Section 5

Structural Engineering Program (STE)

Based on Credit Hours System (CHS)

September 2013

1. INTRODUCTION

Civil Engineering is a vital traditional profession for the development, construction and maintenance of the infrastructure of the nation as well as for the growth of the nation's resources and the sustainability of a better quality and safer environment for future generations. It embraces various engineering fields including Structural Engineering, Construction Engineering, Geotechnical Engineering, Environmental Engineering, Hydrological Engineering, and Transportation Engineering. Hence, Civil Engineering graduates can apply for diverse jobs in government, public and private practice.

Structural Engineering is a fundamental Civil Engineering field because of its main contribution in driving the progress wheel forward through urban renaissance. In practice, the structural engineer is an essential member in engineering projects with responsibilities ranging from the design and construction of new structures, such as buildings, bridges, dams, tunnels, pipelines, and oil platforms, to the planning and management of the project. Furthermore, the structural engineer is responsible for the maintenance, repair, and rehabilitation of existing structures according to the latest technical techniques and for the utilization of natural resources of the nation. Hence, there is always a great demand for skillful structural engineers in both the national and international job-markets. In 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 established a new Bachelor program in Structural Engineering (STE) based on the credit hours system (CHS). This program will provide the society with proficient structural engineers capable of supporting the progress efforts and urban renaissance in Egypt, in the middle-east region, and abroad by possessing good knowledge and hands-on skills according to the latest technical advancement to work in the areas of structural design, stress analysis, project planning, construction, site management, and maintenance of structures. In addition, the STE graduates will participate in fulfilling the on-growing demand on skillful structural engineers in the job-market. In the following sections, the mission of the STE program, its educational objectives and learning outcomes are presented. Then, a full description of the program and a sample study plan are provided. Finally, the syllabi of the program courses, compulsory and elective, are listed.

2. PROGRAM MISSION

Structural Engineering field continues to prosper and advance so that new and better energy-efficient structures can be designed and constructed, a cleaner and safer environment can be provided, existing structures can be maintained, and innovative cost-effective solutions to infrastructure problems can be developed. The demand for skillful structural engineers continues to be high; therefore, the graduates of the STE program would be highly demanded in the national, regional and international job markets as evident by the following:

- Continuing need for Structural Engineering graduates because of the booming development activities and urban projects nationally and abroad.
- Escalating shortage of skillful structural engineers who can cooperate with national and international design firms and consulting offices, since many of the current practitioners in the profession are retiring.
- Growing recognition that the field of Structural Engineering should be distinct from Civil Engineering, where several states in the USA license structural engineers separately from other professional engineers[1].

Thus, the mission of the Structural Engineering (STE) program based on the credit hours system at the Faculty of Engineering, Cairo University, is to provide a broad, well-rounded, and high-quality education in Civil Engineering with emphasis on the profession of Structural Engineering and its specific areas of materials, mechanics, analysis and design. By completing the B.Sc. degree requirements of the STE program, the graduates will demonstrate professional competence to contribute in future efforts for developing and maintaining the infrastructure and environment at the national, regional and international dimensions.

3. EDUCATIONAL OBJECTIVES

The educational objectives of the Structural Engineering program at the Faculty of Engineering, Cairo University, are to prepare its graduates to:

1. Perform successfully in a work environment by utilizing their technical knowledge, intellectual abilities and practical skills.
2. Communicate effectively in a business environment and present high work ethics.
3. Design and construct efficient civil structures and infrastructure systems by applying the principles and methods of structural engineering and sustainability.
4. Analyze and solve complex engineering problems by working individually or within multidisciplinary teams.
5. Examine and evaluate different practical alternatives and select efficient structural systems for engineering projects.
6. Plan and manage diverse engineering projects by applying their management, scheduling, intellectual, leadership and professional skills.
7. Apply information technology and computational abilities in structural engineering projects.
8. Continue career development through life-long learning, professional seminars and licensure.

[1] Sputo, T., and Lammert, K., "Reviving Art and Practice in Structural Engineering Education", Leadership and Management in Engineering, April 2008, pp. 49-53.

