ملحق (3)

اللائحة الدراسية لبرنامج هندسة وإدارة التشييد بنظام الساعات المعتمدة.

B.Sc. in Construction Engineering and Management (CEM-C) Based on Credit Hours System

Faculty of Engineering - Fayoum University

December 2013

1. INTRODUCTION

The objective of this program is to prepare engineers at the entry professional level to conceive, plan, design, direct, estimate the cost and safely manage the construction process. The program is designed to turn out future construction engineers who will understand and accept the moral, ethical, legal and professional obligations for protecting the public welfare. Also, those engineers will acquire the kind of critical thinking and creativity needed for successful development by gaining the leadership and management skills that will create effective teams and communication routines.

Civil Engineering is one of the oldest engineering professions. It is committed to the control and improvement of our environment through planning, design and construction of systems and physical facilities such as: buildings, roads, bridges, airports, transportation systems, offshore and coastal protection structures, flood and pollution control systems for rivers and lakes, dams, water resources projects, urban development projects and pollution control, and waste disposal projects.

It is worth emphasizing that engineers with B.Sc. Civil Engineering are mainly design and planning engineers, and they have to acquire their own construction skills through working experience. This is because Civil Engineering programs are being offered in almost every engineering college all over the world, while the Construction Engineering Program is still in its infancy. For this reason, Fayoum University is offering this program to fill a very important gap in the job market in Egypt as well as in the other Middle Eastern states.

There is always immediate and wide spread increase in demand for construction engineering and management from both government and private industry, giving rise to many job opportunities for construction engineers. This can be manifested by the continuous demand for construction engineers by Construction firms, Consulting firms, General contractors, Research organizations, as well as Sales engineering companies.

The general character of this Construction Engineering curriculum has been designed with the aim of providing the student with fundamental training of Civil Engineering disciplines and is further extended towards enabling him to acquire sufficient Construction Engineering education.

2. PROGRAM MISSION

The program prepares students for leadership roles in construction engineering. The program provides high-quality education to support and enhance the profession of Construction Engineering through its education, research and service activities. Students will be taught to address problems building on solid technical foundations while taking advantage of advanced technologies. Our graduates will be prepared for the pursuit of advanced learning in construction engineering and related fields, as well as for the practice of Construction Engineering at the highest professional levels.

3. EDUCATIONAL OBJECTIVES

One of the main goals of the Faculty of Engineering, Fayoum University, is to cope with the new advances in the field of construction Engineering as it is one of the most prominent fields in industry worldwide. Along this line, Fayoum University considers the development of the proposed program one of its top urgent plans. The main goal of the proposed CEM Program is to provide a well-integrated program that gives the student the opportunity to develop the proficiencies necessary for a successful, professional career in construction.

On successful completion of the programs graduates must be able to demonstrate knowledge and understanding of:

- Reviewing the contract strategies for construction projects and to investigate the appropriate contract forms and payment methods.
- Producing tender and contract documents along with the ability to carry out estimation of costs and expenditures during all project stages.
- carrying out appraisal of tenders and to negotiate with bidders
- supervising constructions projects and monitoring their progress
- Measuring the executed work, and certify interim payments and final account.
- Contract change orders and enhancing their abilities in dealing with such changes during construction.
- advising clients on settling claims and disputes
- handing over completed construction projects along with their designated maintenance and operational plans

4. PROGRAM LEARNING OUTCOMES

4.1 Knowledge and Understanding

On successful completion of the construction and building engineering program of study, the graduate should be able to demonstrate knowledge and understanding of:

a. Concepts and theories of mathematics and sciences, appropriate to the discipline.

b. Basics of information and communication technology (ICT)

c. Principles of design including elements design, process and/or a system related to specific disciplines.

d. Methodologies of solving engineering problems.

e. Professional ethics and socio-economical impact of engineering solutions

f. Current engineering technologies as related to disciplines.

g. Quality assurance systems, codes of practice and standards, health and safety requirements and environmental issues.

h. Business and management principles relevant to engineering.

i. Contemporary engineering topics.

j. Topics related to humanitarian interests and moral issues.

k. The impact of engineering solutions in a global and societal context;

l. The essential construction processes and the technologies and techniques used in the construction and building engineering field.

m. Natural sciences, mathematical methods and principles of construction and building engineering sciences as applied to civil engineering principles;

n. Engineering principles in the fields of:

- a. Construction management;
- b. Construction engineering;
- c. Structures;
- d. Geotechnics & foundations;

o. Water resources, hydraulics, irrigation and coastal engineering;

- a. Environmental engineering;
- b. Transportation systems and traffic;

c. Surveying; and

p. Properties, behavior & fabrication of construction materials.

q. Principles of design specific to construction and building.

r. Projects management, including planning, finance, bidding, contract procedures, cost estimators and quality systems.

s. The different analytical and computer methods that can be applied to the various areas of construction and building engineering.

4.2 Intellectual Skills

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

a. Select appropriate mathematical and computer-based methods for modeling and analyzing problems.

b. Design and/or create a process, component or system applying appropriate knowledge and principles

c. Select appropriate solutions for engineering problems based on analytical thinking

d. Consider the applicability, economy and risk management in design.

e. Assess and evaluate effectively the characteristics and performance of components, systems and processes

f. Solve engineering design and production problems, often on the basis of limited and possibly contradicting information;

g. Analyze results of numerical models and appreciate their limitations.

h. Maintain a systematic and methodic approach in dealing with new and advancing technology,

i. Reach engineering judgments considering balanced costs, benefits, safety, quality, reliability, and environmental impact.

j. Analyze systems, processes and components critically.

k. Select and appraise appropriate ICT tools to a variety of engineering problems.

l. Demonstrate a high level of competence in identifying, defining, and solving construction engineering problems.

m. Select and apply appropriate mathematical tools and computing methods for modeling and analyzing engineering problems.

n. Apply engineering principles, theories and sciences in solving environmental and socioeconomic problems.

o. Apply appropriate geotechnical techniques and codes of practice to determine levels, types and systems of building foundations.

p. Apply appropriate design techniques and codes of practice.

q. Evaluate and integrate information and processes through

r. individual and group project work.

s. Solve a wide range of problems related to the analysis, design, and the construction of buildings and civil engineering projects.

t. Define, plan, conduct and report management techniques.

u. Analyze and interpret financial information.

v. Understand the requirements of health and safety in construction projects

w. Suggest solutions and designs on a conceptual level and in detail that consider sustainability and other issues of importance.

