Section 4

Construction Engineering and Management Program (CEM)

Based on Credit Hours System (CHS)

September 2013

1. INTRODUCTION

Construction is one of the largest and most important industries in the world today. With modern technological advancements, construction is rapidly becoming one of the most difficult and complex businesses to manage. Statistics indicate that the manpower involved in that construction sector represents over 11% of the total Egyptian workforce. The construction sector is considered one of the largest industries in Egypt, and in the world as well. This can be revealed from its share in .the total National Gross Income which approaches about 8%

Contemporary construction practice demands that the construction professional not only understands construction concepts, but also have a strong background in engineering and management techniques. Emphasis is placed on new technologies, developments, and techniques in both domestic and international construction fields. The field of construction engineering and management is obviously critical to the development of civil infrastructure. Every new construction project involves a design phase followed by a construction phase. The study of project management spans all phases of the project life cycle, from preliminary feasibility analysis and concept development through to commissioning of the project. The study of construction management focuses on the construction or execution phase. Both of these disciplines contain interrelated processes that should be offered to graduates. Therefore, Cairo University, Faculty of Engineering is proposing to establish a new bachelor program in Construction Engineering and Management (CEM) based on the credit-hours system (CHS) of education. This program will train the students in construction management which is considered a multidisciplinary field that integrates engineering, technology and management of people and physical resources. As such, the graduates would be able to carry out successful design and to develop, construct and operate residential, commercial and public properties.

2. PROGRAM MISSION

The construction sector is one of the most dynamic sectors in the Egyptian economy and has been growing rapidly since the 1980s. The development and competitiveness of the Egyptian construction sector in the local and international markets is affected by five factors including; construction companies, government policies and strategies, available resources, institutional backing and supporting industries. Modifications and developments within these categories will lead to further growth and greater competitiveness[1]. The Faculty of Engineering, Cairo University, has the initiative of proposing this newly developed program which is concerned with the CEM in order to address the fourth factor (institutional backing). The graduates of the program are essentially a good support for the government in achieving the established policies and plans with respect to private and public sectors. For the former sector, they help in running private sectors investments because of their solid backgrounds in project and construction managements. Whereas, for the public sector, the graduates would fill the

[1] The Construction Sector in Egypt - Development and Competitiveness, American Chamber of Commerce in Egypt, September 2003

gap that exists in public agencies including Ministry of Housing, Utilities and Urban Communities, Housing and Building Research Center (HBRC), the Holding Company for Housing, etc.

Furthermore, the graduates of the program (who possess special skills and capabilities) would be highly demanded in region due to several factors:

- Program specialty and its scarcity in the region.
- Booming in the construction sector.
- Dealing with international construction companies and engineering firms which deals with international forms of contracts (e.g., FIDIC).

The above-mentioned reasons clarify the importance and the feasibility of the proposed CEM program in the national and regional levels for both private and public sectors.

3. EDUCATIONAL OBJECTIVES

One of the main goals of the Faculty of Engineering, Cairo 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, Cairo 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 stage.
- 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 this program graduates must be able to demonstrate knowledge and understanding of:

a) Essential facts, concepts, principles and theories relevant to civil engineering
b) Natural sciences, mathematical methods and principles of civil engineering sciences as applied to civil engineering systems
c) Engineering principles in the fields of reinforced concrete and metallic structures analysis and design, geotechnics and foundations, hydraulics and hydrology, water resources, environmental and sanitary engineering, roadways and traffic systems, surveying and photogrametry, Properties, behavior and fabrication of building materials
d) Up-to-date technology relevant to civil engineering disciplines
e) Projects' and construction management, including planning, finance, bidding and contracts
f) Procedures and quality systems
g) Codes of practice in civil engineering disciplines and the regularity framework in design and practice
h) Professional and ethical responsibilities that should be taken by civil engineer
i) Broad education necessary to understand the impact of civil engineering solutions on the environment

4.2 Intellectual Skills

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

a) Adopt, create and innovate thinking in solving problems, and in designing systems, components and processes
b) Demonstrate a high level of competence in identifying, defining and solving civil engineering problems
c) Adopt appropriate mathematical principles, natural sciences, technology, computing methods, design techniques and codes of practice in civil engineering disciplines, for modeling, analyzing and solving engineering problem
d) Apply appropriate structural analysis and codes of practice in designing reinforced concrete and metallic structures of all types
e) Apply appropriate geotechnical techniques and codes of practice to determine levels, types and design systems of building foundations, tunnels and excavations
f) Define, plan, conduct and report management techniques
g) Assess and evaluate different techniques and strategies for solving engineering problem
h) Apply engineering principles, theories and sciences in solving environmental and socioeconomic problems
i) Solve engineering problems, on the basis of limited and possibly contradictory information
j) Maintain a sound theoretical approach in dealing with new and advancing technology
k) Select and apply appropriate IT tools to a variety of engineering problems
l) Assess and analyze risks, and take appropriate steps to manage them