4. PROGRAM LEARNING OUTCOMES

The STE 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 STE 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)

4.1 Knowledge and Understanding

(K1) Explain the basic concepts, theories and laws of mathematics and sciences.
(K2) Recognize the basics of information and communication technology (ICT).
(K3) Classify the characteristics of engineering materials related to the discipline.
(K4) Recognize the principles of design including elements design, process and/or a system related to specific disciplines.
(K5) Identify methodologies of solving engineering problems, data collection and interpretation.
(K6) Recognize quality assurance systems, codes of practice and standards, health and safety requirements and environmental issues.
(K7) Describe business and management principles relevant to engineering.
(K8) Classify current engineering technologies as related to disciplines.
(K9) Discuss topics related to humanitarian interests and moral issues.
(K10) Demonstrate knowledge of technical language and report writing techniques.
(K11) Outline and confirm the importance of professional ethics and socio-economical impacts of engineering solutions on society and environment.
(K12) Discuss contemporary engineering topics.
(K13) Explain engineering principles in the fields of reinforced concrete and metallic structures' analysis and design, geo-techniques and foundations, hydraulics and hydrology, water resources, environmental and sanitary engineering, roadways and traffic systems, surveying and photogrametry.
(K14) Identify and discuss properties, behavior and fabrication of building materials.
(K15) Recognize and describe projects and construction management including planning, finance, bidding and contracts.

4.2 Intellectual Skills

(I1) Select appropriate mathematical and computer-based methods for modeling and analyzing problems .
(I2) Select appropriate solutions for engineering problems based on analytical thinking.
(I3) Think in creative and innovative way in problem solving and design.
(I4) Combine, exchange, and assess different ideas, views, and knowledge from a range of sources.

(I5) Assess and evaluate effectively the characteristics and performance of components, systems and processes.
(I6) Investigate the failure of components, systems and processes.
(I7) Solve engineering problems, often on the basis of limited and possibly contradicting information.
(I8) Select and appraise appropriate ICT tools to a variety of engineering problems.
(I9) Judge engineering decisions considering balanced costs, benefits, safety, quality, reliability, and environmental impact.
(I10) Incorporate economic, societal, environmental dimensions and risk management in design.
(I11) Analyze results of numerical models and appreciate their limitations.
(I12) Create systematic and methodic approach when dealing with new and advancing technology.
(I13) Select appropriate building materials from the perspective of strength, durability, suitability of use to location, temperature, weather conditions and impacts of seawater and environment.
(I14) Select and design adequate water control structures, irrigation and water networks, sewerage systems and pumping stations.
(I15) Analyze and select codes of practice in designing reinforced concrete and metallic structures of all types. Determine the levels, types and design systems of building foundations tunnels and excavations.
(I16) Define, plan, conduct and report management techniques.
(I17) Assess and evaluate different techniques and strategies for solving civil engineering problems.

4.3 Practical and Professional Skills

(P1) Apply knowledge of mathematics, science, information technology, design, business context and engineering practice to solve engineering problems.
(P2) Professionally merge the engineering knowledge, understanding and feedback to improve design, products and/or services.
(P3) Create and/or re-design a process, component or system, and carry out specialized engineering designs.
(P4) Practice the neatness and aesthetics in design and approach.
(P5) Use computational facilities and techniques, measuring instruments, workshops and laboratories equipment to design experiments, collect, analyze and interpret results.
(P6) Use a wide range of analytical tools, techniques, equipment, and software packages for the discipline and develop required computer programs.
(P7) Apply numerical modeling methods to engineering problems.
(P8) Apply safe systems at work and observe appropriate steps to manage risks.
(P9) Demonstrate basic organizational and project management skills.
(P10) Apply quality assurance procedures and follow codes an standards.
(P11) Exchange knowledge and skills to engineering community and industry.
(P12) Prepare and present technical reports.
(P13) Use laboratory and field equipment competently and safely.
(P14) Observe, record, and analyze data in laboratory and in the field.

(P15) Practice professionally management skills. Prepare technical drafts and detailed drawings both manually and using CAD
(P16) Carry out maintenance of all types of road ways and traffic systems.
(P17) Prepare quantity surveying reports
(P18) Plan, design, construct, operate, control and carry out maintenance of all types of road ways and traffic systems.

4.4 General and Transferable Skills

(T1) Collaborate effectively within multidisciplinary team.
(T2) Work in stressful environment and within constraints.
(T3) Communicate effectively.
(T4) Demonstrate efficient IT capabilities.
(T5) Lead and motivate individuals.
(T6) Effectively manage tasks, time and resources.
(T7) Search for information and engage life-long self learning discipline.
(T8) Acquire entrepreneurial skills.
(T9) Refer to relevant literatures.