4.3 Practical and Professional Skills

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

a. Integrate knowledge of mathematics, science, information technology, design, business context and engineering practice to solve engineering problems

b. Employ computational facilities, measuring instruments, workshops and laboratories equipment to design experiments and collect, analyze and interpret results.

c. Merge engineering knowledge and understanding to improve design, products and/or services.

d. Apply numerical modeling methods and/or appropriate computational techniques to engineering problems

e. Implement comprehensive engineering knowledge and understanding and intellectual skills in projects

f. Commercialize knowledge and skills to engineering community and industry

g. Apply safe systems at work.

h. Prepare and present technical material.

i. Demonstrate project management skills

j. Appreciate the neatness and aesthetics in design and approach.

k. Plan and undertake individual construction engineering projects.

l. Use laboratory and field equipment competently and safely.

m. Observe record and analyze data in laboratory as well as in the field.

n. Use appropriate computer-based support tools and software packages for problem-solving and analysis of results.

o. Prepare technical drafts and finished drawings both manually and using CAD.

p. Prepare quantity surveying reports, cost estimates, construction schedules, and plan and design the necessary elements used in a variety of construction methods.

q. Administer contracts and control time, cost and quality of projects.

r. Apply the Give technical presentation suitable for the time, place and audience.

s. Give technical presentation suitable for the time, place and audience.

u. Use the scientific literature effectively, and make discriminating use of Internet resources.

v. Display an integrated approach to the deployment of communications skills.

w. Use IT skills and display mature computer literacy.

x. Prepare and deliver coherent and structured verbal and written technical reports.

y. Give technical presentation suitable for the time, place and audience.

z. Use the scientific literature effectively, and make discriminating use of Internet resources.

aa. Work effectively with and for others, and function professionally, independently and in a multidisciplinary team.

bb. Display personal responsibility by working to multiple deadlines in complex activities.

cc. Manage time effectively.

dd. Monitor, plan and reflect upon personal, educational and career development.

ee. Communicate with others applying different codes of practice.

ff. Demonstrate significantly enhanced group working abilities.

gg. Further develop career plans and personal objectives.

4.4 General and Transferable Skills

The ability to:

a. Collaborate effectively within multidisciplinary team.

b. Work in stressful environment and within constraints.

c. Communicate effectively.

d. Demonstrate efficient IT capabilities.

e. Lead and motivate individuals.

f. Manage tasks and resources.

g. Search for information and adopt life-long self learning.

h. Acquire entrepreneurial skills..

5. PROGRAM DESCRIPTION

To achieve the above mentioned goal, a four years curriculum following the freshman year is proposed. The curriculum is planned to qualify undergraduates to have a firm grasp of the subject upon graduation and be capable of effectively participating in almost all project/site activities. To build such a necessary background, the curriculum is planed to cover the fundamental and advanced subjects in engineering and construction.

As the curriculum is based on credit hours, a total of 180 hrs should be completed by the student; about 36 credit hours of those are in the freshman year. After this first academic year, student starts to be exposed to fundamental engineering courses pertinent to Civil Engineering, design courses in Civil Engineering, and to Construction Engineering Management courses. During the last two years, the B.Sc. in Construction Engineering and Management (CEM-C) Based on Credit Hours System student is allowed to choose courses from specific electives in order to enhance his/her interest in a specific subject(s).

5.1 Curriculum Overview

The curriculum consists of courses In Humanities, Basic Science, Basic Engineering Science, and Applied Engineering. Sample Courses in each category are presented as follows:

5.1.1 Humanities and Social Sciences

• Humanities and Engineering
• English Language
• Technical Writing
• Fundamentals of Management
• Communication and Presentation Skills
• Risk Management and Environment
• Ethics and Legislation
• Human Resources Management
• Selections of Life Long Skills

5.1.2. Basic Sciences

• Mathematics
• Physics
• Mechanics
• Dynamics of Rigid Bodies
• Chemistry
• Accounting
• Economics
• Marketing

5.1.3. Basic Engineering Sciences

• Basic Architectural Design
• Fundamentals of Manufacturing Engineering
• Statistics and Probability
• Structural Analysis
• Engineering Materials
• Mechanics of Materials
• Fluid Mechanics

• Building Construction and City Planning

5.1.4. Applied Engineering Sciences

• Steel Structures Design
• Reinforced Concrete Design
• Open Channel Hydraulics
• Highway Engineering
• Soil Mechanics and Foundation Design
• Construction Project Management
• Economy strategies in construction industry
• Construction Planning and Scheduling
• Risk Management in Construction Industry
• Construction Methods.
• Law and Construction Industry
• Introduction to Construction Contracts
• Cost Engineering
• Estimating and Quantity Surveying

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)**

	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)**

	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	Selections of Life-long Skills	2
5	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 hour programs is implemented. This unified college core contains two types of course work. 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, Chemistry. The second category includes course work that all students are required to undertake in order to develop certain intended learning outcomes common to all engineering graduates. These include: Seminar work, Industrial Training, Graduation Project. The common college core consists of 45 compulsory credits representing 25% of the total credits hours of the degree. A list of common college core courses is shown in Table 2.

It is worth noting that the program contains other college core courses that are common with some other – but not all – credit hour programs. For example, there is a considerable commonality between the CEM program, STE program; Structural Engineering program, and the ABT program; Architectural Engineering and Building Technology; as will be discussed later.

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

	Code	Course Title	Credits
1	ENG-C002	General Chemistry	3
2	GEN-C003	Basic Engineering Design	2
3	ENG-C003	Engineering Drawing & Projection	3
4	IND-C004	Fundamentals of Manufacturing Processes	3
5	MEC-C001	Mechanics-1	2
6	MEC-C002	Mechanics-2	2
7	MTH-C001	Introduction to Linear Algebra and Analytic Geometry	3
8	MTH-C002	Calculus I	3
9	MTH-C003	Calculus II	3
10	MTH-C101	Calculus III & Linear Algebra	3
11	MTH-C111	Probability and Statistics	3
12	PHY-C001	Mechanics, Oscillations, Waves and Thermodynamics	3
13	PHY-C002	Electricity and Magnetism	3
14	CEM-C280	Seminar-1	1
15	CEM-C281	Industrial Training-1	1
16	CEM-C380	Seminar-2	1
17	CEM-C381	Industrial Training-2	2
18	CEM-C480	Graduation Project-1	1
19	CEM-C481	Graduation Project-2	3

In addition to the above common college core, CEM program contains 16 credits as non-common college core (interdisciplinary courses) order to cater for necessary courses from other engineering disciplines as illustrated in the Table 3 below. The 16 credits contain 2 credits as a non-engineering elective course chosen from 3 options.