4.3 Practical and Professional Skills

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

a) Use laboratory and field equipment competently and safely
b) Observe record and analyze data in laboratory as well as in the field

c) Demonstrate basic organizational and construction management skills
d) Use appropriate specialized computer software, computational tools and packages
e) Prepare technical drafts and finished drawings both manually and using CAD
f) Prepare quantity surveying reports
g) Give technical presentations
h) Refer effectively to relevant literature

4.4 General and Transferable Skills

CEM graduates will be able to communicate effectively, apply IT technologies, and develop skills that are life enriching and have value in other occupations:

a) Present data/results in alternative forms for better understanding and/or greater impression, and utilize appropriate level of delivery
b) Communicate effectively the information in verbal and writing
c) Develop systematic thinking skills to solve general problems and identify critical factors
d) Evaluate given information and derive practical and new solutions
e) Perform efficient teamwork in multi-member projects
f) Understand the usage of common IT tools
g) Realize the need for life-long learning and develop aptitude for continuous and independent learning of new concepts and information

5. PROGRAM DESCRIPTION

To achieve the above mentioned goal, a 4 year 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 system, a total of 180 credit hours 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 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 of the CEM program consists of 180 credits spread over 75 courses covering topics in Humanities and Social Sciences (HSS), Basic Sciences (BS), Engineering Sciences (ES), and Applied Engineering Sciences (AS) as required by the Supreme Council of Universities (SCU). Sample Courses in each category are presented as follows.

5.1.1 Humanities and Social Sciences Courses

- 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 Courses

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

5.1.3 Engineering Sciences Courses

- 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 Courses

- 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, Cairo University helps students to gain an appreciative understanding of the natural and cultural environments in which they live and their roles in the society and community services.

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

1. Nine (9) compulsory courses equivalent to 18 credits (10.0%), as listed in Table 1a.
2. Three (3) elective courses equivalent to 6 credits (13.3%), as listed in Table 1b. The CEM students should take the course GENN301, Ethics and Legislation.

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

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

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

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

Remarks:

(1) Student selects at least three (3) courses equivalent to 6 credits, such that one of the three courses should be GENN301

5.3 College Requirements

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

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

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

	Code	Course Title	Credits
1	CHEN001	Chemistry	3
2	GENN003	Basic Engineering Design	2
3	MDPN001	Engineering Graphics	3
4	MDPN002	Fundamentals of Manufacturing Engineering	3
5	MECN001	Mechanics-1	2
6	MECN002	Mechanics-2	2
7	MTHN001	Introduction to Linear Algebra and Analytic Geometry	3
8	MTHN002	Calculus I	3
9	MTHN003	Calculus II	3
10	MTHN102	Multivariable Calculus and Linear Algebra	3
11	MTHN203	Probability and Statistics	3
12	PHYN001	Mechanics, Oscillations, Waves and Thermodynamics	3
13	PHYN002	Electricity and Magnetism	3
14	CEMN280	Seminar-1	1
15	CEMN281	Industrial Training-1	1
16	CEMN380	Seminar-2	1
17	CEMN381	Industrial Training-2	2
18	CEMN480	Graduation Project-1	1
19	CEMN481	Graduation Project-2	3

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

The discipline requirements of the CEM bachelor program consist of 65 credits (36.1% of total 180 credits), which are satisfied by completing twenty-eight (26) courses in Civil Engineering that cover topics in Structural, Construction, Geotechnical, Environmental, Hydraulic, Public-Works and Transportation Engineering:

1. Twenty-four (24) compulsory courses equivalent to 60 credits (33.3%), as listed in Table 3a. Six (6) of these courses cover other engineering disciplines (coded by ARC, INT, MEC, MTH) and are equivalent to 14 credits (7.8%).
2. Two (2) elective courses equivalent to 5 credits (2.8%), as listed in Table 3b.

