics	2

Table 1b. Elective Courses of University Requirements (Student should select only 6 Credits, 3.3% of total 180 Credits)

No.	Code	Course title	Credits
1	GEN-C010	Ethics and Legislation	2
2	GEN-C011	Technical Writing in Arabic	2
3	GEN-C013	Marketing	2
4	GEN-C014	Selection of Life-long Skills	2
5	GEN-C012	Foreign Language	2
6	GEN-C332	Service Management	2

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. These include courses of Seminar, Industrial Training, and Graduation Project. The common college core consists of 45 compulsory credits representing 25% of the total 180 credit hours of the B.Sc. degree. These 45 credits of the college core are spread over 18 compulsory courses, as shown in Table 2.

Table 2. Compulsory Courses of College Requirements (45 Credits, 25% of total 180 Credits)

No	Code	Course title	Credits
1	ENG-C002	General Chemistry	3
2	ENG-C107	Computer Science & Programming	3
3	ENG-C003	Engineering Drawing & Projection	3
4	MEC-C001	Mechanics I	2
5	MEC-C002	Mechanics II	2
6	IND-C004	Fundamentals of Manufacturing Processes	3
7	MCE-C105	Theory of Machines	3
8	PHY-C003	Physics	3
9	MTH-C001	Introduction to Linear Algebra& analytic Geometry	3
10	MTH-C002	Calculus **I**	3
11	MTH-C003	Calculus II	3
12	MTH-C101	Calculus III & Linear Algebra	3
13	MTH-C102	Differential Equations	3
14	MTH-C111	Probability and Statistics	2
15	MCE-C100	Industrial Training	1
16	GEN-C015	Seminar	2
17	MCE-C480	Graduation Project-1	1
18	MCE-C481	Graduation Project-2	3

5.4 Discipline Requirements

Graduates of MCE-C program should acquire the knowledge and skills of electrical and mechanical engineering discipline at large. Mechatronics is a multidisciplinary field that includes a combination of mechanical engineering, electrical engineering, control engineering, and computer engineering.The general core

(discipline) requirements comprise 48 Hours (about 26.7% of the total degree Hours). Table 3 lists the discipline core courses.

Table 3. List of Discipline Requirements (48 Credits, 26.7% of total 180 Credits)

No.	Code	Course title	Credits
1	EE-C102	Circuits I	2
2	MEC-C101	Mechanics and Thermodynamics	3
3	EE-C101	Electromagnetic fields	3
4	MCE-C103	Production Technology	3
5	IND-C107	Mechanical Drawings	3
6	ECE-C206	Electric Signal Analysis	3
7	ECE-C203	Logic Design & Microprocessors	3
8	ECE-C204	Programming & Algorithms	3
9	ECE-C201	Electronics I	3
10	EPE-C205	Fundamentals of Electric Machines	3
11	EE-C202	Circuits II	3
12	MCE-C209	Control I	3
13	MCE-C201	Modeling & Simulation of Mechatronics Systems	3
14	IND-C201	Thermodynamics	3
15	MCE-C206	Fundamentals of Metrology	3
16	IND-C202	Stress Analysis	3

5.5 Major Requirements

A mechatronics engineer unites the principles of mechanics, electronics, and computing to generate a simpler, more economical and reliable system. The major requirements include specialized courses in mechanical engineering, materials science engineering, electronic engineering, computer engineering, system engineering,

control and automation engineering, and robotics engineering. Few major requirement courses appear at the early stages of the program. The major requirements include both compulsory courses (17 courses, [51 credit hours]) and electives courses (4 courses, [12 credit hours]). Elective courses provide advanced knowledge and skills in the areas of Industrial Control, Robotics, Industrial Engineering Applications, and Automated Engineering Instrumentation. Table 4 shows the list of courses under the major requirements (51 Hours), which constitute about 28.3% of the total hours.

Table 4. List of Compulsory Courses of Major Requirements(51 Credits, 28.3% of total 180 Credits)

No.	Code	Course title	Credits
1	MCE-C203	Machine Design I	3
2	MCE-C202	Mechatronics I	3
3	MCE-C309	Control II	3
4	MTH-C201	Numerical analysis	3
5	EPE-C311	Industrial Electronics	3
6	ECE-C301	Electronics II	3
7	IND-C305	Mechanical Vibrations	3
8	MCE-C311	Machine Design II	3
9	MCE-C307	Mechatronics Sensors & Actuators	3
10	MCE-C321	Robotics Engineering	3
11	MCE-C323	Numerical Control and Computer Aided Manufacturing	3
12	MCE-C325	Pneumatic and Hydraulic Control	3
13	MCE-C324	Fluid Mechanics	3
14	MCE-C327	Microcontroller & Mechatronics	3
15	MCE-C401	Mechatronics II	3
16	MCE-C422	Autonomous Vehicle Systems	3
17	MCE-C411	PLC & SCADA Systems	3

Table 5 shows the list of elective courses. Students are required to complete 12 credit hours of the elective courses.