Table 3. Interdisciplinary Non-Common College Core (16 Credits, 8.8% of total 180 Credits)

	Code	Course Title	Credits
1	CEM-C106	Introduction to CAD Systems	2
2	MEC-C103	Dynamics of Rigid Bodies	3
3	MTH-C102	Differential Equations	3
4	ARC-C101	Basic Architectural Design	2
5	ARC-C211	Building Construction and City Planning	2
6	CIV-C203	Mechanical and Electrical Systems	2
7	See Sample Study Plan and Course Contents	Discipline Elective: list E-2	2

5.4 Discipline Requirements

The Construction Engineering Management is a program under the umbrella of Civil Engineering Departments; Structural Engineering, Public Works, and Irrigation and Hydraulics. A Student who needs to peruse a degree in Construction Engineering Management has to finish the Civil Engineering major requirements. The discipline core contains 55 credits (30.6% from the total credits hours); from which 9 credits are elective courses. Table 4 shows a list of the Civil Engineering core courses.

Table 4. List of Civil Engineering Discipline Courses
(55 Credits, 30.6% of total 180 Credits)

	Code	Course Title	Credits
1	CIV-C101	Structural Analysis-1	3
2	CIV-C105	Engineering Materials	3
3	CIV-C103	Civil Engineering Drawing	2
4	CIV-C102	Structural Analysis-2	3
5	CIV-C104	Mechanics of Materials	3
6	CIV-C205	Surveying for Engineers	3
7	CIV-C201	Fluid Mechanics	3
8	CIV-C202	Open Channel Hydraulics	2
9	CIV-C204	Water and Waste Water Engineering	2
10	CIV-C206	Reinforced Concrete Design I	2
11	CIV-C304	Steel structures Design I	2
12	CIV-C305	Reinforced Concrete Design II	3
13	CIV-C401	Reinforced Concrete Design III	3
14	CIV-C307	Steel structures Design II	3
15	CEM-C327	Law and Construction Industry	2
16	CIV-C306	Highway Engineering	2
17	CIV-C302	Soil Mechanics	3
18	CIV-C303	Foundations	2
19	See Sample Study Plan and Course Contents	Discipline Technical Elective: list E-3	3
20		Discipline Technical Elective: list E-5	3
21		Discipline Technical Elective: list E-6	3

5.5 Major Requirements

The program offers a specialty in Construction Engineering Management. A student who wishes to complete a specialty in Construction Engineering Management must complete the minimum major requirement which represent 40 credits (22.2 % from the total credits) as presented in Table 5 below. The major courses contains 9 credits as electives; chosen from a number of options.

Table 5. List of Major Construction Engineering Courses
(40 Credits, 22.2% of total 180 Credits)

	Code	Course Title	Credits
1	CEM-C122	Introduction to Construction Engineering.	2
2	CEM-C105	Human Resources Management	2
3	CEM-C221	Economic Strategies In Construction Industry	3
4	CIV-C207	Construction Project Management	3
5	CEM-C322	Construction Planning and scheduling	3
6	CEM-C325	Construction Equipment	2
7	CEM-C424	Construction Methods	2
8	CEM-C420	Introduction to Construction Contracts	2
9	CEM-C421	Risk Management in Construction Industry	3
10	CEM-C422	Cost Engineering	3
12	CIV-C405	Estimating and Quantity Surveying	3
13	CEM-C427	Contract Administration	3
14	See Sample Study Plan and Course Contents	Major Technical Elective: list E-4	3
15		Major Technical Elective: list E-7	3
16		Major Technical Elective: list E-8	3

5.6 Conformity to SCU Requirements

Classification and categorization of courses against the guidelines provided by the Supreme Council of Universities is provided in Table 6 below. The classification is based upon the "Sample Study Plan and Program Details" given in Section 6 below. The categorization is also shown for the five student standings:

- Freshman: a student who completed less than 36 credits
- Sophomore: a student who completed more than 35 credits but less than 72 credits
- Junior: a student who completed more than 71 credits but less than 108 credits
- Senior-1: a student who completed more than 107 credits but less than 144 credits
- Senior-2: a student who completed more than 143 credits but less than 180 credits

Note that the total contract hours of the program are 300 real hours as a result of implementing the concept of 3 contact hours for 1 credit of tutorials or laboratory work, as shown in Table 7.

Table 6. Conformity to Supreme Council Criterion

Category	Freshman	Sophomore	Junior	Senior-1	Senior-2	Total Credits	%
Humanities and Social Sciences	4	6	9	9	0	28	15.5
Basic Sciences	24	9	3	0	0	36	20.0
Engineering Sciences	8	18	14	3	0	43	23.9
Applied Engineering Sciences	0	2	11	25	35	73	40.6
Total	36	35	37	37	35	180	100
University Requirements	6	4	8	6	0	24	13.3
College Requirements	30	3	4	2	6	45	25.0
Discipline Requirements	0	24	19	19	9	71	39.5
Major Requirements	0	4	6	10	20	40	22.2
Total	36	35	37	37	35	180	100

Table 7. Course Status of CEM Program and Equivalent Contact Hours

			Equivalent Contact Hours			
	Courses	**Credits**	**LEC**	**PS**	**PP**	**Total**
Compulsory =	64	154	94	118	48	260
Electives =	10	26	16	24	0	40
Total =	74	180	110	142	48	300
			36.7%	47.3%	16.0%	100%

6. SAMPLE STUDY PLAN and PROGRAM DETAILS

The following tables provide a sample study plan divided over 10 main semesters. Particulars of each course such as code, prerequisite, credits, categorization of credits

over lectures and tutorials, total contact hours, are given, in addition to various course classifications.

The curriculum also gives the students the opportunity to select 10 courses from eight groups of electives. Each group of discipline and major electives contains three courses to choose from (i.e., total of 26 choices); which represent about 14.4% of the total credits of the degree. Students in the Construction Engineering Management are also encouraged to participate in research through independent study projects. Moreover, the curriculum gives the students the opportunity to interact with the industrial sector and government agencies through two practical training summer courses. In addition, students will be exposed to large construction project in their practical training and graduation projects.