5. PROGRAM DESCRIPTION

To achieve the educational goals, a four-year curriculum following the freshman year is developed. The curriculum covers the core topics in the Civil Engineering discipline, as well as fundamental and advanced topics in the field of Structural Engineering. Thus, the STE graduates will have both broad and in-depth knowledge and skills of the civil and structural engineering professions, in particular the areas of materials, mechanics, analysis and design. Also, they will be capable of effectively participating in the design, construction and project management activities.

As the curriculum is based on the credit hours system, a total of 180 credits should be completed before graduation, where 36 credits are given in the freshman year. The 180 credits are spread over 72 courses and offered over a period of 10 main semesters, the Fall and Spring semesters per academic year. After the freshman year, the students study core courses of Civil Engineering and its main fields: Construction, Geotechnical, Hydrological, Environmental, Public-Works, and Transportation Engineering. They also study fundamental and specialized courses in the field of Structural Engineering related to structural analysis and design, engineering materials and mechanics. Additionally, they are allowed to select a number of elective courses to fit their interests.

The STE program accepts a maximum of 40 students per year. This number may increase in the future if the job-market demand calls for such an action. Hence, the total number of students enrolled in the STE program is expected not to exceed 200 students by the end of its fifth year. The STE program accepts national, Arab, regional and international students.

5.1 Curriculum Overview

The curriculum of the STE program consists of 180 credits spread over 72 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):

5.1.1 Humanities and Social Sciences Courses

GENN001: Humanities and Engineering
GENN002: English Language
GENN101: Technical Writing
GENN102: Fundamentals of Management
GENN201: Communication and Presentation Skills
GENN210: Risk Management and Environment
GENN301: Ethics and Legislation
GENN310: Advanced Risk Management
GENN311: Technical Writing in Arabic
GENN321: Foreign Language
GENN326: Marketing
GENN327: Selections of Life-long Skills
GENN331: Business Communication
GENN332: Service Management
STEN280: Seminar-1
STEN380: Seminar-2
STRN100: Introduction to Structural Engineering

5.1.2 Basic Sciences Courses

CHEN001: Chemistry
GENN004: Computers for Engineers
GENN204: Accounting
GENN221: Economics
IHDN201: Fluid Mechanics
MECN001: Mechanics-1
MECN002: Mechanics-2
MECN101: Dynamics of Rigid Bodies
MTHN001: Introduction to Linear Algebra and Analytic Geometry
MTHN002: Calculus I
MTHN003: Calculus II
MTHN102: Multivariable Calculus and Linear Algebra
MTHN103: Differential Equations
MTHN203: Probability and Statistics
PHYN001: Mechanics, Oscillations, Waves and Thermodynamics
PHYN002: Electricity and Magnetism
STRN103: Engineering Materials

5.1.3 Engineering Sciences Courses

ARCN106: Introduction to CAD Systems
ARCN201: Building Construction and City Planning
GENN003: Basic Engineering Design
IHDN104: Civil Engineering Drawing
MDPN001: Engineering Graphics
MDPN002: Fundamentals of Manufacturing Engineering
PBWN201: Water and Waste Water Engineering
PBWN202: Surveying for Engineers
PBWN302: Soil Mechanics
STRN101: Structural Analysis-1
STRN102: Structural Analysis-2
STRN104: Mechanics of Materials
STRN122: Introduction to Construction Engineering
STRN203: Properties and Strength of Concrete I
STRN215: Engineering Computations
STRN224: Construction Project Management
STRN305: Matrix Structural Analysis
STRN306: Properties and Strength of Concrete II
STRN322: Construction Planning and Scheduling
STRN408: Structural Dynamics and Vibrations

5.1.4 Applied Engineering Sciences Courses

ARCN110: Basic Architectural Design
CVEN361: Special Topics in Civil Engineering
INTN203: Mechanical and Electrical Systems
IHDN301: Introduction to Water Resources Engineering
IHDN312: Hydraulic Engineering
IHDN358: Design of Pipelines and Pumping Stations
IHDN401: Coastal and Harbour Engineering
PBWN301: Highway Engineering
PBWN303: Foundations
PBWN342: Ground Water Control Systems
PBWN445: GIS and Remote Sensing Applications
PBWN446: Deep Excavation and Side Support
STEN281: Industrial Training-1
STEN381: Industrial Training-2
STEN480: Graduation Project-1
STEN481: Graduation Project-2
STRN201: Reinforced Concrete Design I
STRN302: Steel Structures Design I