Table 3a Compulsory Courses of Discipline Requirements: Civil Engineering (60 credits, 33.3% of total 180 credits)

	Code	Course Title	Credits
1	ARCN106	Introduction to CAD Systems	2
2	ARCN110	Basic Architectural Design	2
3	ARCN201	Building Construction and City Planning	2
4	IHDN104	Civil Engineering Drawing	2
5	IHDN201	Fluid Mechanics	3
6	IHDN202	Open Channel Hydraulics	2
7	INTN203	Mechanical and Electrical Systems	2
8	MECN101	Dynamics of Rigid Bodies	3
9	MTHN103	Differential Equations	3
10	PBWN202	Surveying for Engineers	3
11	PBWN201	Water and Waste Water Engineering	2
12	PBWN301	Highway Engineering	2
13	PBWN302	Soil Mechanics	3
14	PBWN303	Foundations	2
15	STRN101	Structural Analysis-1	3
16	STRN102	Structural Analysis-2	3
17	STRN103	Engineering Materials	3
18	STRN104	Mechanics of Materials	3
19	STRN201	Reinforced Concrete Design I	2

	Code	Course Title	Credits
20	STRN302	Steel structures Design I	2
21	STRN303	Reinforced Concrete Design II	3
22	STRN304	Steel structures Design II	3
23	STRN327	Law and Construction Industry	2
24	STRN441	Reinforced Concrete Design III	3

Table 3b Elective Courses of Discipline Requirements: Civil Engineering (5 credits, 2.8% of total 180 credits)

	Code	Course Title	Credits	Group
1	ARCN211	Urban Planning	2	E-2(1)
2	GENN341	Operation Research	2	
3	GENN342	Decision Support System	2	
1	IHDN301	Introduction to Water Resources Engineering	3	E-3(2)
2	PBWN343	Transportation and Logistic Management	3	
3	STRN341	Masonry Structures	3	

Remarks:

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

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

5.5 Major Requirements

The program offers a major specialty in Construction Engineering Management. A student who wishes to complete the specialty of Construction Engineering and Management must complete the minimum major requirements of 46 credits (25.6% of total 180 credits), which are satisfied by completing seventeen (17) courses as follows:

1. Twelve (12) compulsory courses equivalent to 31 credits (17.2%), as listed in Table 4.
2. Five (5) elective courses equivalent to 15 credits (8.4%), as listed in Table 5.

Table 4 Compulsory Courses of Major Requirements: Construction Engineering and Management (31 credits, 17.2% of total 180 credits)

	Code	Course Title	Credits
1	STRN105	Human Resources Management	2
2	STRN122	Introduction to Construction Engineering.	2
3	STRN221	Economic Strategies In Construction Industry	3
4	STRN224	Construction Project Management	3
5	STRN322	Construction Planning and scheduling	3
6	STRN325	Construction Equipment	2

	Code	Course Title	Credits
7	STRN420	Introduction to Construction Contracts	2
8	STRN421	Risk Management in Construction Industry	3
9	STRN422	Cost Engineering	3
10	STRN424	Construction Methods	2
11	STRN426	Estimating and Quantity Surveying	3
12	STRN427	Contract Administration	3

Table 5 Elective Courses of Major Requirements: Construction Engineering and Management (15 credits, 8.4% of total 180 credits)

	Code	Course Title	Credits	Group
1	STRN342	Project Resources Management	3	E-4(1)
2	STRN344	Construction Material and Quality Control	3	
3	STRN447	Strategic Planning	3	
4	STRN464	Sustainability and Public Policy in the Construction Industry	3	
1	STRN423	Financial Management	3	E-5(2)
2	STRN443	Temporary Structures and Form Work Design	3	
3	STRN444	Special Concrete Structures	3	
4	STRN452	Information Technology in Construction	3	
5	STRN454	Special Problems in Construction	3	
6	STRN455	Feasibility Studies and Project Evaluation	3	
7	STRN465	Inspection and Maintenance of Structures	3	
1	PBWN342	Ground Water Control Systems	3	E-6(3)
2	PBWN446	Deep Excavation and Side Support	3	
3	STRN445	Steel Structures Design III	3	
4	STRN448	Quality and Safety Management	3	
5	STRN449	Organization Management	3	
6	STRN453	Project Specifications and Bids	3	
7	STRN456	Claims In Construction Industry	3	
8	STRN463	Building Information Modeling	3	

Remarks:

(1) Student selects at least one (1) course from group E-4 equivalent to 3 credits

(2) Student selects at least two (2) courses from group E-5 equivalent to 6 credits

(3) Student selects at least two (2) courses from group E-6 equivalent to 6 credits

5.6 Conformity to SCU Requirements

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

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

Table 6 Conformity to Supreme Council Criterion

Category	Freshman	Sophomore	Junior	Senior-1	Senior-2	Total Credits	%
Humanities and Social Sciences	6	6	4	10	2	28	15.6
Basic Sciences	22	9	5	0	0	36	20.0
Engineering Sciences	8	18	12	5	0	43	23.9
Applied Engineering Sciences	0	2	16	23	32	73	40.5
Total	36	35	37	38	34	180	100
University Requirements	6	4	6	6	2	24	13.3
College Requirements	30	3	4	4	4	45	25.0
Discipline Requirements	0	24	21	15	5	65	36.1
Major Requirements	0	4	6	13	23	46	25.6
Total	36	35	37	38	34	180	100

