Section 9

Civil Infrastructure Engineering Program (CIE)

Based on Credit Hours System (CHS)

September 2019

1. INTRODUCTION

Civil infrastructure engineering is a fundamental and vital field that reflects the nation's development owing to its major contribution in driving process wheel forward through urban renaissance. In practice, the civil infrastructure engineer is an essential member in various engineering projects with responsibilities including the planning, design, construction, maintenance, and operation of large and permanent engineering projects of our civilization such as roads, highways, airports, water and wastewater treatment plants, water distribution networks, and sanitary sewers. Civil Infrastructure engineers are in demand wherever there are people.

Accordingly, there is always a vast demand on skillful civil infrastructure engineers in both the national and international job-markets. In the recent years, this demand has increased drastically due to the large number of major development plans and urban projects in Egypt and world-wide. Therefore, the Faculty of Engineering at Cairo University is proposing to establish a new B.Sc. program in Civil Infrastructure Engineering (CIE). This program will provide the society with proficient civil infrastructure engineers capable of supporting the progress efforts and urban renaissance in Egypt and the middle-east region by possessing good knowledge and hands-on skills according to the latest technical advancement to work in the areas of, surveying and mapping, geotechnical engineering, environmental engineering, sanitary, water resources and hydraulics, and transportation and traffic engineering. It will also assist in fulfilling the on-growing demand on skillful infrastructure engineers in the job-market.

2. PROGRAM MISSION

The field of civil infrastructure engineering is by far the most growing and demanding field in the construction market in Egypt. The country is in a need for more public works projects: roads, highways, airports, railways, water and wastewater treatment plants, water distribution networks, and sanitary sewers, to satisfy the community's needs of both citizens and investors. This sector is also lacking specialized engineers for its operation, maintenance, and rehabilitation of those projects.

This program is the first of its kind, as one of the credit hour system programs in Egypt, and would provide the regional and Egyptian job market with engineers having an intense knowledge of the different infrastructure sciences: geotechnical, survey, transport, highways and airports, railways, and sanitary and environmental engineering.

The program vision: "leadership in the field of civil infrastructure engineering education to achieve national and regional recognition for the innovation of Egypt and all humanities"

The mission of the program is to educate students to become qualified engineers who are capable of generating effective solutions by using engineering approaches in the field of Civil Infrastructure Engineering.
The program achieves its mission via teaching, scholarship, creative work, research, and service, and commits itself to the highest ideals of the profession of infrastructure. The graduates of the CIE program would be highly demanded in the national and regional markets due to the following factors:

- The shortage of skillful infrastructure engineers who are capable of designing, constructing and operating the public works projects.
- The growing need for the CIE specialty at the local, regional and international market because of the booming development activities.

This illustrates the feasibility of the CIE program proposed by the Faculty of Engineering, Cairo University and its impact on the national, regional and international markets.

3. EDUCATIONAL OBJECTIVES

One of the goals of the Faculty of Engineering, Cairo University is to cope with the new advances in the field of Engineering, including civil Infrastructure engineering. It is one of the significant fields both in Egypt and worldwide and the basis upon which cities builds strong communities. The program is aimed at providing a civil engineer with strong knowledge, skills and abilities in the field of infrastructure engineering including design, operation, and maintenance and rehabilitation. Moreover, the program endeavors bridging the gap between academic knowledge and practical experience through the following approaches: introducing students to laboratory, designing experiments, conducting site and field visits, and inviting guest and renowned speakers from the industry. While this is the ultimate goal across the program, some of these approaches might apply better in certain courses depending on the course content and field of study.
The main objectives of the CIE program are to:

- Equip graduates with the problem-solving skills and knowledge necessary for employment as Civil Infrastructure Engineers and in related job functions in consulting, industry, government, and academia.
- Engage graduates in the engineering practice of planning, designing, constructing, operating and maintaining infrastructure.
- Engage graduates in public discussions concerning infrastructure projects settings by providing professional guidance.
- Prepare graduates capable of working in geotechnical, transportation and environmental fields to design, implement, and maintain national and/or global infrastructure.
- Provide graduates appropriate technical proficiency in and lead interdisciplinary teams needed to design sustainable transportation, water, environmental, and structural infrastructure.
- Provide graduates with deep appreciation of ethical issues associated with their profession.
- Building the leadership skills, teamwork, life-long learning, career advancement and engineering capabilities
  - Additionally, the program targets enhancing the soft and leadership skills among students through encouraging participatory assignments, team work spirit, working groups, term projects, and presentation and communication skills.

4. PROGRAM LEARNING OUTCOMES

The CIE program has adopted the National Academic Reference Standards (NARS) for Engineering issued by the National Authority for Quality Assurance and Accreditation for Education (NAQAAE) as the program learning outcomes to ensure the satisfaction of the national quality assurance standards. The NARS for Engineering are broad statements that define the main characteristics and performance expected from all engineering students upon their graduation so that the educational objectives of the CIE program can be achieved. They are divided into four categories:

- Knowledge and Understanding (K)
- Intellectual Skills (I)
- Professional and Practical Skills (P)
- General and Transferable Skills (T)

4.a. Knowledge and Understanding

CIE graduates will be able to demonstrate knowledge and understanding of:

a. Fundamental facts, concepts, theories, principles, and methods that are related to the civil infrastructure field.
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, metallic structures analysis and design, geotechnical and foundation engineering, hydraulics and hydrology, water resources, environmental and sanitary engineering, roadways and traffic systems, geomatics engineering, surveying and photogrammetry, properties behavior and fabrication of building materials.
d. More advanced skills in the field of geomatics engineering to cover the needs of infrastructure design and building including data analysis and least square adjustments, GPS systems, GIS and remote sensing applications, role of advances positioning techniques in Infrastructure Projects.
e. Focused knowledge in the field of geotechnical engineering including deep excavation and side support, ground water control systems, and other advanced topics in the field.
f. In depth knowledge of sanitary engineering including wastewater treatment plants, water distribution networks, and sanitary sewers.
g. Distinctive knowledge in the field of transportation engineering including traffic engineering theory and applications, transport planning and travel demand modeling, highway geometric design and safety, pavement design, railway engineering advanced courses, airport planning, and freight transportation.
h. Codes of practice in civil engineering disciplines and the regularity framework in design and practice.
i. Attaining important knowledge on humanities, ethics, professionalism, legislations, economics, marketing, environment and management and their impact on the field of engineering.

j. Broad education necessary to understand the impact of civil engineering solutions on the environment.