STRN303: Reinforced Concrete Design II
STRN304: Steel Structures Design II
STRN308: Structural Systems and Optimization
STRN341: Masonry Structures
STRN342: Project Resources Management
STRN410: Metallic Bridges
STRN411: Project Management and Evaluation
STRN413: Earth Retaining Structures
STRN417: Computer-Aided Analysis and Design
STRN419: Quantity Surveying and Cost Engineering
STRN431: Concrete Durability
STRN432: Composite Materials
STRN433: Structural Mechanics and Stability
STRN435: Introduction to Earthquake Engineering
STRN437: Seismic Design of Structures
STRN441: Reinforced Concrete Design III
STRN443: Temporary Structures and Form Work Design
STRN444: Special Concrete Structures
STRN445: Steel Structures Design III
STRN446: Special Civil Structures
STRN450: Engineering Risk Analysis
STRN452: Information Technology in Construction
STRN461: Special Topics in Structural Engineering
STRN462: Advanced Topics in Structural Engineering
STRN465: Inspection and Maintenance of Structures
STRN466: Design and Construction of Water and Wastewater Structures

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 STE 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	STEN280	Seminar-1	1
15	STEN281	Industrial Training-1	1
16	STEN380	Seminar-2	1
17	STEN381	Industrial Training-2	2
18	STEN480	Graduation Project-1	1
19	STEN481	Graduation Project-2	3

5.4 Discipline Requirements

Structural Engineering is one of the key fields in the Civil Engineering discipline. Thus, the STE program offers several courses that are common with some – but not all – CHS Bachelor programs. For example, there are common civil engineering courses between the STE program and the CEM program (Construction Engineering and Management) and the WEE program (Water Engineering and Environment).

The discipline requirements of the STE bachelor program consist of 64 credits (35.6% of total 180 credits), which are satisfied by completing twenty-five (25) courses in Civil Engineering that cover topics on Structural, Construction, Geotechnical, Hydrological, Environmental, Public-Works and Transportation Engineering:

1. Twenty-three (23) compulsory courses equivalent to 58 credits (32.3%), 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 6 credits (3.3%), as listed in Table 3b.

Table 3a Compulsory Courses of Discipline Requirements: Civil Engineering (58 credits, 32.3% 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	INTN203	Mechanical and Electrical Systems	2
7	MECN101	Dynamics of Rigid Bodies	3
8	MTHN103	Differential Equations	3
9	PBWN201	Water and Waste Water Engineering	2
10	PBWN202	Surveying for Engineers	3
11	PBWN301	Highway Engineering	2
12	PBWN302	Soil Mechanics	3
13	PBWN303	Foundations	2
14	STRN101	Structural Analysis-1	3
15	STRN102	Structural Analysis-2	3
16	STRN103	Engineering Materials	3
17	STRN104	Mechanics of Materials	3
18	STRN122	Introduction to Construction Engineering	2
19	STRN201	Reinforced Concrete Design I	2
20	STRN224	Construction Project Management	3
21	STRN302	Steel Structures Design I	2
22	STRN303	Reinforced Concrete Design II	3
23	STRN322	Construction Planning and Scheduling	3

Table 3b Elective Courses of Discipline Requirements: Civil Engineering (6 credits, 3.3% of total 180 credits)

	Code	Course Title	Credits	Group
1	CVEN361	Special Topics in Civil Engineering	3	E-2(1)
2	IHDN301	Introduction to Water Resources Engineering	3	
3	IHDN312	Hydraulic Engineering	3	
4	IHDN358	Design of Pipelines and Pumping Stations	3	
5	IHDN401	Coastal and Harbour Engineering	3	
6	PBWN342	Ground Water Control Systems	3	
7	PBWN445	GIS and Remote Sensing Applications	3	
8	PBWN446	Deep Excavation and Side Support	3	
9	STRN341	Masonry Structures	3	
10	STRN342	Project Resources Management	3	
11	STRN452	Information Technology in Construction	3	

Remarks:

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

5.5 Major Requirements

The STE program offers a Bachelor Degree in Civil Engineering with a major specialty in Structural Engineering by offering courses that cover technical knowledge and hands-on training in the areas of structures, mechanics, materials, analysis and design.