Table 5. List of Elective Courses of Major Requirements(12 Credits, 6.6% of total 180 Credits)

No.	Code	Course title	Credits
1	MCE-C440	Digital Control	3
2	MCE-C448	Manufacturing System Automation	3
3	MCE-C449	Design of Engineering Systems	3
4	MCE-C441	Robotics: Design, Analysis and Control	3
5	MCE-C442	Supervisory Control	3
6	MCE-C443	Practical Data Acquisition	3
7	MCE-C446	Reverse Engineering	3
8	MCE-C447	Computer Integrated Manufacturing	3
9	MCE-C444	MMS	3

6. SAMPLE STUDY PLAN and PROGRAM DETAILS

The tables below present a sample study plan spread over 10 main semesters. Since the program is credit hours based curriculum, the student does not have to take the courses during the semester indicated as long as prerequisites of a particular course are satisfied. The curriculum gives the student the opportunity to select courses from a number of electives. Moreover, the curriculum gives the students the opportunity to interact with industry and government agencies through two practical training summer courses. Due to adoption of 2/3 contact hours for each one hour of tutorials or laboratory work, the total number of contact hours of the degree is about 304 contact hours, which will be used to enhance the students' understanding and practicing of all sciences.

S1: Freshman, Fall Semester (18 Credits, 7 Courses)

No	Code	Course title	Credits
1	GEN-C001	Humanities and Engineering	2
2	ENG-C003	Engineering Drawing & Projection	3
3	ENG-C001	Computers for Engineers	2
4	MEC-C001	Mechanics I	2
5	MTH-C002	Calculus **I**	3
6	MTH-C001	Introduction to Linear Algebra & Analytic Geometry	3
7	PHY-C003	Physics	3

S2: Freshman, Spring Semester (18 Credits, 7 Courses)

No.	Code	Course title	Credits
1	ENG-C002	General Chemistry	3
2	GEN-C002	English Language	2
3	GEN-C005	Fundamentals of Management	2
4	MEC-C002	Mechanics II	2
5	MTH-C003	Calculus **II**	3
6	MEC-C101	Mechanics & Thermodynamics	3
7	ENG-C107	Computer Science & Programing	3

S3: Sophomore, Fall Semester (19 Credits, 7 Courses)

No.	Code	Course title	Credits
1	GEN-C103	Technical Writing	2
2	IND-C004	Fundamentals of Manufacturing processes	3
3	MTH-C102	Differential Equations	3
4	EE-C101	Electromagnetic fields	3
5	EE-C102	Circuits I	2
6	MTH-C101	Calculus III &Linear Algebra	3
7	MCE-C105	Theory of Machines	3

S4: Sophomore, Spring Semester (17 Credits,6 Courses)

No.	Code	Course title	Credits
1	GEN-C206	Communication & Presentation Skills	2
2	ECE-C201	Electronics I	3
3	ECE-C206	Electric Signal Analysis	3
4	ECE-C203	Logic Design & Microprocessor	3
5	ECE-C204	Programming & Algorithms	3
6	IND-C107	Mechanical Drawings	3

S5: Junior, Fall Semester (17 Credits, 6 Courses)

No.	Code	Course title	Credits
1	GEN-C409	Economics	2
2	EPE-C205	Fundamentals of Electric Machines	3
3	MCE-C209	Control I	3
4	EE-C202	Circuits II	3
5	IND-C201	Thermodynamics	3
6	MTH-C111	Probability and Statistics	3

S6: Junior, Spring Semester (18 Credits, 7 Courses)

No.	Code	Course title	Credits
1	GEN-C011	Technical Writing in Arabic	2
2	GEN-C013	Marketing	2
3	GEN-C332	Service Management	2
4	EPE-C311	Industrial Electronics	3
5	MCE-C201	Modeling & Simulation of Mechatronics Systems	3
6	ECE-C301	Electronics II	3
7	IND-C202	Stress Analysis	3

S7: Senior-1, Fall Semester (18 Credits, 7 Courses)

No.	Code	Course title	Credits
1	GEN-C108	Risk Management and Environment	2
2	MCE-C 206	Fundamentals of Metrology	3
3	MCE-C 100	Industrial Training	1
4	MTH-C 201	Numerical Analysis	3
5	MCE-C 202	Mechatronics I	3
6	MCE-C203	Machine Design I	3
7	IND-C 305	Mechanical Vibrations	3

S8: Senior-1, Spring Semester (19 Credits, 7 Courses)

No.	Code	Course title	Credits
1	GEN-C015	Seminar	1
2	MCE-C103	Production Technology	3
3	MCE-C309	Control II	3
4	MCE-C311	Machine Design II	3
5	MCE-C327	Microcontroller & Mechatronics	3
6	MCE-C307	Mechatronics Sensors & Actuators	3
7	MCE-C324	Fluid Mechanics	3

S9: Senior-2, Fall Semester (19 Credits, 7 Courses)

No.	Code	Course title	Credits
1	MCE-C323	Numerical Control and Computer Aided Manufacturing	3
2	MCE-C325	Pneumatic and Hydraulic Control	3
3	MCE-C401	Mechatronics II	3
4	MCE-C44X	Elective Course	3
5	MCE-C321	Robotics Engineering	3
6	MCE-C44X	Elective Course	3
7	MCE-C480	Graduation Project-1	1