The Construction Engineering and Construction program consists of 75 courses: 65 compulsory courses (154 credits) and 10 elective courses (26 credits). The total 180 credits of the CEM program are distributed between lectures (LEC) and tutorials (TUT), where a tutorial is classified as a problem solving session (PSS) and/or a practical work/laboratory session (PLS). The one credit of a tutorial corresponds to 2-3 hours to provide sufficient practical training for the students. Thus, the total contact hours of learning are about 300 hrs.

6. SAMPLE STUDY PLAN and COURSE SEQUENCE

A sample study plan for the CEM program is presented as one recommended sequence to complete the graduation requirements over 10 main semesters, the Fall and Spring semesters per academic year. Since the program is based on the credit

hours system of education, the student does not have to take the courses during the semester indicated in the study plan as long as the course prerequisites are satisfied.

The CEM curriculum encourages students to interact with the industrial sector and government agencies by offering two industrial training courses in at least two summer sessions. Additionally, the students are encouraged to participate in research through independent study projects, and they will be exposed to actual construction projects in their practical training and graduation projects.

Freshman Year Course Schedule

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

Remarks:

(1) Course MECN002 has a prerequisite course MECN001

(2) Course MTHN003 has a prerequisite course MTHN002

CEM Program Study Plan

	Semester-3: Fall		Semester-4: Spring		Semester-5: Fall		Semester-6: Spring	
	Course Code	CR	Course Code	CR	Course Code	CR	Course Code	CR
1.	ARCN106	2	ARCN110	2	ARCN201	2	GENN204	2
2.	GENN102	2	GENN101	2	GENN221	2	IHDN202	2
3.	IHDN104	2	MTHN103	3	IHDN201	3	INTN203	2
4.	MECN101	3	STRN102	3	MTHN203	3	PBWN201	2
5.	MTHN102	3	STRN104	3	STRN201	2	STRN302	2
6.	STRN101	3	STRN105	2	PBWN202	3	STRN221	3
7.	STRN103	3	STRN122	2	STRN224	3	GENN301(1)	2
8.	----------	------	----------	------	----------	------	XXXNXXX(3)	3
9.	----------	------	----------	------	----------	------	CEMN281(0)	1
Semester Credit Hrs		18		17		18		18+1(0)

	Semester-7: Fall		Semester-8: Spring		Semester-9: Fall		Semester-10: Spring	
	Course Code	CR	Course Code	CR	Course Code	CR	Course Code	CR
1.	GENN201	2	GENN210	2	PBWN303	2	GENN3XX(1)	2
2.	PBWN302	3	PBWN301	2	STRN420	2	STRN421	3
3.	STRN303	3	STRN304	3	STRN426	3	STRN427	3
4.	STRN322	3	STRN327	2	STRN441	3	CEMN481	3
5.	STRN325	2	STRN422	3	CEMN480	1	STRN4XX(5)	3
6.	CEMN280	1	STRN424	2	STRN4XX(5)	3	XXXNXXX(6)	3
7.	GENN3XX(1)	2	CEMN380	1	XXXNXXX(6)	3	----------	------
8.	XXXNXXX(2)	2	STRNXXX(4)	3	----------	-----	----------	------
9.	----------	-----	CEMN381(0)	2	----------	-----	----------	------
Semester Credit Hrs		18		18+2(0)		17		17

Remarks:

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

(1) General elective course (group E-1, 2 credits per course): GENN301, GENN310, GENN311, GENN321, GENN326, GENN327, GENN331, GENN332
(CEM students are advised to study the course GENN301 in the shown semester)

(2) Discipline elective course (group E-2, 2 credits per course): ARCN211, GENN341, GENN342

(3) Discipline elective course (group E-3, 3 credits per course): IHDN301, PBWN343, STRN341

(4) Major elective course (group E-4, 3 credits per course): STRN342, STRN344, STRN447, STRN464

(5) Major elective course (group E-5, 3 credits per course): STRN423, STRN443, STRN444, STRN452, STRN454, STRN455, STRN465

(6) Major elective course (group E-6, 3 credits per course): PBWN342, PBWN446, STRN445, STRN448, STRN449, STRN453, STRN456, STRN463