The major specialty requirements of the STE bachelor program consist of 47 credits (26.1% of total 180 credits), which are satisfied by completing sixteen (16) courses in the field of Structural Engineering:

1. Eleven (11) compulsory courses equivalent to 32 credits (17.8%), as listed in Table 4.
2. Five (5) elective courses equivalent to 15 credits (8.3%), as listed in Table 5.

Table 4 Compulsory Courses of Major Requirements: Structural Engineering (32 credits, 17.8% of total 180 credits)

	Code	Course Title	Credits
1	STRN100	Introduction to Structural Engineering	3
2	STRN203	Properties and Strength of Concrete I	3
3	STRN215	Engineering Computations	3
4	STRN304	Steel Structures Design II	3
5	STRN305	Matrix Structural Analysis	3

	Code	Course Title	Credits
6	STRN306	Properties and Strength of Concrete II	3
7	STRN308	Structural Systems and Optimization	2
8	STRN408	Structural Dynamics and Vibrations	3
9	STRN419	Quantity Surveying and Cost Engineering	3
10	STRN437	Seismic Design of Structures	3
11	STRN441	Reinforced Concrete Design III	3

Table 5 Elective Courses of Major Requirements: Structural Engineering (15 credits, 8.3% of total 180 credits)

	Code	Course Title	Credits	Group
1	STRN410	Metallic Bridges	3	E-3(1)
2	STRN411	Project Management and Evaluation	3	
3	STRN413	Earth Retaining Structures	3	
4	STRN417	Computer-Aided Analysis and Design	3	
5	STRN431	Concrete Durability	3	
6	STRN432	Composite Materials	3	
7	STRN433	Structural Mechanics and Stability	3	
8	STRN435	Introduction to Earthquake Engineering	3	
9	STRN443	Temporary Structures and Form Work Design	3	
10	STRN444	Special Concrete Structures	3	
11	STRN445	Steel Structures Design III	3	
12	STRN446	Special Civil Structures	3	
13	STRN450	Engineering Risk Analysis	3	
14	STRN461	Special Topics in Structural Engineering	3	
15	STRN462	Advanced Topics in Structural Engineering	3	
16	STRN465	Inspection and Maintenance of Structures	3	
17	STRN466	Design and Construction of Water and Wastewater Structures	3	

Remarks:

(1) Student selects at least five (5) courses from group E-3 equivalent to 15 credits

5.6 Conformity to SCU Requirements

The classification and categorization of courses offered by the Structural Engineering program follow the guidelines provided by the Supreme Council of Universities (SCU), as shown in Table 6. The classification is based upon the "Sample Study Plan and Course Sequence" described in Section 6. The categorization is given for the following five student levels according to the regulations of the credit hours system (CHS) of 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	9	7	3	2	27	15.0
Basic Sciences	22	12	8	0	0	42	23.3
Engineering Sciences	8	15	18	12	0	53	29.5
Applied Engineering Sciences	0	0	5	23	30	58	32.2
Total	36	36	38	38	32	180	100
University Requirements	6	6	8	2	2	24	13.3
College Requirements	30	3	5	3	4	45	25.0
Discipline Requirements	0	24	19	19	2	64	35.6
Major Requirements	0	3	6	14	24	47	26.1
Total	36	36	38	38	32	180	100

The Structural Engineering program consists of 72 courses: 62 compulsory courses (153 credits) and 10 elective courses (27 credits). The total 180 credits of the STE 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 STE 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 STE 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 STE 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 trained on teamwork and exposed to large and practical structural engineering 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

STE 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.	GENN101 or GENN102	2	GENN102 or GENN101	2	GENN201 or GENN210	2	GENN210 or GENN201	2
2.	ARCN106	2	GENN204	2	GENN221	2	MTHN203	3
3.	IHDN104	2	ARCN110	2	PBWN201 or STRN201	2	STRN201 or PBWN201	2
4.	MTHN102 or MTHN103	3	MTHN103 or MTHN102	3	IHDN201 or PBWN202	3	PBWN202 or IHDN201	3
5.	MECN101	3	STRN100	3	INTN203	2	STRN224	3
6.	STRN101	3	STRN102	3	STRN122	2	STRN306	3
7.	STRN103	3	STRN104	3	ARCN201	2	STEN280	1
8.	----------	------			STRN203	3	GENN301(1)	2
9.	----------	------	----------	------	----------	------	STEN281(0)	1
Semester Credit Hrs		18		18		18		19+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.	STRN215	3	PBWN303	2	PBWN301	2	STRN437	3
2.	STRN305 or STRN322	3	STRN322 or STRN305	3	STRN408	3	STEN481	3
3.	PBWN302	3	STRN304	3	STRN419	3	STRN4XX(3)	3
4.	STRN302	2	STRN308	2	STEN480	1	STRN4XX(3)	3
5.	STRN303	3	STRN441	3	GENN3XX(1)	2	STRN4XX(3)	3
6.	STEN380	1	GENN3XX(1)	2	STRN4XX(3)	3	----------	------
7.	XXXNXXX(2)	3	XXXNXXX(2)	3	STRN4XX(3)	3	----------	------
8.	----------	-----	STEN381(0)	2	----------	-----	----------	------
Semester Credit Hrs		18		18+2(0)		17		15