S10: Senior-2, Spring Semester (17 Credits, 6 Courses)

No.	Code	Course title	Credits
1	GEN-C007	Accounting	2
2	MCE-C422	Autonomous Vehicle Systems	3
3	MCE-C411	PLC & SCADA Systems	3
4	MCE-C44X	Elective Course	3
5	MCE-C481	Graduation Project-2	3
6	MCE-C44X	Elective Course	3

7. COURSE CONTENTS

7.1 UNIVERSITY CORE COURSES

GEN-C001	**Humanities and Engineering** **Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s): ---------** 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 the Humanities: Introduction to modes of thought found within humanities and social sciences. Humanities for Engineers: Humanities themes of increased complexity - Different work methodologies - Critical analysis of information and choice of argumentation - Work methodologies and pedagogical interest.

GEN-C002	**English Language** **Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): ----------** Discovering personal opinion, composing essay and thesis statements, importance of figurative language, typical English writing errors and pitfalls, effective reading skills, organizing written material, skills for implementing transitions and enhancing introductions, control of sentence and paragraph length, peer evaluation, final essay revision.
ENG-C001	**Computers for Engineers** **Compulsory, Credits: 2 (1+0+2)** **Prerequisite(s): ----------** Basic concepts of data representation, storage, processing and reasoning, introduction to computer logic, programming techniques and development of automated applications, introduction to differenttechnologies of computer interfaces. Hands on using mimic examples and a general-purpose software package.
GEN-C103	**Technical Writing** **Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): GEN-C002** Discovering Ideas. Outlining Ideas and Organizing Outlines. Ways To Begin. The Three Parts of Technical Texts. Writing Abstracts, Summaries, and Conclusions of Long Reports. The Thesis Statement. Forms: 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, Vocabulary Building, Basic Types and Patterns of Argument: Terminology, Building Sub-Arguments of Fact and Policy.
GEN-C005	**Fundamentals of Management** **Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s): ---------**

	Introduction to management, Historical view and evolution of concepts. Basic Managerial Functions: Planning, Strategies, Objectives, MBO; Organizing, Departmentation, Job Descriptions; Elements of Human Resource Management: Staffing, Directing, Controlling. Total Quality Management, Continuous Improvement. Various Engineering Applications.
GEN-C206	**Communication and Presentation Skills** **Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): GEN-C103** Introduction. Planning a presentation. The communication process. The Concept of Thesis Statement. Way To Develop the Thesis Statement. Structuring a presentation. Rules for Writing Text Charts. Writing Titles. Rules for Designing Effective Slides and Charts. Other Elements. Presentations. How to Deal With a Hostile Audience. Elements of An Effective Speech. Speech Preparation as a Process, How to Gesture Effectively. Using LCD Projectors. How To Use Transitions Effectively. Four Ways To Remember Thoughts. Making a Dynamic Presentation Gathering Information & Materials.
GEN-C007	**Accounting** **Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): ----------** Basic accounting concepts: Accounting Terms and Assumptions, Accounting Methodology: balance sheet, income statement, cash flow statement. Income Determination: Cash Effects, Basis of Accounting. Accounting ratio – measuring the performance – cost concepts – cost accumulation – cost allocation – cost/volume/profit analysis – budgets – forecasting. Cost Accounting.
GEN-C108	**Risk Management and Environment** **Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): GEN-C005**

	Risk Management: Introduction. Risk Definition and Accident Theory. Principle of Risk Management: Identification of Risks. Preliminary Risk Analysis (PRA). Failure Modes, Effect and Criticality Analysis (FMECA). HAZOP. Methods of System Analysis. What is Risk Assessment. Risk Control. Apply hierarchy of Control. Monitoring and Review. The Process of Fire Risk Management. Regulations and agencies, non-governmental organizations, fires and explosions, pressure relief systems, process hazard analysis, inherently safe design. Study of a problem from upstream/downstream in which the student apply 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 and Control of Air Pollution, Contaminated Land and Its Reclamation, Principals and Uses of the Environmental Risk Assessment, Environmental Risk Assessment Methodology, Environmental Impact Assessment Environmental Health Risk Assessment. National and International regulations.
GEN-C409	**Economics** **Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): ----------** Economics as a Discipline: Economics as a Social Science, Micro-economics and Macroeconomics, Theories in Economics, Barriers to Clear Thinking in Economics. The Economic Problem: Scarcity, Resources and Production, Production Possibility Boundaries, Choices and Opportunity Costs, Resource Use (Fundamental Choices). Demand and Supply: The Mechanics of a Market. Demand and Supply, Consumers Behavior (Demand, Individual Demand and Market Demand), Properties of Demand Curves, Demand versus Quantity Demanded, Producers Behavior: Supply,