4.b. Intellectual Skills

CIE graduates will be able to select appropriate design tools and apply proper knowledge to the solution of existing and new problems in civil infrastructure engineering. To be able to achieve that, they will be able to:

a. Apply the knowledge and understanding attained in order to apply innovative thinking in solving nonconventional and complex problems.
b. Use critical thinking approach to deal with different engineering problems and understand the technical uncertainty involved in design.
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 problems.
d. Apply appropriate analysis and relevant codes of practice in the design of different infrastructure elements.
e. Determine the risks and ethical issues related to different engineering situations.
f. Have the ability to analyze and interpret field data results.
g. Have the ability to use gained principle knowledge and principles, theories and sciences in solving problems with limited or contradictory information, and in solving broad scope problems such as environmental and socioeconomic problems.

4.c. Professional and Practical Skills

CIE graduates will be able to display and apply technical proficiency and hands-on skills on multi-disciplinary projects. This would include:

a. Formulate and solve practical infrastructure engineering problems and prepare design reports containing analysis methods and evaluation of results.
b. Ability to design special infrastructure systems using the proper technical proficiency and meet the required specifications.
c. Ability to select and perform the appropriate experimental tests for engineering materials, interpret the results, and understand quality control needs.
d. Ability to apply computer software and simulations related to infrastructure engineering practice used in analysis and design.
e. Select and use suitable procedures to inspect and repair existing structures.
f. Ability to prepare quantity surveying reports.

4.d. General and Transferable Skills

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. Effectively manage tasks, time and resources.
g. Search for information and engage life-long self-learning discipline.
h. Acquire entrepreneurial skills.
i. Refer to relevant literatures.

5. MARKET NEEDS ASSESSMENT

The civil infrastructure engineering is by far the most growing and demanding field in the construction market in Egypt. The Egyptian government is aiming at building more public works projects: roads, highways, airports, railways, water and wastewater treatment plants, water distribution networks, and sanitary sewers, to satisfy the community's needs of both citizens and investors. Multinational, regional, and national construction companies are seeking fresh graduates to cover the increasing demand for skilled engineers with strong up to date knowledge, and training to work in the design, construction and operation of infrastructure projects.

6. PROGRAM DESCRIPTION

To achieve the educational goals, a four-year curriculum following the freshman year is developed. The curriculum covers the core courses in the Civil Engineering discipline, as well as the fundamental and advanced courses of Civil Infrastructure Engineering so that the CIE graduate will have a broad knowledge of the Civil and Civil Infrastructure Engineering professions. The necessary fundamental background in structures, materials, mechanics, soil, fluid mechanics, geomatics as well as some other engineering disciplines is also covered. At the end of these courses, students are expected to gain knowledge in planning and design of highways, railways, airports, drainage and sewer systems, water and waste water treatment systems, and transport planning and travel demand modeling.
As the curriculum is based on the credit hour system, a total of 175 credits should be completed before graduation, where about 36 credits are given in the freshman year. The 175 credits are spread over 69 courses and are offered over a period of 10 main semesters, where there are two main semesters, Fall and Spring, per academic year. During these subsequent years, the student is gradually exposed to fundamental and applied courses pertinent to civil engineering, and to courses dealing with transportation engineering, sanitary engineering, geotechnical engineering and geomatics engineering. The courses are offered and taught in English.

6.1 Curriculum Overview

The curriculum of the CIE program consists of 175 credits spread over 86 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.

6.1.1 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
- Three elective courses from a basket of 13 electives

6.1.2 Basic Sciences Courses

- Mathematics
- Physics
- Mechanics
- Chemistry
- Accounting
- Economics
- Marketing

6.1.3 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
- Geomatics
- Steel Structures Design
- Reinforced Concrete Design
- Soil Mechanics
- Construction Project Management

6.1.4 Applied Engineering Sciences Courses

- Transport Planning and Travel Demand Modeling
- Traffic Engineering Theory and Applications
- Geometric & pavement Design and Safety of Highways
- Airport Engineering
- Railway Engineering
- Open Channel Hydraulics
- Water Supply Works
- Advanced Water and Wastewater Treatment Technologies
- Coastal and Harbour Engineering
- Bridge Engineering
- Foundation and Tunnel Engineering

6.2 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 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.

A university requirement of the CHS bachelor programs consist of 19 credits (10.85 % of total 175 credits) spread over 10 courses is common to all credit hour programs. This common university core consists of 13 compulsory credits (7.4% of total 175 credits) and 6 elective credits (3.4% of total 175 credits). Table 1a lists the seven (7) university core compulsory courses which represent 13 credits. Table 1b lists the university electives, where students should select only three (3) courses which represent 6 credits. The CIE students should take the course GENN301, Ethics and Legislation.

Table 1a: Compulsory Courses of University Requirements (13 credits, 7.4% of total 175 credits)

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

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

	Code	Course Title	Credits	Group
1	GENN301	Ethics and Legislation(1)	2	E-1(1)
2	GENN303	Critical thinking	2	
3	GENN305	Interdisciplinary Project	2	
4	GENN310	Advanced Risk Management	2	
5	GENN311	Technical Writing in Arabic	2	
6	GENN321	Foreign Language	2	
7	GENN326	Marketing	2	
8	GENN327	Selections of Life-long Skills	2	
9	GENN328	Scientific Research Methods	2	
10	GENN331	Business Communication	2	
11	GENN332	Service Management	2	
12	GENN333	Creativity, Art & Design	2	
13	GENN380	Thesis Writing for GP	2	

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

6.3 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 51 compulsory credits representing 29.1% of the total credits hours of the degree. A list of common college core courses is shown in Tables 2a and 2b.