Freshman, Fall Semester (18 Credits, 7 Courses)		S1
Code	**Course Title**	**Credits**
GEN-C002	English Language	2
ENG-C001	Computers for Engineers	2
ENG-C003	Engineering Drawing & Projection	3
MEC-C001	Mechanics-1 (Statics)	2
MTH-C001	Introduction to Linear Algebra and Analytic Geometry	3
MTH-C002	Calculus I	3
PHY-C001	Mechanics, Oscillations, Waves and Thermodynamics	3

Freshman, Spring Semester (18 Credits, 7 Courses)		S2
Code	**Course Title**	**Credits**
ENG-C002	General Chemistry	3
GEN-C001	Humanities and Engineering	2
GEN-C003	Basic Engineering Design	2
IND-C004	Fundamentals of Manufacturing Processes	3
MEC-C002	Mechanics-2 (Dynamics)	2
MTH-C003	Calculus II	3
PHY-C002	Electricity and Magnetism	3

Sophomore, Fall Semester (18 Credits, 7 Courses)		S3
Code	**Course Title**	**Credits**
CEM-C106	Introduction to CAD Systems	2
GEN-C005	Fundamentals of Management	2
CIV-C103	Civil Engineering Drawing	2
MEC-C103	Dynamics Of Rigid Bodies	3
MTH-C101	Calculus III & Linear Algebra	3
CIV-C101	Structural Analysis-1	3
CIV-C105	Engineering Materials	3

Sophomore, Spring Semester (17 Credits, 7 Courses)		S4
Code	**Course Title**	**Credits**
ARC-C101	Basic Architectural Design	2
GEN-C103	Technical Writing	2
MTH-C102	Differential Equations	3
CIV-C102	Structural Analysis-2	3
CIV-C104	Mechanics of Materials	3
CEM-C105	Human Resources Management	2
CEM-C122	Introduction to Construction Engineering	2

Junior, Fall Semester (18 Credits, 7 Courses)		S5
Code	**Course Title**	**Credits**
ARC-C211	Building Construction and City Planning	2
GEN-C409	Economics	2
CIV-C201	Fluid Mechanics	3
MTH-C111	Probability and Statistics	3
CIV-C204	Water and Waste Water Engineering	2
CIV-C205	Surveying for Engineers	3
CIV-C207	Construction Project Management	3

Junior, Spring Semester (19 Credits, 9 Courses)		S6
Code	**Course Title**	**Credits**
GEN-C206	Communication and Presentation Skills	2
GEN-C007	Accounting	2
GEN-C108	Risk Management & Environment	2
CIV-C202	Open Channel Hydraulics	2
CIV-C203	Mechanical and Electrical Systems	2
CEM-C221	Economic Strategies in Construction Industry	3

	Discipline Elective (list E-2)	2
	Discipline Technical Elective (list E-3)	3
CEM-C280	Seminar-1	1

Senior-1, Fall Semester (17 Credits, 8 Courses)		S7
Code	**Course Title**	**Credits**
CEM-C281	Industrial Training-1	1
GEN-C3XX	University Elective (list E-1, recommended GEN-C010)	2
GEN-C3XX	University Elective (list E-1)	2
CIV-C302	Soil Mechanics	3
CIV-C206	Reinforced Concrete Design I	2
CIV-C304	Steel Structures Design I	2
CEM-C322	Construction Planning and Scheduling	3
CEM-C325	Construction Equipment	2

Senior-1, Spring Semester (20 Credits, 9 Courses)		S8
Code	**Course Title**	**Credits**
GEN-C3XX	University Elective (list E-1)	2
CIV-C306	Highway Engineering	2
CIV-C303	Foundations	2
CIV-C305	Reinforced Concrete Design II	3
CIV-C307	Steel Structures Design II	3
CEM-C327	Law and Construction Industry	2
CEM-C424	Construction Methods	2
CEM-C380	Seminar-2	1
	Major Technical Elective (list E-4)	3

Senior-2, Fall Semester (17 Credits, 7 Courses)		S9
Code	**Course Title**	**Credits**
CEM-C381	Industrial Training-2	2
CEM-C420	Introduction to Construction Contracts	2
CEM-C422	Cost Engineering	3
CIV-C401	Reinforced Concrete Design III	3
	Discipline Technical Elective (list E-5)	3
	Discipline Technical Elective (list E-6)	3
CEM-C480	Graduation Project-1	1

Senior-2, Spring Semester (18 Credits, 6 Courses)		S10
Code	**Course Title**	**Credits**
CEM-C421	Risk Management in Construction Industry	3
CIV-C405	Estimating and Quantity Surveying	3
CEM-C427	Contract Administration	3
CEM-C 4XX	Major Technical Elective (list E-7)	3
CIV-C411 CEM-C 4XX	Major Technical Elective (list E-8)	3
CEM-C481	Graduation Project-2	3

Program Electives

E-1. University Electives, 6 Credits (2 credits per course)

Student should select only three (3) courses equivalent to 6 credits, such that one of the selected courses must be GEN-C010 .

	Code	Course Title	Credits
1	GEN-C010	Ethics and Legislation	2
2	GEN-C011	Technical Writing in Arabic	2
4	GEN-C013	Marketing	2
5	GEN-C014	Selections of Life-long Skills	2
6	GEN-C332	Service Management	2

E-2. Discipline Elective, 2 Credits (2 credits per course)

Student should select only one (1) course equivalent to 2 credits.

	Code	Course Title	Credits
1	ARC-C203	Urban Planning	2
2	CIV-C309	Operation Research	2
3	GEN-C342	Decision Support System	2

E-3. Discipline Technical Elective, 3 Credits (3 credits per course)

Student should select only one (1) course equivalent to 3 credits.

	Code	Course Title	Credits
1	CIV-C301	Introduction to Water Resources Engineering	3

2	CIV-C342	Ground Water Control Systems	3
3	CIV-C341	Masonry Structures	3

E-4. Major Technical Elective, 3 Credits (3 credits per course)

Student should select only one (1) course equivalent to 3 credits.

	Code	Course Title	Credits
1	CIV-C343	Transportation and Logistic Management	3
2	CEM-C342	Project Resources Management	3
3	CEM-C344	Construction Material and Quality Control	3
4	CEM-C447	Strategic Planning	3

E-5. Discipline Technical Elective, 3 Credits (3 credits per course)

Student should select only one (1) course equivalent to 3 credits.