	Individual Supply and Market Supply, Properties of Supply Curves, Supply versus Quantity Supplied, Equilibrium of Demand and Supply, Adjustment in Market Equilibrium. Supply and Demand Analysis: Economic Analysis, Demand Shifts: Substitutes and Complements, Demand Shifts: Superior and Inferior Goods, Price Ceilings, Price Floor, Excise Taxes. Price Elasticity of Demand: Price Sensitivity, Price Elasticity of Demand, Measuring Price Elasticity of Demand with the Arc Formula, Price Elasticity of Demand and Slope, Price Elasticity of Demand and Total Revenue, Determinants of Price elasticity of Demand, Other Elasticities. Perfect Competition and Monopoly Production and Input Use: Production, Production Functions, Short-Run Functions, Long-Run Production, Choices of Inputs. Economic Costs: Economic Costs, Short-Run Costs, Short-Run Cost Curves, Long-Run Costs and Long-Run Cost Curves. Profits, Interests, and Rent. Interest Rates, Time Value of Money. Feasibility Studies. Project Economic Analysis. Depreciation. Factor Markets: Perfect and Imperfect Competition.
GEN-C010	**Ethics and Legislation** **Elective, Credits: 2 (1+2+0)** **Prerequisite(s): --------** 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.
GEN-C011	**Technical Writing in Arabic** **Elective, Credits: 2 (1+2+0)** **Prerequisite(s): GEN-C103** 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.
GEN-C013	**Marketing** **Elective, Credits: 2 (1+2+0)** **Prerequisite(s): GEN-C005** 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 and Profitability Analysis, Performance Evaluation; Ethical and Legal Responsibilities tender writing.
GEN-C014	**Selection of Life-long Skills** **Elective, Credits: 2 (1+2+0)** **Prerequisite(s): GEN-C005** 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.
GEN-C012	**Foreign Language** **Elective, Credits: 2 (1+2+0)** **Prerequisite(s): GEN-C002** 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.
GEN-C332	**Service Management** **Elective, Credits: 2 (1+2+0)** **Prerequisite(s): GEN-C005** Role of services in the economy, The nature of services, Service quality, Service Strategy, Developing new services, The role of technology in supporting service delivery, Design of services, Capacity planning and managing queues, Quantitative methods for service management.

7.2 COLLEGE CORE COURSES

ENG-C002	**General Chemistry:** **Compulsory, Credits: 3 (2+1+1)** **Prerequisite(s):----------**

	Gaseous state – Thermo chemistry – Material and thermal balance in combustion processes – Liquid state – Solutions – Thermochemistry – Corrosion – Chemical equilibrium – Ionic equilibrium - Water treatment – Air pollution – Selected chemical industries (Cement – Oils and Lubricants – Polymers – Semiconductors).
ENG-C107	**Computer Science & Programming** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): ----------** Concepts of a computer language – Program development cycle – Basics of high level programming language C++ - variables Types, basic I/O, expressions, Arithmetic expressions, computer arithmetic, Strings, Conditional statements, - if, Decision making, switch, Iteration, do-while, while, for, Loops - examples and techniques, Functions - basic concepts, Functions - return values, Functions – parameters, Files – streams, Arrays, Arrays - 2D, structs, classes, strings - the C++ string class, Types - internal representations App, Base conversion App, 2's complement App, Dynamic memory – pointers, Linked lists, Recursion, Sorting.
ENG-C003	**Engineering Drawing & Projection** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): ----------** Uses of geometric tools , Geometric constructions and geometric pictorial , Orthogonal projection , Auxiliary projection ,Rolled sections and steel beams used in steel constructions , Column and connecting steel , Different sections of machine , Uses of computer in engineering drawing
MEC-C001	**Mechanics I** **Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): ----------** Static of particles, forces in 3-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, equilibrium of a rigid body in two dimensions, reactions at supports and connections for a two dimensional structure,2-D trusses, equilibrium of a rigid body in three dimensions, reactions at supports and connections for a three dimensional structure; centroids and centers of gravity, center of gravity of a two-dimensional body, 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.
MEC-C002	**Mechanics II** **Compulsory, Credits: 2 (1+1+1)** **Prerequisite(s): MEC-C001** Kinematics of particles: rectilinear motion of particles, position, velocity and acceleration, uniform rectilinear motion, uniformly accelerated rectilinear motion, curvilinear motion of particles, 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 and 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 the coefficient of restitution, oblique central impact.
IND-C004	**Fundamentals of Manufacturing Processes** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): ENG-C003** Production cycle – Introduction to industrial engineering – Engineering material – Characteristics and properties of materials – Metal forming processes: Casting, Forging, Rolling, Drawing and Extrusion – Joining processes: Riveting, Welding – Machining processes: Manual cutting, Mechanical turning, Shaping, Drilling, Milling and Grinding – Measuring processes: Length and Angle measurements – Engineering standard.
MCE-C105	**Theory of Machines** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): ------** Introduction to mechanisms – kinematic analysis of mechanisms: position, velocity and acceleration – gear trains: simple, compound & planetary – cams – force analysis of mechanisms – balancing of rotating machinery – dynamics and balancing of reciprocating machinery – gyroscopic couples and their effect on machines – Planar Robots Kinematics and dynamics, applications – use of computers in mechanism analysis, Course Project
PHY-C003	**Physics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): ----------** Physical measurements - measurement units for fundamental quantities – dimensional analysis - unit