Table 2a: Compulsory Courses of Common College Requirements (44 credits, 25.1 % of total 175 credits)

	Code	Course Title	Credits
1	CHEN001	Chemistry	3
2	GENN003	Basic Engineering Design	2
4	MDPN001	Engineering Graphics	3
6	MDPN002	Fund. of Manufacturing Engineering	3
7	MECN001	Mechanics-1	2
8	MECN002	Mechanics-2	2
9	MTHN001	Algebra and Analytic Geometry	3
10	MTHN002	Calculus I	3
11	MTHN003	Calculus II	3
12	MTHN102	Multivariable calculus and Linear Algebra	3
13	MTHN203	Probability and Statistics	3
14	CIEN280	Engineering Seminar	1
15	CIEN281	Industrial Training (1)	1
16	CIEN381	Industrial Training (2)	2
17	CIEN480	Graduation Project-1	1
18	CIEN481	Graduation Project-2	3
19	PHYN001	Mechanics, Waves and thermodynamic	3
20	PHYN002	Electricity and Magnetism	3

Table 2b: Compulsory Courses of Non-Common College Requirements (7 credits, 4 % of total 175 credits)

	Code	Course Title	Credits
1	ARCN116	Introduction to CAD Systems for Civil Engineers	2
2	ARCN110	Basic Architectural Design and Building Construction	2
3	MTHN103	Differential Equations	3

6.4 Discipline Requirements

The Civil Infrastructure Engineering program is one of the bases of Civil Engineering Discipline which includes Structural Engineering, Public Works, and Irrigation and Hydraulics. A Student who needs to pursue a degree in Civil Infrastructure Engineering has to finish the Civil Engineering major requirements. He has to finish 59 credits (32.6% of the total 175 credits) spread over 21 courses to satisfy the requirements of the Civil Engineering discipline by covering topics in Geomatics, Construction, Geotechnical, Environmental, Hydrological, and Transportation Engineering. This discipline core consists of 53 compulsory credits (30.28 % of total 175 credits) and six (6) elective credits (3.4% of the total 175 credits). First, the 53 compulsory credits of the discipline are satisfied by completing 19 compulsory courses, as shown in Table 3a. Second, the elective credits are satisfied by completing only two (2) Elective courses (6 credits) from the list in Table 3b.

Table 3a. Compulsory Courses of Civil Engineering Discipline Requirements (53 Credits, 30.28 % of total 175 Credits)

	Code	Course Title	Credits
1	IHDN101	Principals of Irrigation and Drainage	3
2	IHDN104	Civil Engineering Drawing	3
3	IHDN201	Fluid Mechanics	3
4	IHDN202	Open Channel Hydraulics	2
5	IHDN203	Water Chemistry and Microbiology	2
6	IHDN 401	Coastal and Harbour Engineering	3
7	PBWN202	Surveying for Engineers	3
8	PBWN302	Soil Mechanics	3
9	PBWN303	Foundation	3
10	STRN101	Structural Analysis-1	3
11	STRN102	Structural Analysis-2	3
12	STRN103	Engineering Materials	3
13	STRN104	Mechanics of Materials	3
14	STRN105	Human Resources Management	2
15	STRN201	Reinforced Concrete Design I	3
16	STRN224	Construction Project Management	3
17	STRN302	Steel structures Design I	3
18	STRN303	Reinforced Concrete Design II	3
19	INTN203	Mechanical & Electrical Systems	2

Table 3b. Elective Courses of Civil Engineering Discipline Requirements (Student should select only 6 Credits, 3.4 % of total 175 Credits)

	Code	Course Title	Credits	Group
1	IHDN302	Irrigation Design Works-1	3	E-2
2	IHDN303	River Engineering	3	
3	IHDN312	Hydraulic Engineering	3	
4	PBWN358	Solid and Hazardous waste management	3	
5	STRN322	Construction Planning and scheduling	3	

6.5 Major Requirements

The program offers a specialty in Civil Infrastructure Engineering. A student who wishes to complete a specialty in Civil Infrastructure Engineering has to complete the minimum major requirement which represent 46 credits (26.3 % from the total credits) spread over 17 courses to satisfy the major requirements by covering technical knowledge and training in areas of transportation, environmental, analysis and design of infrastructures. This major core consists of 31 compulsory credits (17.7% of total 175 credits) and 15 elective credits (8.6% of total 175 credits) covering topics of engineering and applied sciences in the in Civil Infrastructure Engineering field. First, the 31 compulsory credits of the CIE major are satisfied by completing 12 compulsory courses, as shown in Table 4. Second, the 15 elective credits are satisfied by completing five (5) courses that should be selected from the courses in Table 4b.

Table 4a. Compulsory Courses of Civil Infrastructure Engineering Requirements (31 Credits, 17.7% of total 175 Credits)

	Code	Course Title	Credits
1	PBWN200	Urban Transportation Planning	2
2	PBWN205	Data Analysis and Least Squares Adjustment in Geomatics	2
3	PBWN206	Geomatics	3
4	PBWN300	Water Supply Works	3
5	PBWN304	Advanced Transport Planning and Travel Demand Modeling	2
6	PBWN305	Traffic Engineering Theory and Applications	3
7	PBWN307	Railway Engineering-1	3
8	PBWN309	Wastewater Works	3
9	PBWN310	Geometric Design and Safety of Highways	3
10	PBWN404	Highways Pavement Design and Construction	3
11	PBWN407	Advanced Water and Wastewater Treatment Technologies	2
12	PBWN453	Tunnel Engineering	2

Table 4b. Elective Courses of Major Requirements: Civil Infrastructure Engineering (15 credits, 8.6 % of total 175 credits)

	Code	Course Title	Credits	
1	PBWN446	Deep excavation and side support	3	E-3(1)
2	PBWN450	Ground water control systems	3	
3	PBWN451	Advanced topics in geotechnical engineering	3	
1	PBWN403	Advanced Railways Engineering	3	E-4(2)
2	PBWN440	Airport Planning and Design	3	
3	PBWN442	Freight Transportation and ITS Applications	3	
4	PBWN454	Fundamentals of Intelligent Transportation Systems	3	
5	PBWN444	Role of Advanced Positioning Techniques in Infrastructure Projects	3	
6	PBWN445	GIS and Remote Sensing Applications	3	
7	PBWN459	Hydrographic Survey	3	
1	IHDN458	Design of Coastal Protection Works		

2	PBWN452	Management of water & wastewater Facilities	3	E-5(3)
3	PBWN455	Environmental Systems Analysis	3	
4	PBWN 456	Advanced Topics in Networks Design	3	
5	PBWN457	Introduction to Environmental Modelling	3	
6	PBWN 458	Membrane technology for water and wastewater treatment	3	
7	STRN466	Design and Construction of Water & Wastewater Structures	3	

Remarks:

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

(2) Student selects two (2) courses from group E-4 equivalent to 6 credits

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

6.6 Conformity to SCU Requirements

Classification and categorization of courses in the Civil Infrastructure Engineering program follow the guidelines provided by the Supreme Council of Universities (SCU), as shown in Table 5. The classification is based upon the "Sample Study Plan and Program Details", which is described in Section 6. The categorization is given for the following five student levels according to the regulations of the credit hour system at the Faculty of Engineering, Cairo University:

- **Freshman**: a student who completed less than 35 credits
- **Sophomore**: a student who completed more than 35 credits but less than 71 credits
- **Junior**: a student who completed more than 70 credits but less than 105 credits
- **Senior-1**: a student who completed more than 104 credits but less than 142 credits
- **Senior-2**: a student who completed more than 141 credits but less than 175 credits

Table 5. Conformity to Supreme Council Criterion

Category	Freshman	Sophomore	Junior	Senior I	Senior II	Tot. cr. Hr.	%
Humanities and Social Sciences	3	4	5.8	2	1.5	16.3	9.3
Basic Sciences	23.8	11	3	2.4	0.5	40.7	23.3
Engineering Sciences	1.2	16	15.6	4.8	3.5	41.1	23.5
Applied Engineering Sciences	0	0	5.4	20.5	7.3	33.2	19
Computer Application	7	5	1	2.4	4.85	20.3	11.6
Project and Practice	0	0	3.2	2.9	9.1	15.2	8.69
Discretion	0	0	0	2.0	6.25	8.25	4.71
Total	35	36	34	37	33	175	100
University Requirements	5	4	4	2	4	19	10.9
College Requirements	30	10	13	3	4	51	29.1
Discipline Requirements	0	22	19	15	3	59	33.7
Major	0	0	0	17	22	46	26.3
Total	35	36	36	37	33	175	100

The total 175 credit hours of the Civil Infrastructure Engineering program are distributed between lectures (Lec) and tutorial sessions, where the tutorial session is classified as a problem solving (PS) session and/or projects, laboratory, and practical work (PP) session, as shown in Table 6. In the CIE program, the one (1) credit hour of a tutorial session (PS or PP) corresponds to 2-3 contact hours to provide sufficient practical training for the students. As a result, the total contact hours of the CIE program are 276 hours, which are divided to 120 contact hours for lectures (43.48% of total 276 real hours), and 156 contact hours for tutorial sessions (56.52% of total 276 hours). The CIE program offers 69 courses which include 59 compulsory courses which cover 148 credits (84.6 % of total credit hours), and 10 elective courses (from a total of which cover 27 credits (15.4% of total credit hours).

7. SAMPLE STUDY PLAN and PROGRAM DETAILS

A sample study plan for the Civil Infrastructure Engineering (CIE) program is provided to present the recommended sequence of delivery of the program 74 courses over 10 main semesters, Fall and Spring semesters per academic year. Since the CIE program is based on the credit hour system, the student does not have to take the courses during the semester indicated in the study plan as long as the prerequisites of a particular course are satisfied. The CIE curriculum encourages students to interact with the industrial sector and government agencies by offering two industrial training courses in two consecutive summer semesters. Also, the CIE students will be trained on teamwork and will be exposed to large Civil Infrastructure Engineering projects during their practical training and graduation projects.

Freshman Year Course Schedule

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

Remarks:

(1) Course MECN002 has a prerequisite course MECN001

(2) Course MTHN003 has a prerequisite course MTHN002

CIE 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.	ARCN110	2	ARCN116	2	INTN203	2	GENN210	2
2.	GENN102	2	GENN201	2	IHDN201	3	GENN224	2
3.	IHDN104	3	IHDN101	3	MTHN203	3	IHDN202	2
4.	IHDN203	2	MTHN103	3	PBWN202	3	PBWN200	2
5.	MTHN102	3	STRN102	3	STRN201	3	PBWN205	2
6.	STRN101	3	STRN104	3	STRN224	3	PBWN206	3
7.	STRN103	3	STRN105	2			STRN302	3
8.							CIEN281(0)	1
Semester Credit Hrs		18		18		17		16+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.	PBWN305	2	PBWN303	3	GENN3XX(1)	2	GENN3XX(1)	2
2.	CIEN280	1	GENN301	3	IHDN 401	3	PBWN4XX(3)	3
3.	PBWN300	3	PBWN307	3	PBWN453	2	PBWN407	2
4.	PBWN302	3	PBWN309	3	PBWN404	3	PBWN4XX(4)	3
5.	PBWN304	2	PBWN310	3	PBWN4XX(4)	3	PBWN4XX(5)	3
6.	STRN303	3	CIEN381(0)	2	PBWN4XX(5)	3	CIEN481	3
7.	XXXN3XX(2)	3	XXXN3XX(2)	3	CIEN480	1		
Semester Credit Hrs		17		18+2(0)		17		16

Remarks:

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

(1) General elective course (group E-1, 2 credits per course): GEN301, GENN310, GENN311, GENN321, GENN326, GENN327, GENN331, GENN332

(2) Discipline elective course (group E-2, 3 credits per course): IHDN302, IHDN303, IHDN312, PBWN358, STRN322

(3) Major elective course (group E-3, 3 credits per course): PBWN446, PBWN450, PBWN451

(4) Major elective course (group E-4, 3 credits per course): PBWN403, PBWN440, PBWN442, PBWN454, PBWN444, PBWN445, PBWN459

(5) Major elective course (group E-5, 3 credits per course): IHDN458, PBWN452, PBWN455, PBWN456, PBWN457, PBWN458, PBWN466

8. COURSE CONTENTS

8.1 University Core Courses

GENN001	**History of Science and Engineering** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): none** History of Technology: Engineering and technology in a cultural, social, and historical context. Development of technology as a key to history of civilization in a comparative perspective - Exploring Humanities: Modes of thought found within humanities and social sciences. Humanities for Engineers: Humanities themes of increased complexity - Different work methodologies - Critical analysis of information & choice of argumentation - Work methodologies and pedagogical interest.
GENN004	**Computers for Engineers** **Compulsory, Credits: 2 (1+0+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.
GENN005	**Technical Writing** **Compulsory, Credits: 2 (1+1+0)** **Prerequisite(s): Passing required exam held in the University** Discovering and outlining ideas. Organizing outlines. Ways to begin the three parts of technical writing. Writing abstracts, summaries, and conclusions of long reports. The thesis 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): GENN005** Analyzing the audience. Selecting presentation topics and objectives. Recognizing different types of speeches and presentations. Overcoming nervousness and developing confidence while addressing an audience.