	Code	Course Title	Credits
1	CIV-C441	Advanced Surveying and Digital Mapping	3
2	CEM-C423	Financial Management	3
3	CEM-C443	Temporary Structures and Form Work Design	3

E-6. Discipline Technical Elective, 3 Credits (3 credits per course)

Student should select only one (1) course equivalent to 3 credits.

	Code	Course Title	Credits
1	CIV-C446	Deep Excavation and Side Support	3
2	CIV-C407	Steel Structures Design III	3
3	CEM-C453	Project Specifications and Bids	3

E-7. Major Technical Elective, 3 Credits (3 credits per course)

Student should select only one (1) course equivalent to 3 credits.

	Code	Course Title	Credits
1	CEM-C448	Quality and Safety Management	3

2	CEM-C449	Organization Management	3
3	CEM-C456	Claims In Construction Industry	3

E-8. Major Technical Elective, 3 Credits (3 credits per course)

Student should select only one (1) course equivalent to 3 credits.

	Code	Course Title	Credits
1	CIV-C411	Special Concrete Structures	3
2	CEM-C452	Information Technology in Construction	3
3	CEM-C454	Special Problems in Construction	3
4	CEM-C455	Feasibility Studies and Project Evaluation	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 different technologies 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 Keywords, 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	**Selections 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-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 COURSES

ENG-C002	**General Chemistry Compulsory, Credits: 3 (2+1+1) Prerequisite(s):** Gaseous state , Thermo chemistry , Material and thermal balance in combustional processes , Liquid state , Solutions , Thermo-chemistry , Corrosion , Chemical equilibrium , Ionic equilibrium , Water treatment , Air pollution , Selected chemical industries (Cement – Oils and Lubricants – Polymers – Semiconductors). .
GEN-C003	**Basic Engineering Design Compulsory, Credits: 2 (1+2+0) Prerequisite(s):** 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 and the Positive Attitudes for Creativity - Systematic generation and evaluation of ideas.
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
IND-C004	**Fundamentals of Manufacturing Processes Compulsory, Credits: 3 (2+1+1) 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.
MEC-C001	**Mechanics-1 (Statics) 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-2 (Dynamics) 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.
MTH-C001	**Introduction to Linear Algebra and 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-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.
PHY-C001	**Mechanics, Oscillations, Waves and Thermodynamics Compulsory, Credits: 3 (2+1+1)** **Prerequisite(s):** Physics and measurements; elastic properties of solids; universal gravitation and motion of planets; fluid mechanics (statics and dynamics); oscillatory motion; wave motion, sound waves; thermodynamics, 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 the course topics.
PHY-C002	**Electricity and Magnetism Compulsory, Credits: 3 (2+1+1)** **Prerequisite(s):** 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.
CEM-C280	**Seminar-1 Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): 72 Credits + AA Approval** Talks and presentations are invited from industrial establishments relevant to the program. The guest speaker should discuss the organization, management, and recent technologies implemented in his/her industrial establishment. Students exercise writing a technical report on the guest presentation and deliver their own presentation about the topic. The course is graded as Pass/Fail system.
CEM-C380	**Seminar-2 Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): CEM-C280** All students will be required to present seminars in a subject assigned to (or chosen by) them on latest technology relevant to the program. 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.

CEM-C281	**Industrial Training-1 Compulsory, Credits: 1 (0+0+3) Prerequisite(s): 90 Credits + AA Approval** 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 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 system.
CEM-C381	**Industrial Training-2 Compulsory, Credits: 2 (0+0+6) Prerequisite(s): CEM-C281 + 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 pays 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 system.
CEM-C480	**Graduation Project-1 Compulsory, Credits: 1 (0+0+3) Prerequisite(s): 136 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 courses graded as Pass/Fail system.
CEM-C481	**Graduation Project-2 Compulsory, Credits: 3 (1+0+6) Prerequisite(s): CEM-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 students examined orally.

7.3 INTERDISCIPLINARY NON-COMMON COLLEGE COURSES

CEM-C106	**Introduction to CAD Systems Compulsory, Credits: 2 (1+0+2) Prerequisite(s): ENG-C001 + ENG-C003** The aim of this course is to explore current CAD technologies and develop skills in the use of specialist CAD software to produce 2D and 3D design specifications, to transform CAD drawings into photo realistic virtual products and to gain an awareness of CAD data and how such information can be transformed to engineering drawings. At the end of the course, the students will understand a variety of terms and terminology as applied to CAD technology; demonstrate the use of an industry standard operating system to create standard CAD packages for 2D and 3D design drawings.

MEC-C103	**Dynamics of Rigid Bodies Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): MEC-C002** Planar kinematics of rigid bodies- center of mass- moment of inertia - planar kinetics of rigid body: linear and angular equations – application of the equations of motion of rigid body, translation, rotation about a fixed axis, and general plane motion - Principle of Work and Kinetic Energy- Conservation of Mechanical Energy- Principle of Impulse and Momentum – Introduction to Vibrations.
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.
ARC-C101	**Basic Architectural Design Compulsory, Credits: 2 (1+1+1)** **Prerequisite(s): GEN-C003 + ENG-C003** Introduction to design, Design as A goal Directed Activity, The Management Of Architectural Information, Architectural Design and Decision Making, Basic Elements of Architectural Design, The Architectural Design Matrix, Form and Form Generation, Space and Compositions, The Building Matrix.
ARC-C211	**Building Construction and City Planning Compulsory, Credits: 2 (1+1+1)** **Prerequisite(s): ARC-C101** Introduction; Aim and definitions; Building construction stages; Wall bearing structures: stone construction, masonry-raw bricks and brick masonry; Vertical circulation element; Stairs detailing, Complementary and finishing materials; Construction building types; Urban and city planning approaches and basic guidelines of the field.
CIV-C203	**Mechanical and Electrical Systems Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s):** Introduction to electrical circuits; Electrical installation in residential and industrial buildings (illumination networks in rural areas, data lines, telephone lines & antenna, control of air conditioning, lift); Requirements of audio systems; Alarm devices (fire - security - gas); HVAC components and systems; Plumbing elements and features; Essential mechanical systems used in typical residential and institutional projects.
ARC-C203	**Urban Planning Elective, Credits: 2 (1+2+0)** **Prerequisite(s): ARC-C211** This course examines the evolving structure of cities and the way that cities, suburbs, and metropolitan areas can be designed and developed. International cities studied to see how physical, social, political and economic forces interact to shape and reshape cities over time.
CIV-C309	**Operation Research Elective, Credits: 2 (1+2+0)** **Prerequisite(s):** Introduction - Linear programming, Network analysis, Decision analysis, Random processes, Queuing models, Inventory analysis, Simulation, Dynamic

	programming, Nonlinear programming, Game Theory, Waiting line theory.
GEN-C342	**Decision Support Systems Elective, Credits: 2 (1+2+0) Prerequisite(s):** Management Support Systems. Decision Making Process: Systems, Models, Sensitivity Analysis, "What-If?" Analysis, Goal Seeking, DSS Characteristics, DSS Components, DSS Hardware and Software, Static and Dynamic Models, Handling Certainty and Uncertainty, Mathematical, Programming, Simulation, Heuristic Programming, Forecasting, Financial and Planning Modeling. Artificial versus Natural Intelligence, Knowledge in AI. Fundamentals of Expert Systems.