	systems - Elasticity: properties for solid bodies – loading types – stress and strain - elasticity modules – Gravity: Newton law of Gravitation and its applications – potential energy – satellites and Kepler's laws – Hydrostatics: Hydrostatic pressure – Pascal's principle – Archimedes' principle – steady flow – equation of continuity – Bernoulli's equation and its applications – viscosity – Vibrations: the simple harmonic motion and its applications – the kinetic energy in the simple harmonic motion - the simple harmonic motion and the circular motion – practical experiments. Electrostatics: electric charge and Coulomb's law: conductors and insulators – Coulomb's law – electrostatic forces' addition law – electric charge nature – electrostatic fields: electric field lines – the field of a point charge, group of point charges and a continuous distribution of charges – Gauss' law: electric flux - Gauss' law and its applications – electrostatic potential: calculating the electric potential from the electric field – the potential of a point charge, group of point charges and a continuous distribution of charges – the derivative of the field from the potential – the electrostatic potential energy – the potential of a charged conductor – dielectric materials and the electric capacitance: dielectric medium and its polarization – electric capacitance - Gauss' law in the presence of dielectric medium – the energy stored in the electrostatic fields – practical applications.
MTH-C001	**Introduction to Linear Algebra & Analytic Geometry** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): ----------** 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.
MTH-C002	**Calculus I** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): ----------** Functions, graphing of functions, combining functions, trigonometric functions; limits and continuity; differentiation; applications of derivatives, inverse functions; inverse trigonometric functions; indeterminate forms and L'Hopital's rule; infinite series, power series; Taylor and Maclaurin expansions.
MTH-C003	**Calculus II** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): MTH-C001, MTH-C002** Anti-derivatives; indefinite integrals; exponential and logarithmic functions; hyperbolic and inverse hyperbolic functions; techniques of integration; definite integrals, improper integrals, applications of definite integrals, functions of several variables; partial derivatives, applications for partial derivatives.
MTH-C101	**Calculus III & Linear Algebra** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): MTH-C003** 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, some vector identities; LU-factorization; vector spaces; inner product spaces; eigenvalues and eigenvectors; diagonalization of matrices; functions of matrices.
MTH-C102	**Differential Equations** **Compulsory, Credits: 3 (2+2+0)**

	Prerequisite(s): MTH-C003 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.
MTH-C111	**Probability and Statistics** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): MTH-C101** 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 , statistical quality control.
MCE-C100	**Industrial Training** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 72 Credits** Training on industrial establishments relevant to the program. Training lasts for total of 90 hours, during a minimum period of three weeks. The program training advisor pays 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.
GEN-C015	**Seminar** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 72 Credits**

	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 a technical report on the guest presentation and deliver their own presentation about the topic. The grade depends on the quality, the content and the organization of both the presentation and the report prepared by the student. The course is graded as Pass/Fail system.
MCE-C480	**Graduation Project-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 130 Credits + AA Approval** All students undertake a major project as part of the program. The aim of the project is to provide the students - in groups - with an opportunity to implement the appropriate concepts and techniques to a particular design. Students are required to choose and research the expected project to be designed and implemented in course Graduation Project-2. The student must give an oral presentation to be approved. The course is graded as Pass/Fail system.
MCE-C481	**Graduation Project-2** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): MCE-C480** All students undertake a major project as part of the program. The aim of the project is to provide the students - 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

EE-C 102	**Circuits I** **Compulsory, Credits: 2 (2+2+1)** **Prerequisite(s): MTH-C002** Introduction to DC and AC electrical circuits – branch currents and node voltages – Circuit Simplification - Δ/Y transformation – Circuits theorems (Norton, Thevenins,….) – Time domain circuit analysis – AC circuit elements (inductance, capacitance,….) - Complex analysis for AC circuits – Power calculation (active, reactive)
MEC-C101	**Mechanics & Thermodynamics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): --------** Temperature, heat quantity and the first law of thermodynamics – the zeroth law of thermodynamics – temperature measurements - Heat expansion – heat quantity – heat absorption by solids and liquids – first law of thermodynamics – the methods of heat transfer and the kinetic theory of gases – ideal gases – molecular velocity distribution – molecular specific heat – degrees of freedom and its relation with the specific heat – practical experiments.
EE-C101	**Electromagnetic fields** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): --------** Electric Current and Magnetism: The electric current and the electrical resistance: the electric current – the electric current density – the electrical resistance – Ohm's law – electric power – semiconductors – direct current circuit – electromotive force – voltage drop – Kirchhoff's rules – multi-loops circuits – The magnetic fields: the field definition – the magnetic force on a conductor carrying current – magnetic field sources – Biot-Savart law – Ampere's law – electromagnetic induction: Faraday's law – Lenz's law – inductance – magnetic energy – mutual