	Researching and generating information for informative presentations. Chucking presentation content. Designing effective visual aids. Using explicit and effective transitions throughout a presentation. Creating benefit statements for persuasive presentations. Using persuasive devices such as pathos and logos in speeches. Planning and delivering informative, persuasive, entertaining and inspiring presentations. Handling question and answer sessions effectively.
GENN210	**Risk Management and Environment** **Compulsory, Credits: 2 (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**.**
GENN224	**Fundamentals of Economics and Accounting** **Compulsory, Credits: 2(2+0+0)** **Prerequisites (s): 42** The main objective of this course is to provide engineers with the basic concepts of Economics and Accounting where the engineer has to be able of conceiving a business' vision from financial & strategic dimensions alongside to his/her technical skills. The course includes introduction to financial accounting, overview of managerial accounting, and economic concepts. The financial accounting includes the accounting cycle and financial statements. It also includes financial ratios for measuring the organization's performance. The Managerial accounting and behavior of cost includes the cost volume relationships and its further use in Budgeting & Forecasting. Economic concepts are addressed in microeconomics & macroeconomics where microeconomics includes the basic principles of economics, theory, assumptions, and models of economics as a social science, it also includes market forces of supply and demand, and elasticity & its applications. Another important topic addressed in this part is the competitive markets where decisions regarding maximizing profit, shutting down or exiting the market are discussed through computational methods & formulas. Macroeconomics includes measuring the nation's income where it explains the gross domestic product (GDP), its components & types.

GENN301	**Ethics and Legislation** **Elective (group E-1), Credits: 2 (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.
GENN303	**Critical Thinking** **Elective (group E-1), Credits: 2 (2+0+0)** **Prerequisite(s): GENN003** The aim of the course is to apply critical thinking in the context of problem solving in the engineering field. Critical thinking and abstract thought are invaluable tools, which complement an engineer's technical expertise. Critical Thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. The following terms and applications are also discussed: Analysis, breaking down the problem into parts and finding the relationships between them; Synthesis, thinking about other ways to solve the problem either by incorporating new information or combining the parts in a different way; and finally, Evaluation is making a judgment about the results using the evidence at hand.
GENN305	**Interdisciplinary Project** **Elective (group E-1), Credits: 2 (2+0+0)** **Prerequisite(s): 108 credits** The course aims to give students more space for creativity, out of box thinking, collaboration and involvement in team work. It's a free specialization course where the subject is to be determined by the student team. The team consists of up to 6 students and minimum of 4 students. A maximum of two students of the same credit hour program can be members of the same student team. The team shall register the topic of the project with the course coordinator and follow up with him/her at least 3 times during the semester. No mid-term Exam for the course and the final Exam jury will be nominated by the course coordinator depending on the project subject, but not necessarily on the student(s) cr. Hr. program. The course is graded as a normal graded course. Final grade consists of: 20% for Semester work + 80% for Final Exam.

GENN310	**Advanced Risk Management** **Elective (group E-1), Credits: 2 (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): GENN005 + 80 credits** Review of the Basics of Arabic Grammar and Mechanics. Writing Effective Sentences and Paragraphs Using Arabic Language. Discovering and Outlining Ideas. Writing Abstracts, Summaries, and Conclusions of Long Reports. The thesis Statement. Writing Technical Forms Using Arabic Language: Letters, Memos, Reports, Scientific Articles, Job Description, CV. Writing References and Footnotes. Selection of Key Words, Titles and Subtitles. Editing, Revising and Proofreading Techniques. Electronic Word Processing and Technical Writing. Integrating Graphs, Tables and Charts in Technical Documents. Vocabulary Building. Basic Types and Patterns of Argument: Terminology, Building Sub-Arguments of Fact and Policy. مراجعة أسس القواعد النحوية و ميكانيكيات اللغة العربية - الأخطاء الشائعة فى إستخدامات اللغة العربية - كتابة جمل وفقرات صحيحة وفعالة بإستخدام 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 - إختيار الكلمات المفتاحية و كذلك العناوين الرئيسية والفرعية - التعرف على تقنيات التحرير و المراجعة و القراءة الإحترافية - إمكانية معالجة النصوص والكتابة الإليكترونية - الرسوم و الجداول و المخططات البيانية في الوثائق الفنية - بناء حصيلة لغوية من الكلمات والمفردات - تعلم الأنماط 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.
GENN328	**Scientific Research Methods** **Elective (group E-1), Credits: 2 (2+0+0)** **Prerequisite(s): 108 credits** Course covers the process of scientific knowledge and practical implementation, underlying research methodology issues. To develop a critical and questioning mindset, critical understanding of issues related to research questions, literature review, methodological design, data collection, analysis and conclusion. Moving you toward fulfillment of the publication and dissertation requirements, perhaps will turn you into a 'Researcher'. All of which to use content to solve technical, practical, and life problems.
GENN331	**Business Communication** **Elective (group E-1), Credits: 2 (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.

8.2 College-Core Courses

ARCN110	**Basic Architectural Design and Building Construction** **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. . Building Loads, Clarifications of Construction Systems, Substructures, Insulation, Staircase Terminologies
ARCN116	**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.
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.

INTN203	**Mechanical and Electrical Systems** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): none** Introduction to electrical circuits; Electrical installation in residential and industrial buildings (illumination networks in rural areas, data lines, telephone lines and 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.
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. Drawing of Architectural projections and reading of blueprints.
MDPN002	**Fundamentals of Manufacturing Engineering** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): none** Engineering Materials - Elements of Manufacturing Processes, material flow, energy flow and information flow - Forming in the liquid state, Casting and molding processes - Forming in the solid state, metal forming, forming of plastics and powder metallurgy - Material Joining processes, welding, soldering and brazing, riveting, joining by mechanical elements, assembly processes - Material removal processes, metal cutting and finishing processes - Computer applications in manufacturing - Term mini-project.
MECN001	**Mechanics-1 (Statics)** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): none** Statics of particles, forces in three-dimensions, vector algebra; equivalent systems of forces, resultant of a group of forces, moments of forces, moment of a couple, reduction of a system of forces, wrench; equilibrium of rigid bodies in two dimensions, reactions at supports and connections for a 2D structure, 2D trusses, equilibrium of rigid bodies in three dimensions, reactions at supports and connections for a three dimensional structure; centroids and centers of gravity, center of gravity of 2D bodies, centroids of areas and lines, first moments of areas and lines, composite plates and wires; moments of inertia, moments of inertia of areas, second moment, or moment of inertia of an area, polar moment of inertia, radius of gyration of an area, parallel-axis theorem, moments of inertia of composite areas, product of inertia, principal axes and principal moments of inertia, moments of inertia of masses, moment of inertia of a mass, parallel axis theorem, moments of inertia of thin plates, moments of inertia of composite bodies, mass product of inertia, principal axes and principal moments of inertia.