7. COURSE CONTENTS

7.1 University-Core Courses

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

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

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

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

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

7.2 College-Core Courses

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

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

MTHN003	**Calculus II** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN002** Anti-derivatives; indefinite integrals; techniques of integration; definite integrals, applications of definite integrals; functions of several variables; partial derivatives, applications for partial derivatives.
MTHN102	**Multivariable Calculus and Linear Algebra** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN001 + MTHN003** Double integrals, double integrals in polar coordinates; triple integrals, triple integrals in spherical and cylindrical coordinates; applications of double and triple integrals; line and surface integrals; vector analysis, gradient of a scalar function, divergence of a vector, curl of a vector, divergence and Stokes' theorems, vector identities; LU-factorization; vector spaces; inner product spaces; eigenvalues and eigenvectors; diagonalization of matrices; functions of matrices.
MTHN203	**Probability and Statistics** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN102** Probability axioms; probability laws; conditional probability; random variables; discrete and continuous distributions; joint distribution; computer simulation; sampling; measures of location and variability; parameter estimation, testing of hypothesis.
PHYN001	**Mechanics, Oscillations, Waves and Thermodynamics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Physics and measurements; elastic properties of solids; universal gravitation and motion of planets; fluid mechanics (statics and dynamics); oscillatory motion; wave motion, sound waves; thermo-dynamics, temperature, heat and the first law of thermodynamics, the kinetic theory of gases, heat engines, entropy and the second law of thermodynamics. Laboratory experiments on course topics.
PHYN002	**Electricity and Magnetism** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): none** Electric field; Gauss' law; electrostatic potential; capacitance and dielectrics; current and resistance; direct current circuits; magnetic fields, sources of magnetic field; Faraday's law; Maxwell's equations; inductances; magnetic properties of matter. Laboratory experiments on the course topics.
CEMN280	**Seminar-1** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): 72 credits + AA Approval** Talks and presentations are invited from industrial establishments relevant to the program. The guest speaker should discuss the organization, management, and recent technologies implemented in his/her industrial establishment. Students exercise writing brief technical

	reports on the guest presentation and deliver their own presentation about the topic. *The course is graded as Pass/Fail grade-system.*
CEMN380	**Seminar-2** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): AA Approval** Students will be required to present seminars on a subject assigned to (or chosen by) them about the latest technology relevant to the program. The grade depends on organization, quality, and content of both the presentation and the report prepared by the student. *The course is graded as Pass/Fail grade-system.*
CEMN281	**Industrial Training-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): STRN201 + 85 credits + AA Approval** Training on industrial establishments relevant to the program. Training lasts for total of 90 hours, during a period about three weeks. The program training advisor schedules at least one follow up visit to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. *The course is graded as Pass/Fail grade-system.*
CEMN381	**Industrial Training-2** **Compulsory, Credits: 2 (0+0+6)** **Prerequisite(s): CEMN281 + AA Approval** Training on industrial establishments relevant to the program. Training lasts for total of 180 hours, during a minimum period of six weeks. The program training advisor schedules at least two follow-up visits to the training venue and formally report on performance of trainee(s). A Mentor in the industrial establishment provides a formal report on the student's performance during training. The student submits a formal report and presentation to be evaluated by a panel of three members with one member being an external examiner appointed from industry or other colleges of engineering. *The course is graded as Pass/Fail grade-system.*
CEMN480	**Graduation Project-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 130 credits + AA Approval** Students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement appropriate concepts and techniques to a particular design. Students are required to select and research the expected project to be designed and implemented in the following course Graduation Project-2. The student should give an oral presentation to be approved. *The course is graded as Pass/Fail grade-system.*

CEMN481	**Graduation Project-2** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): CEMN480 + AA Approval** All students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement the appropriate concepts and techniques to a particular design. A dissertation on the project is submitted on which the student is examined orally.

7.3 Discipline Courses

ARCN106	**Introduction to CAD Systems** **Compulsory, Credits: 2 (1+0+3)** **Prerequisite(s): GENN004 + MDPN001** 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.
ARCN110	**Basic Architectural Design** **Compulsory, Credits: 2 (1+1+2)** **Prerequisite(s): GENN003 + MDPN001** 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.
ARCN201	**Building Construction and City Planning** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): ARCN110** 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.
IHDN104	**Civil Engineering Drawing** **Compulsory, Credits: 2 (1+1+2)** **Prerequisite(s): MDPN001** Introduction to civil engineering projects, General Concepts, Legend and symbols, Scales and drawing size, General layout and plans, Longitudinal and cross sections, Detailing, Earthworks and retaining walls, Applications on irrigation and land reclamation projects, Half-earth-removed views,