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
(STE students are advised to study the course GENN301 in the shown semester)

(2) Discipline elective course (group E-2, 3 credits per course): CVEN361, IHDN301, IHDN312, IHDN358, IHDN401, PBWN342, PBWN445, PBWN446, STRN341, STRN342, STRN452

(3) Major elective course (group E-3, 3 credits per course): STRN410, STRN411, STRN413, STRN417, STRN431, STRN432, STRN433, STRN435, STRN443, STRN444, STRN445, STRN446, STRN450, STRN461, STRN462, STRN465, STRN466

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.
STEN280	**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.*
STEN380	**Seminar-2** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): STEN280 + GENN201** 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.*
STEN281	**Industrial Training-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 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.*
STEN381	**Industrial Training-2** **Compulsory, Credits: 2 (0+0+6)** **Prerequisite(s): STEN281 + 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.*
STEN480	**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.*

STEN481	**Graduation Project-2** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): STEN480 + 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)
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 & vertical alignments – cross section elements – type of road pavement – vehicle – load and stresses – construction equipments – method statement & 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.
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.
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.

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.
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.
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.
CVEN361	**Special Topics in Civil Engineering** **Elective (group E-2), Credits: 3 (2+2+1)** **Prerequisite(s): PBWN202 + IHDN201** One or more topics in the discipline of Civil Engineering that are not covered by other program courses and/or present recent or advanced development of interest to civil engineers.
IHDN301	**Introduction to Water Resources Engineering** **Elective (group E-2), 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.

IHDN312	**Hydraulic Engineering** **Elective (group E-2), Credits: 3 (2+2+1)** **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; 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.
IHDN358	**Design of Pipelines and Pumping Stations** **Elective (group E-2), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN201** Flow in pipes, friction losses, local losses, pump-pipeline systems, pump characteristic curves, system curves, pipe material, fittings and accessories, control valve sizing and selection of air valve design. Basic water-hammer concepts, wave propagation, elastic considerations, wave speed equation, the ΔH equation, fluid compressibility, pipe elasticity. Computation of pressure surge, unsteady flow equation, wave attenuation (method of characteristics), boundary conditions (vaves, reservoir, pipe junction, minor losses).
IHDN401	**Coastal and Harbour Engineering** **Elective (group E-2), 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 - Case studies.
PBWN342	**Ground Water Control Systems** **Elective (group E-2), Credits: 3 (2+2+0)** **Prerequisite(s): PBWN302** Soil Permeability; Seepage; Groundwater Control Systems; Construction Dewatering; Grout Plugs; Selection of Proper System.
PBWN445	**GIS and Remote Sensing Applications** **Elective (group E-2), Credits: 3 (2+3+0)** **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
PBWN446	**Deep Excavation and Side Support** **Elective (group E-2), 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
STRN341	**Masonry Structures** **Elective (group E-2), 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
STRN342	**Project Resources Management** **Elective (group E-2), Credits: 3 (2+2+0)** **Prerequisite(s): STRN224** Introduction, critical project resources, material management: planning and control; Procurement and acquisition, costs; Material management information systems; Inventory analysis and inventory factors; Human resources management: manpower planning and organization; Job description and evaluation; Recruiting and training; Wage incentive systems; Labor relations; Site management: selection and layout; Preparation and evacuation; Case study.
STRN452	**Information Technology in Construction** **Elective (group E-2), 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.