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

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.
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.
CIEN280	**Engineering Seminar** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): 72 Credits + AA Approval** Talks and presentations are invited from industrial establishments relevant to the program. The guest speaker should discuss the organization, management, and recent technologies implemented in his/her industrial establishment. Students exercise writing a technical report on the guest presentation and deliver their own presentation about the topic. The course is graded as Pass/Fail system
CIEN281	**Industrial Training-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 72 Credits + AA Approval** Field Training on industrial establishments of infrastructure projects including; water/waste water treatment plants, waste/wastewater networks, roads, bridges, tunnels, airports' airfield, rail, and other transport projects. 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.

CIEN381	**Industrial Training-2** **Compulsory, Credits: 2 (0+0+6)** **Prerequisite(s): CIEN281 + AA Approval** Field and Office Training on industrial establishments of infrastructure projects including; water/waste water treatment plants, waste/wastewater networks, roads, bridges, tunnels, airports' airfield, rail, and other transport projects. Training lasts for total of 180 hours (90 hours field training, and 90 hours office training), 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.
CIEN480	**Graduation Project-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 130 Credits + AA Approval** All students undertake a major project as part of the program. The aim of the project is to provide the students - in groups - with an opportunity to implement the appropriate concepts and techniques to a particular design. Students are required to choose and research the expected project to be designed and implemented in course Graduation Project-2. The student must give an oral presentation to be approved. The course is graded as Pass/Fail system.
CIEN481	**Graduation Project-2** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): CIEN480** All students undertake a major project as part of the program. The aim of the project is to provide the students - in groups - with an opportunity to implement the appropriate concepts and techniques to a particular design. A dissertation on the project is submitted on which the student is examined orally.
PHYN001	**Mechanics, Oscillations, Waves and Thermodynamics** **Compulsory, Credits: 3 (2+2+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.

PHYN002	**Electricity and Magnetism** **Compulsory, Credits: 3 (2+2+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.

8.3 Discipline Courses

IHDN101	**Principles of Irrigation and Drainage Engineering** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): none** Definitions, Water resources, Components of irrigation systems, Irrigation water quality, Soil - water plant relationships, Estimation of irrigation water requirements, Introduction to various types of irrigation systems (Surface - Sprinkler - Drip), Subsurface drainage, Horizontal and vertical drainage. , Concepts of irrigation efficiency and uniformity.
IHDN104	**Civil Engineering Drawing** **Compulsory, Credits: 3 (2+1+1)** **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** Fluid Properties: Units, Dimensions, The Continuum, Viscosity, Specific: Volume, Weight, Gravity, Heat, Pressure, Compressibility, Vapor pressure, Surface tension. Fluid Statistics, Pressure at a Point, Pressure Measuring Devices, Forces on Plane and curved Surfaces. Buoyant Force, Stability of floating and submerged bodies, Horizontal, vertical and radial acceleration, and Forced vortex. Ideal-Fluid Flow, Flow classification, The Continuity, Requirements for Ideal Flow, Euler's equation of Motion, Irrotational flow, Velocity potential, Integration of Euler's Equation, Bernoulli's Equation, The Stream function, Sink, Source, Doublet.

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
IHDN203	**Water Chemistry and Microbiology** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): CHEN001** Basic water quality concepts, Basic chemistry concepts, Good laboratory practice, Standard solutions, Water color, odour and temperature, Understanding and measuring pH, Understanding and measuring EC, Understanding and measuring DO, Understanding and measuring COD, Understanding and measuring BOD, Basic aquatic chemistry concepts, Oxygen balance in surface waters, Major ions in water, Trace compounds in the aquatic environment, Potentiometric analysis of water quality, Use of ion selective probes, Absorption spectroscopy, Emission spectroscopy, Measurement of selected ions in water, Introduction to microbiology, Microbiological laboratory techniques, Coliforms as indicators of faecal pollution, How to measure coliforms
IHDN302	**Irrigation Design Works-1** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): IHDN101** Planning and design of irrigation and drainage networks, seepage losses, technical and economic feasibility of canal lining, irrigation structures and their functions, general requirements and design considerations (hydraulics, loads, stability, structural aspects), transitions and wing walls, design of typical conveyance and crossing structures (culverts, syphons, aqueducts, short span bridges), tail escapes, construction methods.
IHDN303	**River Engineering** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): IHDN202** Introduction, Sediment properties, Erosion, Transportation and deposition of sediments, River morphology, River Meanders, Hydraulics of flow in river channels, Design of stable channels, Local scour around piers and abutments, , Flow in curved river channels, Physical and mathematical modeling of erodible channels, River training works, Field visits, Case studies.

IHDN312	**Hydraulic Engineering** **Elective, Credits: 3 (2+3+0)** **Prerequisite(s): IHDN201** Open channel flow: types of flow, conservation laws of mass and energy, specific energy concept, flow resistance in channels, sketching and calculations of water surface profile for gradually varied flow, design of cross sections in open channels, momentum equation and specific force concept, design of stilling basins downstream of gates and pipe outlets, physical models; Introduction to river engineering and sediment transport; Pumps: types and characteristics of pumps, pumps and pipeline systems; Hydraulics of groundwater: types of aquifers, groundwater flow, design of wells.
IHDN401	**Coastal and Harbour Engineering** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): IHDN201** Introduction - Wave theory and characteristics - Wave forecasting - Wave transformation - Tides and water levels - Coastal sediment - Harbour planning - Harbour and port facilities - Design of breakwaters - Design of berths - Inland navigation - Case studies.
IHDN458	**Design of Coastal Protection Works** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN401** Causes of beach erosion, protection of beaches against erosion, design of seawalls, breakwaters, groins and jetties, beach nourishment design, shoreline impact assessment, Construction materials and methods, Case studies.
PBWN358	**Solid and Hazardous waste management** **Elective, Credits: 3(2+3+0)** **Prerequisite(s): -** Solid waste characteristics and composition, Onsite handling, storage and processing of solid wastes, Transfer and transportation of solid wastes, Street cleansing, Recovery of resources, conversion products and energy, Processing techniques and technologies, Management of solid wastes in developing countries, Planning in solid waste management, hazardous wastes
PBWN202	**Surveying for Engineers** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MTHN003** The course covers basic concepts of surveying in relation to civil engineering. It provides technical knowledge and practical experience in surveying. Students will learn the theory of surveying, use and proper care of surveying instruments, field data measurement (distances, angles, and height differences). Emphasis is placed on the operation of modern surveying equipment (automatic level, theodolite, total station Terrestrial Laser Scanner and GPS), awareness of GIS, along with office computations and field work of detail surveying, including traverse surveys, earthwork computation; setting out engineering structures and construction projects.