7.4 DISCIPLINE COURSES

CIV-C101	**Structural Analysis-1 Compulsory, Credits: 3 (2+2+0) Prerequisite(s):** Types of structures, loads supports, reactions, internal forces, analysis of beams, frames, trusses. Influence lines of statically determined structures, Moving loads
CIV-C105	**Engineering Materials Compulsory, Credits: 3 (2+1+1) Prerequisite(s): PHY-C001 + MEC-C001** Classification of types of materials- Concrete and asphalt concrete; constituent materials and their properties, mix design, manufacture, properties, and standard and quality control testing- Steel, Building stones- Bricks- Timber- Heat insulating and acoustic materials. Laboratory: Testing for QC.
CIV-C103	**Civil Engineering Drawing Compulsory, Credits: 2 (1+1+1) Prerequisite(s): ENG-C003** Steel structures drawing: Built up sections – Beam connections – Beam to column connections – Trusses and bridges. Irrigation drawing: Canals and drains cross sections – slopes – walls – Siphons – Culverts – Aqueducts – Locks – regulators – Short span bridges. Concrete drawing: Slabs – Simply supported and continuous beams – Cantilever beams – Columns – Footings - Laboratory sessions about using AutoCad software in engineering drawing.
CIV-C102	**Structural Analysis-2 Compulsory, Credits: 3 (2+2+0) Prerequisite(s): CIV-C101** Deformations: deferential equations, virtual work. Indeterminate structures: consistent deformation, moment distribution. Buckling of columns.
CIV-C104	**Mechanics of Materials Compulsory, Credits: 3 (2+2+0) Prerequisite(s): CIV-C105** Mechanics of materials: Loads – Stresses – strains – Deformations – Elastic constants – Failure theories – Mechanical properties- Testing machines – Strain gages – Calibration – Strength and behavior of materials under static loads: Tension – Compression – Bending – Torsion – Ordinary and non-ordinary construction materials – Laboratory sessions describing the previously mentioned topics

CIV-C205	**Surveying for Engineers Compulsory, Credits: 3 (2+1+1) Prerequisite(s): MTH-C003** Theory of measurements and errors – Longitudinal measurements and its corrections – Surveying using longitudinal measurements – Electronic measurement of distance – Topographic survey – Angular measurements – topographic areas and dividing lands – Angular measurements using Theodolites – Total stations – Traverses – Tacheometric surveying – Map drawing – Volume of land fill – Field calculations.
CIV-C201	**Fluid Mechanics Compulsory, Credits: 3 (2+1+1) Prerequisite(s): PHY-C001** Definitions – Fluid properties – Fluid statics – Up-thrust force of fluids – equilibrium of floating objects – Kinematics of fluid flow – Conservation of energy laws in steady flow: Bernoulli equation and its applications – Fluid measurements – Fluid momentum and the forces acting on moving fluids and its applications – Laminar flow in pressure conduits – Viscous and turbulent flow – Main and secondary losses – Hydraulic analysis of pipeline networks.
CIV-C202	**Open Channel Hydraulics Compulsory, Credits: 2 (1+1+1) Prerequisite(s): CIV-C201** Channel flow: Uniform flow – Design of cross sections of open channels – Rapid varying flow: Hydraulic jump – Weirs – Gradually varying flow: Fluid surface shapes and its calculations – Back water curves – Hydraulic of channels with sedimentary sides: Properties of sedimentary materials – Motion initiation – Roughness of water channels – Behavior of sedimentary materials – Design of canals – Hydroelectric projects and turbines – Dimensional analysis and hydraulic models.
CIV-C204	**Water and Waste Water Engineering Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s):** Introduction– Definitions– Fields of Environmental Engineering– Environmental system – waste cycles – Main Environmental problems – Global problems – water pollution – water supply Engineering – water purification works – water Distribution system and Storage tanks. Sanitary Drainage. Sewerage System – wastewater Treatment Works.
CIV-C206	**Reinforced Concrete I Compulsory, Credits: 2 (1+2+0) Prerequisite(s): CIV-C102 + CIV-C104** Methods of design; Codes; Structural systems and load distribution; Design using limit states method; Section subjected to bending moments; Section subjected to shear and torsion; Reinforcement details for beams; Limit state of deflection, Working stress design method.
CIV-C304	**Steel Structures Design I Compulsory, Credits: 2 (1 +2+0) Prerequisite(s): CIV-C102 + CIV-C104** Introduction to structural steel design – Design criteria (materials, loads, and systems) – General layout – Design of tension members –Design of compression members – Design of beams – Design of beam-columns.