7.4 Major Courses: STE

STRN100	**Introduction to Structural Engineering** **Credits: 3 (2+1+2), compulsory course** **Prerequisite(s): GENN003** Historical background about the Civil Engineering Discipline and its key fields, case studies, responsibilities of civil engineers and their role in society. Structural engineering profession, Structural design process, Role and responsibility of structural engineers in society and urban development; Professional ethics; Historical and modern case studies of buildings, bridges, and other structures; Structural loads, form and function; Introduction to structural design codes; Concepts of structural failure, safety and risk; Use of word processor software, and spreadsheets in solving civil and structural engineering problems and presenting solutions and design reports.
STRN203	**Properties and Strength of Concrete I** **Credits: 3 (2+1+2), compulsory course** **Prerequisite(s): STRN103 + STRN100** Admixtures (mineral and non-mineral); Concrete manufacturing; Properties of fresh concrete; Properties of hardened concrete; Applied mix design; Code provisions for durable concrete; Creep.
STRN215	**Engineering Computations** **Credits: 3 (2+1+2), compulsory course** **Prerequisite(s): MTHN102 + STRN201** This course focuses on problem-solving techniques and skills for civil and structural engineering problems by using spread sheets and software packages such as MATLAB and Mathematica; Topics include roots of nonlinear equations, simultaneous linear equations, interpolation and curve fitting, data approximation, optimization, matrices and eigenvalues, ordinary differential equations, numerical integration/differentiation; Applications emphasize the development of special-purpose codes by the students for structural analysis and design methods.
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.
STRN305	**Matrix Structural Analysis** **Credits: 3 (2+1+2), compulsory course** **Prerequisite(s): STRN201** Structure idealization and degrees of freedom; Coordinate systems; Equilibrium, compatibility and constitutive relations; Force-displacement relations for bars and beams; Stiffness versus flexibility; Stiffness matrix of bar, beam, and frame members; Global stiffness equations; Inclined members and special topics; Matrix analysis of trusses, beams, frames

	and grids; Self-strained problems; Approximate analysis of structures; Computer applications.
STRN306	**Properties and Strength of Concrete II** **Credits: 3 (2+1+2), compulsory course** **Prerequisite(s): STRN203** Introduction to composite materials: fiber reinforcement, types of fibers, physical, mechanical and chemical characteristics of different metallic and natural fibers, behavior of fiber reinforced composites; Non-destructive evaluation of concrete: strength evaluation using rebound hammer, ultrasonic, windsor probe, concrete core and load tests; Reinforcement corrosion; Hot and cold weather concreting.
STRN308	**Structural Systems and Optimization** **Credits: 2 (1+2+1), compulsory course** **Prerequisite(s): STRN215** Overall structural response and design: structural form, structural layout and idealization, global stability, beam and column systems, arches, cable systems, truss systems, braced frames, large span structures; Vertical and lateral load resisting systems; Mathematical optimization, engineering economic analysis, and decision analysis tools to evaluate and design engineering systems. Applications of linear and dynamic programming to engineering systems design problems. Applications.
STRN408	**Structural Dynamics and Vibrations** **Credits: 3 (2+2+1), compulsory course** **Prerequisite(s): MECN101 + STRN305** Dynamic equilibrium; Dynamic equations of motion for single-degree-of-freedom systems; Analysis of free and forced vibration; Response to impulsive loading; Numerical evaluation of dynamic response; Generalized single-degree-of-freedom systems; Dynamic equations of motion for multi-degree-of-freedom structures; Natural vibration properties of structures; Damping in structures; Introduction to response history analysis; Vibrations of bars and beams; Computer applications.
STRN419	**Quantity Surveying and Cost Engineering** **Credits: 3 (2+2+1), compulsory course** **Prerequisite(s): GENN301 + STRN303** Importance of quantity surveying and pricing for engineering projects; Estimating principles: approximate and detailed estimates, quantity survey, labor & equipment cost, subcontractor cost, purchasing orders, indirect costs; Bidding process, strategy, documents and calculations; Unit cost estimate; Cost planning; Traditional cost control methods; Network base cost control methods; Contract forms and administration.
STRN437	**Seismic Design of Structures** **Credits: 3 (2+2+1), compulsory course** **Prerequisite(s): STRN308 + STRN303** Conceptual design of structures to resist earthquakes; Ductility concepts and capacity design; Structural configurations and irregularities; Lateral force resisting systems; Methods of analysis: equivalent static forces,