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	**Foundation** **Compulsory, Credits: 3 (2+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, reactions, internal forces, analysis of beams, frames, trusses. Influence lines of statically determined structures, Moving loads
STRN102	**Structural Analysis-2** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN101** Deformations: differential equations, virtual work. Indeterminate structures: consistent deformation, 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 cases of loading. The load and corresponding deformation diagram is to be plotted. The different properties are to be determined.

STRN105	**Human Resources Management** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): 45 credit hours** 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
STRN201	**Reinforced Concrete Design I** **Compulsory, Credits: 3 (2+2+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.
STRN224	**Construction Project Management** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): 54 Credit hours** Project management definition, project delivery methods, contracting strategies, basic management functions, construction scheduling, bar charts, 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.
STRN302	**Steel Structures Design I** **Compulsory, Credits: 3 (2+2+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.
STRN322	**Construction Planning and Scheduling** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): STRN224** Construction planning, importance of scheduling, scheduling techniques, AOA and AON networks, 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

8.4 Major Courses

PBWN200	**Urban Transportation Planning** **Compulsory, Credits: 2 (1+2+0)** **Prerequisite(s): MTHN003** This course provides an introductory for various fields within planning, such as housing, transportation, environmental planning, urban sprawl and growth management. It focuses on the transportation's methodologies for planning transportation systems, and developing feasible alternatives. It also comprises transportation engineering basic definitions, time horizons of transport planning procedures, introduction to travel demand forecasting models and introduction to public transport.
PBWN205	**Data Analysis and Least Squares Adjustment in Geomatics** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): PBWN202** Geomatics data and data errors types. Blunder detection, systematic errors modeling, and random error distribution. Pre-analysis for Geomatics measurements and evaluation of expected results. Least squares principles and concepts. Reasons for applying least squares solutions to geomatics observations. Determining input into, and analyzing output from, typical least squares adjustment software. Modelling observations, observation equations, and parametric method. Linearization of equations. Derivation of least squares. Methods of forming normal equations. Worked examples in various Geomatics areas such as leveling, positioning, and deformation monitoring.
PBWN206	**Geomatics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PBWN202** Coordinate systems, Cartesian, Geographic, and plane. Horizontal and vertical datum. Coordinates transformation and datum transformation problem. Computation on Ellipsoid. GNSS Overview with emphasis on GPS. Absolute, Differential, and Relative positioning by GPS. Using of RTK and kinematic positioning by GPS for surveying, construction and as built of infra-structures projects. Basic principles for Map Projection with emphasis on current situation for Egypt. Introduction for Photogrammetry. Camera Calibration- Aerial Photogrammetry and Close Range Photogrammetry-overview for Mobile Mapping Systems-UAV Photogrammetry concept and applications- Remote Sensing definition and basic concept - Classification of Sensor. Overview for GIS & BIM applications in CIE

PBWN300	**Water Supply Works** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): IHDN 201, IHDN203** Water resources studies including: ground, surface, rain and sea water- water consumption and population studies- collection works for ground and surface water- treatment works: coagulation, filtration, sedimentation, filtration, disinfection, taste and odor control, iron and manganese removal, RO. Water distribution Systems: Planning, and design using WaterCAD.
PBWN304	**Advanced Transport Planning and Travel Demand Modeling** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): PBWN200** • Types of demand analysis (aggregate, disaggregate and other applications of choice models) • Trip based demand modeling • Activity based demand modeling • Trip distribution models calibration • Discrete mode choice models • Dynamic and static traffic assignment models • Applications using commercial software (e.g., PTV Visum)
PBWN305	**Traffic Engineering Theory and Applications** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PBWN200** The Traffic Engineering course will introduce students to the fundamentals of traffic flow characteristics and theory, macroscopic and microscopic traffic flow models, traffic network modeling, traffic simulation models, shockwave analysis, queuing theory and applications, traffic operations analysis, capacity and level of service, traffic impact studies, and traffic signal design and control. Students will be introduced to specialized traffic simulation and control design software and applications (e.g. Synchro, VISSIM, Aimsun, etc.)
PBWN307	**Railway Engineering** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): PBWN200** Train resistance and tractive forces, Elements of geometric alignment of railway, Design of different elements of railway track, • Renewal and maintenance of railway lines, Geometric design of different types of turnouts & crossings, Design of railway stations and yards, Safety and types of railway signals

PBWN309	**Wastewater Works** **Compulsory, Credits: 3(2+3+0)** **Prerequisite(s):PBWN300** Collection works: Planning, flow components and estimation, pipe sizing and design using SewerCad. Pump stations: types, and sizing. Wastewater treatment: physical, chemical and biological processes. Design of treatment units: screens, grit chambers, sedimentation tanks with full details, biological treatment units: trickling filters, activated sludge, and oxidation ponds, introduction to anaerobic treatment systems. Sludge Handling
PBWN310	**Geometric Design & Safety of Highways** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): PBWN305** Introduction and Highway Classifications, Driver, Vehicle, and Road Characteristics, Route Layout, Highway Design Standards, Cross-Section Elements, Vertical Alignment, Horizontal Alignment, Evaluation of Earth Work Requirements, Design Consistency, Safety Considerations, Intersection Design, Computer tools (Civil 3D, AutoCAD)
PBWN403	**Advanced Railways Engineering** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): PBWN307** Characteristics of brakes for passenger and freight trains, stopping distance and breaking time estimation by the graphical method. The definition of braked weight and its characteristics- Curve rectification of railway track- Long-welded rails and safety against buckling -Advanced turnouts for high speeds - Marshalling yards and Loco yards - Applications on electric signals.
PBWN404	**Highways Pavement Design & Construction** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): PBWN305** Introduction , Principles of pavement design, Stresses in flexible pavements, Stresses in rigid pavements, Traffic loads and its characteristics, Soil classification systems ,Material characterization, Pavement materials, Design of flexible highway pavements ,Design of rigid highway pavement, Pavement Construction Equipment and methods, Pavement Evaluation, Maintenance and Rehabilitation Techniques
PBWN407	**Advanced Water and Wastewater Treatment Technologies** **Compulsory, Credits: 2(1+3+0)** **Prerequisite(s): PBWN309.** Phosphorus removal, Nitrogen removal, Membrane filtration, SBR, Ion exchange, floatation, Anaerobic treatment, Wastewater Re-use and reclamation, Water hardness, Iron and manganese removal, Color and odor removal