CIV-C305	**Reinforced Concrete Design II Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C206** Design and reinforcement details: solid slabs, ribbed slabs, paneled beams slab, flat slabs (beamless slabs), stairs; Design of sections under axial forces; Design of sections under eccentric forces; Design and reinforcement details of concrete columns.
CIV-C401	**Reinforced Concrete Design III Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C305** Statical systems for halls with large spans – Design of reinforced concrete frames - Design of reinforced concrete trusses – Industrial building roofs (indirect light) – Design of rectangular and circular reinforced concrete fluid tanks.
CIV-C307	**Steel Structures Design II Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C304** Welded connections – Bolted connections (bearing and friction bolts) –Steel details for frames – Steel details for trusses – steel details for wind bracing.
CEM-C327	**Law and Construction Industry Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): GEN-C010** Theory of Obligation; definition, forms. Sources of Obligations. The contract; Parties, Formation, Validity, Effect, Interpretation, Responsibilities, Dissolution, and compensation of Damage. Types of Engineering Contracts. Construction Contracts. Liability of the engineer and contractor in design, supervision and construction; Dispute resolutions; Adjudication, mediation, Arbitration. Commercial Law; Commercial activities, Merchant.
CIV-C306	**Highway Engineering Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s):** Transportation planning: Introduction to transportation planning – Essential principles and definitions – Elements of transportation planning chart – Data base for transportation planning – Introduction to prediction models for transportation demand – Introduction to planning and management of traffic and public transportation – Principles of assessment of transportation charts and urgent programs for traffic management. Engineering traffic: Definitions of basic variables in traffic movement – The Vehicle – The driver – The road – Curriculum of traffic data analysis: Traffic volumes – Speed – Lag time – Waiting times – Accidents – Road capacity – Method of traffic control: Traffic lights – Traffic signs – Traffic rules.
CIV-C302	**Soil Mechanics Compulsory, Credits: 3 (2+1+1)** **Prerequisite(s): CIV-C102 + CIV-C104** Introduction – Methods of soil formation – Basic principles of soil – Soil classification – Soil compaction – Soil permeability – Effective stresses – Soil stresses – Analysis of soil settlement – Consolidation of soil – Shear strength of soil – Lateral earth pressure – Soil bearing strength.

CIV-C303	**Foundations Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): CIV-C302** Design of shallow foundation – Deep foundations and piles – Retaining walls – Water evacuation form an excavation site – Slope stability – Site soil tests and research – Choice of best type of foundation for a certain soil.
CIV-C301	**Introduction to Water Resources Engineering Elective, Credits: 3 (2+2+0)** **Prerequisite(s):** Hydrologic cycle, precipitation, infiltration, evaporation and evapo-transpiration, rainfall - runoff relationships (rational method, unit hydrograph, statistical and probability approaches), stream flow hydrographs, types of aquifers, groundwater flow equations, well hydraulics, monitoring of groundwater levels, hydraulic characteristics of aquifers, groundwater management and safe yields.
CIV-C342	**Ground Water Control Systems Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C302** Soil Permeability – Seepage – Groundwater Control systems –Construction Dewatering – Grout plugs – Selection of Proper System.
CIV-C341	**Masonry Structures Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C206** Masonry Materials, Development of Building Structures, Elements, Systems. Types of Masonry Construction (Un-reinforced, Reinforced, Prestressed), Structural Design, Structural Requirements, Mortar –Grout – Reinforcement – Masonry Assemblages – Strength; Flexural, Axial compression, Combined axial comp. and Flexure, and Shear. Beams and Lintels. Axial and out of Plane loads, Columns and Pilasters, Shear Walls, Construction Considerations and Details
CIV-C441	**Advanced Surveying and Digital Mapping Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C205** Geodesy: Introduction in Geodetic Sciences – Earth's shape – Coordinate systems – Calculations on the ellipsoid surface – Calculations on the spherical surface – Geodetic connecting networks – Method of constructing Geodetic connecting networks – Triangular networks – Observation and signaling towers – Noncentralized observations – Conditions for the strength of shapes – Introduction in geographic information systems – Geodetic longitudinal measurements – Accurate longitudinal measurements – Probabilistic distribution of observation measurements – Measurements and observation weights – Least squares principle – Observations adjustment using matrices – Introduction to global positioning systems (GPS) Introduction to photogrammetry: Aerial cameras – Vertical photographs – Tilted photographs – Corrections – Normal photographs – Measurements and corrections of photograph coordinates – Flight planning – Stereographs – Aiming theory – Digital photographic surveying
CEM-C423	**Financial Management Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CEM-C221** Review of accounting principles - Financial planning – Capital-cost control; cycle; economic study – financial ratio analysis – financial markets - Value-control cycle: preliminary return analysis; comparative return analysis – Debit and loan management – risk and return –stocks and bonds – mortgagee: first market; second market.

CEM-C443	**Temporary Structures and Form Work Design Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C305** Introduction to construction applications of concrete, Economy and safety of formwork, Material properties and allowable stresses, Design loads of formwork (vertical loads , lateral pressure), Method of analysis, Forms for footings, Forms for walls and columns, Forms for beams and floor slabs, Failures of formwork, Shores and scaffolding.
CIV-C446	**Deep Excavation and Side Support Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C302** Introduction to deep excavation – Slope stability – Construction of: sheet pile walls, -Selection of proper Retaining system – Insulation
CIV-C407	**Steel Structures Design III Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C307** Steel bridges – Special steel structures (Tanks, silos, and towers) –Steel fabrication and erection (inspection procedures and tolerances) –Shop drawings.
CEM-C453	**Project Specification and Bids Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CEM-C420** Bids vs. negotiations, open bids vs. short listed bidders, instructions to bidders, bid forms, pre-qualifications, bid management, addenda and response to queries, bid opening and review, evaluation and recommendation, bid documents and their priority, preliminary vs. general requirements, types of specifications, reference, cash allowance, specification deficiency and common errors, specifications and liability, case studies.

7.5 MAJOR COURSES

CEM-C122	**Introduction to Construction Engineering Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s):** Construction industry and national economy, construction project concepts and characteristics, construction project life cycle, major types of construction, sample construction projects, design and construction integration, innovation, constructability and technological feasibility, organizing for project participants, organization structure and staffing, work breakdown structure, construction quality, safety concerns.
CEM-C105	**Human Resources Management Compulsory, Credits: 2 (2 +0+0)** **Prerequisite(s): GEN-C005** HR planning: Job analysis, demand for HR, Supply of HR – Staffing: Recruitment, Selection – Training and development – Performance Appraisal – Compensation: Type of equity, Designing the pay structure, employee benefits – Labor/management relations – Motivation – Leadership – Communication
CEM-C221	**Economy Strategies in Construction Industry Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): GEN-C409** Money/time analysis, Alternative comparison, rate of return, cost/benefit ratio, depreciation and taxes, replacement analysis, public utilities analysis, estimating for economic analysis, capital planning and budgeting, introduction to risk and