	Pitching and protection. Drawing of steel sections and connections, reinforced concrete sections. Projection of beams and columns.
IHDN201	**Fluid Mechanics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PHYN001** Introduction, Dimensions and units, Fluid properties (density, specific weight, specific gravity, specific heat, vapor pressure, compressibility, viscosity, surface tension), Fluid Statics (absolute and gage pressure, pressure at a point, pressure transmit ion , pressure measurements, pressure prism, hydrostatic force on a plane surface, hydrostatic force on a curved surface, buoyancy, flotation, and stability), Rigid body motion of a fluid, Fluid Kinematics (continuity equation, steady and unsteady flow, laminar and turbulent flows, path line and stream line, ideal and real, rotational and ir-rotational flow, Fluid Dynamics (Bernoulli's Equation, total and hydraulic gradient lines, application of Bernoulli Equation, Pitot Tube, stagnation point, Venturi Meter , orifice , nozzles , flow over notches and weirs)**,** Momentum analysis of flow Systems (conservation of momentum, control volume, forces on control volume, forces acting on plates, turbines concept, forces acting on bends & reducers , calculations of minor losses), Flow through pipe lines (Reynold's Number, Darcy-Weisbach Equation, friction head losses, Moody Charts, design of pipe flow system, branching pipe, pipes in series and in parallel, head loss problems, discharge problems, sizing problem, reservoir system)
IHDN202	**Open Channel Hydraulics** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): IHDN201** Introduction, Types of cross sections, Stage and depth measurements, Types of flow, Velocity distribution, Velocity measurements, Kinetic energy and momentum, correction factors, Curvilinear pressure distribution, Steady uniform flow, Resistance to flow, Design of cross sections, Design of circular cross sections, Specific energy and critical flow, Applications on specific energy, Specific force, Steady rapidly varied flow, Hydraulic Jump, Weirs, Discharge measurements, Steady gradually varied flow, Water surface profiles, Computation of water surface profiles length, Flow control, Laboratory experiments.
INTN203	**Mechanical and Electrical Systems** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): 54 credits** 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 residential & institutional projects.

MECN101	**Dynamics of Rigid Bodies** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MECN002** 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.
MTHN103	**Differential Equations** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN003** First-order differential equations, separable, exact, linear, homogeneous and Bernoulli equations; modeling with first order differential equations; higher-order differential equations; method of undetermined coefficients; variation of parameters; modeling with higher order differential equations; series solutions; Laplace transform; properties and applications, shifting theorems, convolution theorem; solutions of differential equations using Laplace transform; Fourier series; Fourier transform.
PBWN201	**Water and Waste Water Engineering** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): 54 credits** 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.
PBWN202	**Surveying for Engineers** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MTHN003** Engineering principles and applications of surveying sciences (with emphasis on plane surveying) are presented in relation to engineering. Popular techniques and engineering uses of distance, angles and height difference measurements are studied and practiced. Applications in detail mapping, earthwork computations, and setting out engineering structures are covered in this course. Integrated digital surveying and mapping using total station are introduced.
PBWN301	**Highway Engineering** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): 90 credits** Introduction to transport planning and traffic engineering – route study and reconnaissance – functional classification of road network – criteria of geometric design – design of road horizontal and vertical alignments – cross section elements – type of road pavement – vehicle – load and stresses – construction equipments – method statement and quality control – pavement management and rehabilitation – traffic control during

	road construction and maintenance. Use of computer simulation for selection of equipment.
PBWN302	**Soil Mechanics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): STRN102 + STRN104** Basic properties of soil, Soil classification, Compaction, Permeability, Soil stresses, Consolidation, Shear strength, and Lateral earth pressure.
PBWN303	**Foundations** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): PBWN302** Basics of soil investigations, Soil bearing capacity, Designs of shallow foundations: wall footings, isolated footings, combined footings and strip footings, Design of retaining walls, Design of deep foundations: pile construction methods, estimation of pile bearing capacity, pile load tests, design of group piles. Considerations for selection of types of foundations.
STRN101	**Structural Analysis-1** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MECN001** Types of structures; Loads; Supports and Reactions; Internal Forces; Analysis of Beams, Frames, and Trusses. Influence lines of Statically Determinate Structures, Moving Loads.
STRN102	**Structural Analysis-2** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN101** Deformations: differential equations, virtual work. Indeterminate structures: consistent deformations, moment distribution. Buckling of columns.
STRN103	**Engineering Materials** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): PHYN001 + MECN001** 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.
STRN104	**Mechanics of Materials** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN103** Analysis of stress, strain, and deformation of sections subjected to tension, compression, bending, shear, and torsion - Buckling - Theories of failure - Laboratory: Lab Testing of materials for strength evaluation; the definition of the mechanical properties (elasticity - plasticity - stiffness - strength - ductility - brittleness - resilience - toughness) and their determination in different loading cases. The load and deformation diagram is to be plotted. The different properties are to be determined.