	induction – Magnetic properties of matter and Maxwell's equations – Gauss' law for magnetism – diamagnetic materials – paramagnetic materials – ferromagnetic materials – the generalization of Amperes's law – Maxwell's equations – practical applications. Electric field; Gauss' law; electrostatic potential; capacitance and dielectrics; current and resistance; direct current circuits; inductances; magnetic properties of matter. Laboratory experiments on the course topics.
MCE-C103	**Production Technology** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): --------** Processing by casting, powder metallurgy, metal working, material removal, welding and joining. Processing of plastics and ceramics. Finishing processes. Materials recycling.
IND-C107	**Mechanical Drawings** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): ENG-C003** Part I: line work, lettering, scale use, and sketching, multi-view drawings, sectional views, limits, fits and tolerance, symbols and conventional representation with the basics of manual drafting techniques and the use of drafting equipment, advanced dimensioning, and auxiliary views. Part II: screw fasteners, key joints, coupling and its types, riveted joints, welded joints, structural applications, assembly drawings, production drawings, reproduction of drawing, introduction of computer aided drafting, introduction of solid 3D modeling.
ECE-C206	**Electric Signal Analysis** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTH-C102** Signals and systems representation - Principals, properties, and representation of SISO linear system- systems transfer function - response of the continuous linear system - frequency response and filters - Signal flow graph - Discrete signals - sampling theory - Z transform – the inverse Z

	transform – the Discrete Fourier Transform - simulation of continuous system by the discrete time – introduction to digital filters - random signal and probabilities.
ECE-C203	**Logic Design & Microprocessors** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): EE-C102** Logic gates- Flip Flops- Counters- timers- Shift register- Synchronous and asynchronous sequential circuit- storage systems - random access memory- read-only memory - Programmable Logic array - Basics Microprocessor - architecture of microprocessor - types of instructions and programming - assembly language - types of interrupt signal – microprocessor interface with input and output - Design and analysis of combinational and sequential logic circuits using a hardware description language such as VHDL. Applications.
ECE-C204	**Programming & Algorithms** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): ENG-C007** Analysis and design of methods used by operating systems to perform typical system services; design and implementation of file and directory systems; I/O methods, including programmed, interrupt-driven, and DMA; CPU scheduling; memory management techniques and implementations; concurrent programming; deadlocks; Introduction to RTOS (real-time operating system), ATML AVR processor, task scheduling, real-time scheduling, memory managements, RTOS specification and design.
ECE-C201	**Electronics I** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): EE-C102** Semi-Conductor basics- diodes- BJT and MOS transistors- Amplifiers - Multi-stage amplifiers and complex circuits - Frequency response - amplifier circuit analysis in high frequency - feedback amplifiers - power amplifiers - differential amplifier - operational amplifier (op amp) - op amp applications - continuous and discrete voltage

	stabilizer.
EPE-C205	**Fundamentals of Electric Machines** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): -------** Single-phase transformers- Three-phase transformers – autotransformer – DC machines (different types, structure and performance)– starting and speed control of machines- DC generators- DC motors: series shunt and compound. Induction motors. Predicting motor performance.
EE-C202	**Circuits II** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): EE-C102** Resonance circuits (series, parallel and magnetically coupled) – Applications on resonance circuits (negative filters) - Two portnetworks – cross-circuit analysis Power - Reactive Power in single phase circuits - Three-Phase Circuits – Magnetic coupled circuits – The Fourier Series and its application in Circuit Analysis - The Laplace Transform in Circuit Analysis – two port circuits – Filter Design- Applications.
MCE-C209	**Control I** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): EE-C202** Modeling, analysis, and control of dynamic systems- System modeling, interconnection laws; actuators and sensors. Linear systems theory: linear algebra; Laplace transform; transfer functions, time response and frequency response, poles and zeros; block diagrams; solutions via analytical and numerical techniques; stability. Introduction to feedback control: closed-loop response; PID compensation; steady-state characteristics, root-locus design concepts, frequency-domain design concepts.
MCE-C201	**Modeling& Simulation ofMechatronics Systems** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): ECE 206, ECE 204,** Analogy between different physical and electrical systems,

	modeling of electrical systems, modeling of mechanical systems, modeling of electromechanical systems, modeling of hydraulic systems, modeling of pneumatic systems, modeling of thermal systems, transducers functions for different physical systems, state space representations for different physical systems, simulation and soft testing of electromechanical systems (MATLAB with Simulink can be used as a simulation tool).
IND-C201	**Thermodynamics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MEC-C103** Thermodynamic systems and boundaries, basic laws of thermodynamics (conservation of mass-conservation of energy or first law-second law), various forms of energy (heat transfer –work), various type of properties (extensive and intensive), using (tables-equations-charts) in evaluation of thermodynamic properties, apply (conservation of mass-first law-second law) in thermodynamic analysis of systems (turbines- pumps-compressors- heat exchangers), power cycles: air standard and actual cycles; reversed cycles: refrigerators and heat pumps, gas mixtures, psychrometry and air conditioning, Introduction to heat transfer and psychrometry, hydrocarbon reactions, waste heat recovery.
MCE-C206	**Fundamentals of Metrology** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): MCE-C105** Characteristics of Measuring Systems, Traceability, Repeatability Accuracy, Surface Assessment, Strain Measurement, Measurement of time, Speed, Acceleration, and Frequency, Measurement of Force, Torque, and Power, Measurement of Pressure, Measurement of Fluid Flow, Viscometry, Measurement of Temperature, Thread measurements, and Gear measurements.
IND-C202	**Stress Analysis** **Compulsory, Credits: 3 (2+2+1)**

	Prerequisite(s): MEC-C003 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.