	uncertainty, sensitivity analysis, bond and shares, mortgage.
CIV-C207	**Construction Project Management Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): CEM-C122** Project management definition, project delivery methods, contracting strategies, basic management functions, construction scheduling, bar charts, AOA and AON networks, critical path method, construction resources, material management, labor productivity, construction equipment, design and analysis of construction operations, construction cost, cost estimating, direct and indirect costs, cash flow calculations, introduction to management information systems.
CEM-C322	**Construction Planning and Scheduling Compulsory, Credits: 3 (2+1+1)** **Prerequisite(s): CIV-C207** Construction planning, importance of scheduling, scheduling techniques, program evaluation and review technique (PERT), line of balance, schedule updating, project crashing, time cost trade-off, resource scheduling, resource allocation and leveling techniques, project planning and control using commercial software.
CEM-C325	**Construction Equipment Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): CEM-C221 + CIV-C207** Introduction to types and sizes of equipment, equipment selection factors, economic principles, equipment acquisition, productivity, cost and time analysis, earthwork equipment, lifting and loading equipment, concrete equipment, pumping equipment, asphalt equipment, equipment fleet management, financing, safety and maintenance.
CEM-C424	**Construction Methods Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): CEM-C325** Building construction systems, traditional, mechanized and prefabrication construction systems. Dewatering systems. Construction methods for roads, pipelines, and tunnels. Evaluation and selection of appropriate construction technology. Construction site layout planning
CEM-C420	**Introduction to construction Contracts Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): CIV-C207 + CEM-C327** National and international legal systems, types of Engineering Contracts. Construction Contracts. Legal responsibilities in construction contractors contractual responsibilities and relationships, interactions with project planning, administration, completion, and startup, bonding, liens and holdbacks, tendering, types of construction contracts, contents of a contract document, application of typical contract clauses to construction-related issues.
CEM-C421	**Risk Management in Construction Industry Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): CEM-C420** Roots of uncertainty in construction projects, need for risk management, steps for managing project risks, risk identification, risk assessment and analysis, qualitative and quantitative approaches, risk mitigation and transfer strategies, risk sharing, risk control during project execution, organizing for risk management, role of risk manager, risk-based decision making, risk considerations for various project participants.

CEM-C422	**Cost Engineering Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C207** Importance of cost engineering, cost estimating, types of estimates, feasibility estimate, budget estimate, detailed estimate, direct cost estimating, quantity take-off, construction resource pricing, indirect costs, general and administrative expenses, risk and contingency estimate, concept of cost monitoring and control, cost breakdown structure, earned value concept, performance indices, cost prediction at completion, value engineering.
CIV-C405	**Estimating and Quantity Surveying Compulsory, Credits: 3 (2+1+1)** **Prerequisite(s): CEM-C422** Bidding process and requirements, bid documents, construction quantities, take-off principles, methods of measurement, pricing for resources, unit pricing, overheads, writing the bill, measuring and valuation of works during project execution, updating and reporting, construction project exercises.
CEM-C427	**Contract Administration Compulsory, Credits: 3 (3+0+0)** **Prerequisite(s): CEM-C420** Professional contract administration, contractual arrangements, legal background, standard contract forms, contract documentation, site organization and supervision, communication and personal skills, valuation of work, claims & disputes, negotiations, project closure.
CIV-C343	**Transportation and Logistic Management Elective, Credits: 3 (2+2+0)** **Prerequisite(s):** Transport systems and basic definitions- Introduction to transport planning and management - Transport operations and scheduling - Logistics supply chain management - Vehicle routing and scheduling - Cost elements - Private participation in transport logistics - International technical cooperation in transport logistics - computer applications.
CEM-C342	**Project Resources Management Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C207** Introduction – critical project resources – material management: planning & control; Procurement & acquisition, costs; Material management information systems – inventory analysis – inventory factors – Human resources management: manpower planning and organization; job description & evaluation; recruiting and training; wage incentive systems; labor relations – site management: selection &layout; preparation and evacuation – case study.
CEM-C344	**Construction Material and Quality Control Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C102 + CIV-C105** Introduction: Engineering materials – Measurements standardization – Standard specifications – Codes – Principle of general quality – Quality control – Principles of strength of materials – Material internal structure – defects – definition of different material phases – Concrete technology: Reinforced concrete materials: Aggregates – Cement – Mixing water – Additives – Reinforcement steel – Concrete industry – Guidelines for quality control –-QC procedures and testing.
CEM-C447	**Strategic Planning Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CEM-C221 + CEM-C322** Competitiveness and strategies, strategic management goals, strategic management process, mission and objectives, resources and capabilities, types and levels of strategies, strategy formulation, Porter's generic strategies, portfolio planning, adaptive strategies, strategy implementation, management practices and

	systems, corporate governance, leadership.
CEM-C448	**Quality and Safety Management Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C207** Quality and safety concerns in construction, organizing for quality and safety, work and material specifications, quality control and inspection, statistical methods, sampling by attributes and variables, total quality management (TQM), ISO concepts and regulations, basics of safety management, OSHA requirements for construction operations, safety plans.
CEM-C449	**Organization Management Elective, Credits: 3 (2+2+0)** **Prerequisite(s):** A survey of classical and modern organization theory; concepts and function of management, the behavior of the individual, the work group, and the organization, all related to construction problems.
CEM-C456	**Claims in Construction Industry Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CEM-C420 + CEM-C322** Definition & Classification, Generation and Procedure of Claims, Claim categories: Claims concerning the Existence of a contract, Claims arising form documentation , Claims arising in connection with exclusion of the works, Claims concerning payment provisions, Claims concerning time, Claims arising from default, determination, Presentation of claims: Mediation, Conciliation, Adjudication, Arbitration, Litigation.
CIV-C411	**Special Concrete Structures Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C305** Pre-stressed concrete – Precast concrete – Composite sections – Shear walls – Retaining walls – Deep beams.
CEM-C452	**Information Technology in Construction Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CIV-C207** Software systems in construction management: scheduling, cost estimating, material management, documents management and, 4DCAD systems. Introduction to Building Information Modeling. Use and design of databases and programmable spreadsheets for construction applications.
CEM-C454	**Special Problems in Construction Elective, Credits: 3 (2+2+0)** **Prerequisite(s): 136 Credits** Special problems in the field are studied under supervision of a faculty member in the program. A final report is submitted to fulfill course requirements.
CEM-C455	**Feasibility Studies and Project Evaluation Elective, Credits: 3 (2+2+0)** **Prerequisite(s): CEM-C221 + CEM-C322** Stages of project feasibility analysis – generation and screening of venture ideas – preparation of terms of reference – pre-feasibility stage– market analysis – technical analysis – financial and economic analysis – sensitivity analysis – evaluation: analyzing historical performance; forecasting performance; estimating the cost of capital-project evaluation methods: comparison sailing; cost calculation; income generation