STRN201	**Reinforced Concrete Design I** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): STRN102 + STRN104** 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.
STRN302	**Steel Structures Design I** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): STRN102 + STRN104** 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.
STRN303	**Reinforced Concrete Design II** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN201** 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.
STRN304	**Steel Structures Design II** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN302** Welded connections – Bolted connections (bearing and friction bolts) – Steel details for frames – Steel details for trusses – steel details for wind bracing.
STRN327	**Law and Construction Industry** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): GENN301** Theory of Obligation; definition, forms. Sources of Obligations. The contract; Parties, Formation, Validity, Effect, Interpretation, Dissolution, and compensation of Damage. Tort; Basis and types. Types of Engineering Contracts. Construction Contracts. Liability of the engineer and contractor in design, supervision and construction; Civil and Criminal Responsibility; Dispute resolutions; Adjudication, mediation, Arbitration. Commercial Law; Commercial activities, Merchant.
STRN441	**Reinforced Concrete Design III** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN303** Design and details of Frames, Cracking limit state; Design of water tanks; Design of footings, raft foundations and pile caps.
ARCN211	**Urban Planning** **Elective (group E-2), Credits: 2 (1+3+0)** **Prerequisite(s): ARCN201** 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.
GENN341	**Operation Research** **Elective (group E-2), Credits: 2 (1+3+0)** **Prerequisite(s): none** Introduction - Linear programming, Network analysis, Decision analysis, Random processes, Queuing models, Inventory analysis, Simulation, Dynamic programming, Nonlinear programming, Game Theory, Waiting line theory.
GENN342	**Decision Support Systems** **Elective (group E-2), Credits: 2 (1+3+0)** **Prerequisite(s): none** 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 & Uncertainty, Mathematical, Programming, Simulation, Heuristic Programming, Forecasting, Financial and Planning Modeling. Artificial versus Natural Intelligence, Knowledge in AI. Fundamentals of Expert Systems.
IHDN301	**Introduction to Water Resources Engineering** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): none** 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, ground-water flow equations, well hydraulics, monitoring of groundwater levels, hydraulic characteristics of aquifers, groundwater management and safe yields.
PBWN343	**Transportation and Logistic Management** **Elective (group E-3), Credits: 3 (2+3+0)** **Prerequisite(s): none** 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.
STRN341	**Masonry Structures** **Elective (group E-3), Credits: 3 (2+3+0)** **Prerequisite(s): STRN201** 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

7.4 Major Courses: CEM

STRN105	**Human Resources Management** **Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s): GENN102** 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 – Labour/management relations – Motivation – Leadership – Communication
STRN122	**Introduction to Construction Engineering** **Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s): none** 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.
STRN221	**Economy Strategies in Construction Industry** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): 54 Credits** 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.
STRN224	**Construction Project Management** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN122** 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.
STRN322	**Construction Planning and Scheduling** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): STRN224** 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.

STRN325	**Construction Equipment** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): STRN221 + STRN224** 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.
STRN420	**Introduction to construction Contracts** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): STRN224 + STRN327** 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.
STRN421	**Risk Management in Construction Industry** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN420** 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.
STRN422	**Cost Engineering** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): STRN224** 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.
STRN424	**Construction Methods** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): STRN325** Building construction systems, concrete and steel construction, slipforming, precast concrete construction. Cofferdams and diaphragm wall construction. Design of dewatering systems. Construction methods for roads, pipelines, and tunnels. Evaluation and selection of appropriate construction technology. Construction site layout planning.

STRN426	**Estimating and Quantity Surveying** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): STRN422** Bidding process and requirements, bid documents, construction quantities, take-off principles, methods of measurement, pricing for resources, unit pricing, overheads, writing the bill, measuring & valuation of works during project execution, updating and reporting, construction project exercises.
STRN427	**Contract Administration** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): STRN420** 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.
STRN342	**Project Resources Management** **Elective (group E-4), Credits: 3 (2+2+0)** **Prerequisite(s): STRN224** 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.
STRN344	**Construction Material and Quality Control** **Elective (group E-4), Credits: 3 (2+2+0)** **Prerequisite(s): STRN102 + STRN103** Specifications and codes- QA & QC- Inspection- Special types of concrete; self compacting concrete, high strength concrete, durable concrete-Fiber concrete-, QC of materials and manufacture of concrete testing- statistical evaluation of testing results- Nondestructive testing of concrete in structures. Bricks, mortar, and grout for masonry- QC procedures and testing. Structural steel, steel pipes, QC testing.
STRN447	**Strategic Planning** **Elective (group E-4), Credits: 3 (2+2+0)** **Prerequisite(s): STRN221 + STRN322** 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.
STRN464	**Sustainability and Public Policy in the Construction Industry** **Elective (group E-4), Credits: 3 (2+2+0)** **Prerequisite(s): STRN224** Evaluating the sustainability of engineering activities, Life Cycle Assessment, Introduction to green building technologies, Environmental management in