PBWN440	**Airport Planning and Design** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): PBWN310, PBWN404** Introduction, Aircraft Technology and Characteristics, Air Traffic Control Systems, Airport Master Planning and Site Selection, Demand Forecasting in Airport Planning, Airport Configuration Design, Airport Airside Capacity Analysis, Capacity Models, Geometric Design, Airport Terminal Configurations, Terminal Design, Pavement Design (Flexible Pavement), Pavement Design (Rigid Pavements), Lighting and Marking, Airport Financing and Economic Analysis, Air Cargo Terminals
PBWN442	**Freight Transportation and ITS Applications** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): PBWN200** Supply of Freight Services, Basics of Logistics and Supply Chains, Demand Models, Shipper Behavior, Role of Advanced Technologies, Implications of E-commerce, Data Sources and Needs, Overview of Planning and Policy Issues
PBWN444	**Role of Advanced Positioning Techniques in Infrastructure Projects** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): PBWN206** Choosing Coordinate system and map projection method to eliminate distortion. Shop drawing preparation for some infrastructure projects. Using of RTK and kinematic positioning by GPS for surveying and construction of projects. As built survey using and advanced surveying equipment such GPS. 3D laser scanner, Total station, and level. Data collection and linking data with maps through GIS & BIM
PBWN445	**GIS and Remote Sensing Applications** **Elective, Credits: 3 (2+2+1)** **Prerequisite(s): PBWN202** This course provides a conceptual overview and hands-on experience using the GIS software, giving the background knowledge to quickly take advantage of GIS powerful display and query capabilities in such enhanced format supporting decision makers. It Introduce the concepts of GIS, Present GIS different uses, learn basic ArcView functionality, become familiar with the ArcView user interface, and Use ArcView to create charts and layouts. GIS graphic user interface (GUI): Interacting with the application window and its components; using online help, Projects and documents: How projects organize, manage and store documents (view, tables, charts and layouts), Creating and editing themes: Using GIS modules to create and edit shape themes, Tables: Creating tables from a variety of tabular data sources; selecting from a table; joining multiple tables; modifying table structure, Charts: Creating a chart for presenting and analyzing tabular data, Layouts: Combining views, tables, charts and images, as well as, logos and scale bars, to create layouts. BIM will be introduced with emphasis on CIE Projects

PBWN446	**Deep excavation and side support** **Elective, Credits: 3(2+3+0)** **Prerequisite(s):PBWN302** Theory of earth pressure, Gravity type retaining walls, Flexible type retaining walls, Deep excavation.
PBWN450	**Ground water control systems** **Elective, Credits: 3(2+3+0)** **Prerequisite(s): PBW302** Soil permeability, Seepage, Flow nets, Theory of wells, Ground water control systems
PBWN451	**Advanced topics in geotechnical engineering** **Elective, Credits: 3(2+3+0)** **Prerequisite(s): PBW302 & PBW303** Laterally loaded piles, Soil improvement techniques, Problematic soils
PBWN452	**Management of water & wastewater Facilities** **Elective, Credits: 3(2+3+0)** **Prerequisite(s): PBW309** Reliability of Treatment Processes, Process control Parameters, Process performance control and management, Odor / Air emissions management, Energy considerations, Introduction to Sludge management systems, Upgrading treatment performance via process optimization, Introduction to Operation and Maintenance planning, Regulations and legislation, EIA and auditing.
PBWN453	**Tunnel Engineering** **Compulsory, Credits: 2(1+3+0)** **Prerequisite(s): PBWN302** Geological investigation and ground characterization, Methods of construction, Tunnel design, Design of supports, Field monitoring of stresses and displacements, Construction control
PBWN454	**Fundamentals of Intelligent Transportation Systems** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): PBWN305** Overview of ITS, Transportation Networks Modeling for ITS, Traffic surveillance technologies and practices, ITS-Capable Traffic Simulation, Traffic Operations Control and Optimization, Introduction to Artificial Intelligence and Applications for ITS, Introduction to ITS Architecture, Standards and Specifications, software applications.
STRN466	**Design and Construction of Water & Wastewater Structures** **Elective, Credits: 3(2+3+0)** **Prerequisite(s): STRN201** Cracking limits, Design of water tight sections, Water pipe sections, Design of water structures; underground circular and rectangular tanks and swimming pools, elevated circular and rectangular deep and shallow tanks, Detailed design and construction of RC water and wastewater treatment facilities.

PBWN455	**Environmental Systems Analysis** **Elective, Credits: 3(2+2+0)** **Prerequisite(s):-** Tools for environmental systems analysis, Strategic environmental assessment, Environmental impact assessment, Life-cycle assessment, Material flow analysis, Cost-benefit analysis.
PBWN456	**Advanced Topics in Networks Design** **Elective, Credits: 3 (2+2+0)** **Prerequisite(s): PBWN309.** Distribution networks, water quality in distribution networks, storm water, vacuum and pressure sewers
PBWN457	**Introduction to Environmental Modelling** **Elective, Credits: 3(2+2+0)** **Prerequisite(s): PBWN309** Movement and fate of environmental pollutants, Principles of kinetics, stoichiometry, mass balances, and reactor theory, Mathematical modeling of water quality in rivers and lakes, Introduction to microbial kinetics, Introduction to mathematical models for Wastewater treatment, Introduction to BioWin computer software
PBWN458	**Membrane technology for water and wastewater treatment** **Elective, Credits: 3(2+2+0)** **Prerequisite(s): PBWN300.** Low-pressure membranes (UF and MF), Desalination by Reverse osmosis (RO), Pre-treatment for RO systems, Fouling and cleaning in membrane systems, Membrane bioreactors for wastewater treatment.
PBWN459	**Hydrographic Survey** **Elective, Credits: 3(2+2+1)** **Prerequisite(s): PBWN202, PBW206.** Elements of hydrography, tides and water levels. Fundamental of RF and acoustic propagation. Marine positioning; shore-based and satellite-based radio navigation systems, integrated positioning systems, positioning accuracies. Sounding methods: shipborne single beam and multibeam echo-sounding, sonars, airborne laser and electromagnetic methods, related corrections. Real time kinetic (RTK) GPS. Maritime boundaries. Choice and establishment of sea level datum for depth sounding.