7.4 **MAJOUR COURSES**

MCE-C203	**Machine Design I** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): MCE-C105** Design procedures – Factors affecting design details – Selection of materials – Modes of loading – Safety factors and allowable stresses – 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, Thin pipes and pressure vessels, Seals and design of hydraulic and pneumatic cylinders. Application of computer aided design. Introduction to power transmission elements.
MCE-C202	**Mechatronics I** **Compulsory, Credits: 3 (2+0+3)** **Prerequ**isite(s): **MCE-C201** Introduction and course objectives; example of a

	mechatronic system; Definitions and impact on industry, with some statistical data and examples; The mechatronics design methodologies, with applications; The MATLAB/SIMULINK, the PROTEUS VSM and the SOLID WORKS packages with examples; Design and implementation of the Discrete Event system . (Implementation in the form of mini-projects).
MCE-C309	**Control II** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCE-C209** Analytical and graphical descriptions of state-determined dynamic physical systems; state-space models; time and frequency domain representations; system characteristics - controllability, observability, stability; linear and nonlinear system responses. Modification of system characteristics using feedback. State observers, Kalman filters.
MTH-C201	**Numerical Analysis** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MTH-C102, MTH-C103** 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.
EPE-C311	**Industrial Electronics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): ECE-C201** Analyzing and characterizing the basic power electronic circuits. Diodes and rectifier circuits. Transistors: DC bias,

	power transistors. Thyristors: operation, rectifier circuits. Design of digital and analogue firing circuits. Operational amplifier circuits and applications. Power electronics circuits, H bridges, PWM control, interfacing, power amplifiers. DC servo & stepper motors, AC synchronous & induction motors. Course project.
ECE-C 301	**Electronics II** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): ECE-C201** Bipolar and MOS gates – Digital SSI and MSI Circuits – Analog Integrated Circuits (Comparators – Multipliers – Phase Detectors - Phase locked loops- voltage regulators- electronic oscillators) – noise in electronics – Data Acquisition Systems.
IND-C 305	**Mechanical Vibrations** **Compulsory, Credits: 3 (2+0+2)** **Prerequisite(s): ---------** Reciprocating movement - the free vibration systems with one degree of freedom - the forced vibration systems with one degree of freedom - special cases unbalance - insulation - vibration measuring devices - systems with two degrees of freedom - numerical methods - large systems - Applications
MCE-C311	**Machine Design II** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): MCE-C203** Design theory and methodology, needs, innovations cognitive andconceptual modeling. Preliminary design of power transmission elements: shafts, gears, bearings, couplings, clutches, brakes, belts, ropes, and chains. Theory and detailed design of shafts and rolling bearings assembly under different loading conditions. Appropriate selection and mounting of rolling bearing elements. Construction details of some machine elements assemblies such as transmission shafts. Computer aided selection of machine elements. Detailed design of power transmission elements: spur gears, helical gears, bevel and worm gears, belts, ropes, chains, couplings, clutches, and brakes. Theory and Design of

	Hydrodynamic and hydrostatic bearings and computer utility in design evaluation. Design of gearboxes, flywheels, machine frames with computer applications (solid work).
MCE-C307	**Mechatronics Sensors & Actuators** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): MCE-C202, MCE-C206** Sensors including: position and speed measurement, Stress and strain measurement, Temperature measurement, Vibration and acceleration measurement, Pressure and flow measurement and semiconductor sensors and MEMS (micro electromechanical systems). Actuators including: solenoids and relays, Electric motors, Stepper motors, Hydraulic and pneumatic actuators. Mechatronics systems including: Control architectures and a number of case studies, Using co-design concepts, Introduction to VHDL for modeling digital hardware devices using structural, Dataflow and behavioral styles, Applications
MCE-C321	**Robotics Engineering** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCE-C307, MCE-C309** Fundamentals of robot mechanisms, dynamics, and controls. Planar and spatial kinematics, differential motion, energy method for robot mechanics; mechanism design for manipulation and locomotion; multi-rigid-body dynamics; force and compliance control, balancing control, visual feedback, human-machine interface; actuators, sensors, wireless networking, and embedded software. Course project.
MCE-C323	**Numerical Control and Computer-Aided Manufacturing** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCE-C209** Control system fundamentals, numerical control (NC) machine control systems, and the design aspect of NC machine tools, programming methods of NC machines, computer-aided manufacturing, CNC, DNC, and process

	optimization.
MCE-C325	**Pneumatic and Hydraulic Control** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCE-C201, MCE-C307** Hydraulic pumps, Pressure regulation, Loading valves, Filters, Air compressor, Air receiver, Air treatment & service unit, Control valves, Servo–valves, Actuators, Circuit diagram & layout, Process control pneumatics, Hydraulic & pneumatic accessories, Fault finding, Safety, preventive maintenance, Comparison between hydraulic and electric DC servos. The electro-hydraulic servo valve as the interface between control circuitry and the mechanical hardware. Design and performance characteristics of electro-hydraulic servo-valves. Problems pertaining to electro-hydraulic servo-valves. Dynamic modeling of hydraulic servo-systems.
MCE-C324	**Fluid Mechanics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCE-C101** Fluid kinematics. flow types. Integral analysis of flow: Continuity, Linear momentum, Angular momentum and Energy equations, Applications. Similitude anddimensional analysis and modeling, Viscous flow in pipes and ducts. Flow measurement. 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. Dimensional analysis, fluid measurements, compressible flow, pipe network and water hammer, turbo machinery, pumps and turbines.Fluidic machine fundamentals
MCE-C327	**Microcontroller and Mechatronics** **Compulsory, Credits: 3 (2+1+2)**