	construction, Establishing policy objectives and goals, Frameworks for the analysis of public policy, Case studies in policy analysis.
STRN423	**Financial Management** **Elective (group E-5), Credits: 3 (2+2+0)** **Prerequisite(s): STRN221** 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.
STRN443	**Temporary Structures and Form Work Design** **Elective (group E-5), Credits: 3 (2+2+0)** **Prerequisite(s): STRN303** 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.
STRN444	**Special Concrete Structures** **Elective (group E-5), Credits: 3 (2+3+0)** **Prerequisite(s): STRN303** Lateral loads; earthquake and wind. Lateral load resisting systems, analysis, design, and detailing. Prestressed concrete design. Reinforced concrete bridges; loads, types and systems, analysis, design, detailing, special considerations
STRN452	**Information Technology in Construction** **Elective (group E-5), Credits: 3 (2+2+0)** **Prerequisite(s): STRN224** Software systems in construction management: scheduling, cost estimating, material management, documents management and, 4D CAD systems. Introduction to Building Information Modeling. Use and design of databases and programmable spreadsheets for construction applications.
STRN454	**Special Problems in Construction** **Elective (group E-5), Credits: 3 (2+2+0)** **Prerequisite(s): 136 Credits** Special problems in the field are studied under supervision of a faculty member from the program. A final report is submitted to fulfill course requirements.
STRN455	**Feasibility Studies and Project Evaluation** **Elective (group E-5), Credits: 3 (2+2+0)** **Prerequisite(s): STRN221 + STRN322** 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; fore-casting performance; estimating the cost of capital- project evaluation methods: comparison sailing; cost calculation; income generation.

STRN465	**Inspection and Maintenance of Structures** **Elective (group E-5), Credits: 3 (2+2+0)** **Prerequisite(s): STRN303** Introduction – Causes of Deterioration and needs for Repair - Methodology and strategy of repair - Symptoms, Diagnosis, Treatment - Assessment of strength of concrete structures - Repair: materials, methods, strengthening - Brick walls: inspection and repair
PBWN342	**Ground Water Control Systems** **Elective (group E-6), Credits: 3 (2+2+0)** **Prerequisite(s): PBWN302** Soil Permeability – Seepage – Groundwater Control systems – Construction Dewatering – Grout plugs – Selection of Proper System.
PBWN446	**Deep Excavation and Side Support** **Elective (group E-6), Credits: 3 (2+2+0)** **Prerequisite(s): PBWN302** Introduction to deep excavation – Slope stability – Construction of: sheet pile walls - Selection of proper Retaining system – Insulation
STRN445	**Steel Structures Design III** **Elective (group E-6), Credits: 3 (2+3+0)** **Prerequisite(s): STRN304** Steel bridges – Special steel structures (Tanks, silos, and towers) – Steel fabrication and erection (inspection procedures and tolerances) – Shop drawings.
STRN448	**Quality and Safety Management** **Elective (group E-6), Credits: 3 (2+2+0)** **Prerequisite(s): STRN224** 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.
STRN449	**Organization Management** **Elective (group E-6), Credits: 3 (2+2+0)** **Prerequisite(s): STRN224** Effective design of organization structural – strategic organization design – job design – power and politics - organization culture – type of departmentalization - method of vertical coordination – method of horizontal coordination - rewards and motivation – managing change and innovation – impact of the global economy – controlling the organization – managerial control methods.
STRN453	**Project Specification and Bids** **Elective (group E-6), Credits: 3 (2+2+0)** **Prerequisite(s): STRN420** 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 & 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.
STRN456	**Claims in Construction Industry** **Elective (group E-6), Credits: 3 (2+2+0)** **Prerequisite(s): STRN420 + STRN322** 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.
STRN463	**Building Information Modeling** **Elective (group E-6), Credits: 3 (2+2+0)** **Prerequisite(s): ARCN106 + STRN224** Introduction to building product models, information interoperability, practical aspects associated with the use of Building Information Model (BIM) in planning the execution of building construction projects. This is a project-based course where students gain knowledge on the implementation of BIM concepts throughout the lifecycle of a building, from planning and design, to construction and operations.