	response spectra and code design procedures; Design of steel and RC structures; Computer applications.
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.
STRN410	**Metallic Bridges** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): STRN304** Structural system for bridges; Floor types; Design loads; Design of plate Girders, buckling considerations, fatigue effect, cross-section design, construction details; Design of composite beams; Design of box girders; Design of truss bridges.
STRN411	**Project Management and Evaluation** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): STRN322 + 130 credits** Topics in the area of project management and evaluation including the project planning process, resource analysis, feasibility and economic analysis, project evaluation techniques, project safety, sustainability and public policy, the use of information technology in project management, applications and case studies.
STRN413	**Earth Retaining Structures** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): PBWN303 + STRN308** Earth pressure theories; Choice of backfill material and backfill drainage; Gravity and cantilever walls; Sheet pile walls: cantilever and anchored pipes; Free and fixed earth support methods; Braced excavations and diaphragm walls; Earth embankment dams: settlements, stability, design, and protection of upstream and downstream slopes; Methods of site investigation, sampling, and borehole logs; Computer applications.
STRN417	**Computer-Aided Analysis and Design** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): STRN308** Selection of suitable models for different structures; Selection of analysis type: static, dynamic, and buckling; Analysis and design of structures using commercial programs; Analysis and design of structures using spreadsheets, Matlab, and Mathematica; Applications.
STRN431	**Concrete Durability** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): STRN306 + 130 credits** Pore Structure; Permeability measurements, porosity and sorptivity: Transport mechanisms; Chloride ion ingress, acid, fresh water and soft water attack; Design for durability and service life estimation.

STRN432	**Composite Materials** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): STRN306 + 130 credits** Definition of a composite material; Natural metallic and synthetic fibers; Composite materials under tension; Composite materials under shear; Fiber reinforced polymers; Non-metallic concrete reinforcement.
STRN433	**Structural Mechanics and Stability** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): STRN305** Mechanics of load-carrying members: 3D stress-strain relations, work and energy, boundary-value problems; Stresses in cable structures; Bending of thin-walled structures and curved beams; Circular and rectangular plates; Membrane stresses in shell structures; Theories of structural stability and buckling modes of bars and beams; Computer applications.
STRN435	**Introduction to Earthquake Engineering** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): STRN408** Basic elements of engineering seismology; Concepts of seismic hazard and seismic risk; Causes of structural failure during earthquakes; Governing equations of motion; Time-history analysis; Modal analysis; Response spectra and their use in seismic analysis of structures; Computer applications.
STRN443	**Temporary Structures and Form Work Design** **Elective (group E-3), Credits: 3 (2+3+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-3), 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.
STRN445	**Steel Structures Design III** **Elective (group E-3), Credits: 3 (2+3+0)** **Prerequisite(s): STR N304** Steel bridges; Special steel structures (Tanks, silos, and towers); Steel fabrication and erection (inspection procedures and tolerances); Shop drawings.

STRN446	**Special Civil Structures** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): STRN419** Methods of analysis, design, and construction of special civil structures and infrastructure systems that have distinctive characteristics related to the strength, stiffness, function, and serviceability requirements such as tall buildings, towers, tunnels, bridges, tanks, dams, silos, and off-shore structures.
STRN450	**Engineering Risk Analysis** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): MTHN203 + STRN419** Applications of probability and statistics in the analysis and design of civil structures; Development of probabilistic models for risk and reliability assessment; Analysis of uncertainties; Occurrence models; Extreme value distributions; Reliability-based optimal design; Application of decision-making and statistical theories in civil and structural engineering problems.
STRN461	**Special Topics in Structural Engineering** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): 130 credits + AA Approval** One or more topics in the specialization of Structural Engineering that are not covered by the other program courses and/or present recent or advanced development of interest to the structural engineers in the areas of building materials, solid mechanics, analysis and design of structures.
STRN462	**Advanced Topics in Structural Engineering** **Elective (group E-3), Credits: 3 (2+2+1)** **Prerequisite(s): 130 credits + AA Approval** One or more topics in the specialization of Structural Engineering that are not covered by the other program courses and/or present recent or advanced development of interest to the structural engineers in the areas of building materials, solid mechanics, analysis and design of structures.
STRN465	**Inspection and Maintenance of Structures** **Elective (group E-3), 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
STRN466	**Design and Construction of Water and Wastewater Structures** **Elective (group E-3), Credits: 3 (2+3+0)** **Prerequisite(s): STRN303** 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.