	Prerequisite(s): ECE-C204, ECE-C203 Mechatronics and digital systems, Digital logic design, Microprocessor and Microcontroller architecture, Embedded systems, Interfacing techniques, A/D and D/A conversion, Memory addressing techniques, Interrupt techniques, I/O needs and expansion, Timers,assembly& C/C++, Microcontroller programming and interfacing using a special example with details of its assembly& C/C++ language programming and interfacing, and project application work.
MCE-C401	**Mechatronics II** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): MCE-C202** Introduction and course objectives; Design and implementation of the Process Control system using PLC and SCADA in the form of mini-project); The Machine Vision with the suitable mechatronics applications, plus mini-project; Train the students to the proficient use of the rapid prototyping technologies of mechatronic systems ; The Autonomous systems with some examples such as Autonomous Vehicles , Autonomous Mobile Robots .
MCE-C422	**Autonomous Vehicle Systems** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): MCE-C401, MCE-C407** Introduction AVS (Autonomous Vehicles Systems) history, missions, capabilities, types, configurations. UAVs (unmanned aerial vehicles), UGVs (ground), USVs (surface water), & UUVs (underwater); levels of autonomy; coordinate systems & equations of motion; coordinate systems & transformations for payloads; sensors & actuators; inertial measurement & navigation, Global Positioning System (GPS); PID automatic control, guidance, & navigation; vision-based guidance for ground vehicles; communication & telemetry systems; mission planning, ground control systems & operator interfaces.

MCE-C411	**PLC & SCADA Systems** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): MCE-C309** Advantages of using PLCs in industrial automation, Basic components of a PLC, Programming of PLCs by ladder logic, Internal markers, Timers, Counters, Conditional jumps and Master Control function, PLC program design, Interfacing sensors and actuators to PLCs, PLC program development for control applications, Advanced Sequential Control Techniques, Data handling instructions, PLC modules, Background to SCADA, SCADA systems, Basic elements of DCS, Relationship between DCS and SCADA.

Major Electives:

MCE-C440	**Digital control** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): MCE-C309** Introduction, Sampled data systems, Z-transform and its properties, Inverse of Z-transform, closed loop performance and stability, Digital PID control design, Pole placement digital control, Independent regulation and tracking pole placement control, Applications.
MCE-C448	**Manufacturing System Automation** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCE-C323** Computer assisted manufacturing systems NC, CNC, DNC, robotics, material handling, group technology, flexible manufacturing systems, process planning and control.

MCE-C449	**Design of Engineering Systems** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCE-C311** Elements of system architecture, product versus process-driven design objectives, design of systems, synthesis and analysis in systems design, case studies.
MCE-C441	**Robotics: Design, Analysis and Control** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MCE-C321** Dynamic analysis, design, and control of robots. Forward and inverse kinematics and dynamics of multi-input, multi-output rigid body systems. Computed torque control. Adaptive control. System identification. Force feedback, adaptive visual servoing. Task planning, teleoperation. Elements of biological planning and control. Motor primitives, entrainment, locomotion, active sensing, binding models. Course projects..
MCE-C442	**Supervisory Control** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): MCE-C411** Background to SCADA, SCADA systems, hardware and firmware, SCADA systems software, protocols and landlines considerations. DCS versus SCADA, Foundation Field bus and Profibus.
MCE-C443	**Practical Data Acquisition** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): MCE-C327** Real-Time PC configuration, Parallel, Serial and USB data communication, Distributed and Stand-alone loggers/controllers, General Purpose Interfacing Bus (GPIB) technology, practical projects.
MCE-C446	**Reverse Engineering** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s):MCE-C311** Component geometry, dimensions, tolerances & fits, design

	verification, Material, surfaces & heat treatment identifications, Identifying the manufacturing processes, component modification, process sheet, economic considerations.
MCE-C447	**<u>Computer Integrated Manufacturing</u>** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): MCE-C323** Manufacturing Systems, CIM, CAD, CAM, computer-aided inspection & assembly processes, planning, materials management, computer simulation of manufacturing Processes & systems, group technology, cellular manufacturing. Flexible manufacturing Systems, just–in-time production, communications networks in manufacturing, artificial intelligence, economic considerations
MCE-C444	**<u>MMS</u>** **Compulsory, Credits: 3 (2+0+3)** **Prerequisite(s): MCE-C307** Intrinsic characteristics of MEMS, Electrostatic sensing and actuating, thermal sensing and actuating, piezoelectric sensing and actuating, Bulk and surface micromachining, micro fluidic applications, Optical MEMS.