Section 6

Water Engineering and Environment Program (WEE)

Based on Credit Hours System (CHS)

September 2013

1. INTRODUCTION

Water is the most precious natural resource in the world. Continuous industrial development and population growth place higher stress on natural resources and environmental systems. This is particularly true for water resources in the Arab countries, Middle Eastern countries as well as the Nile Basin countries. Anticipated shortage in water resources coupled with the ambitious development plans in human life maximize the stress on the water sector in the above regions.

Moreover, there has been a growing world-wide concern about environmental water management issues including, for example, concerns about coastal and estuarine water pollution, river flooding and urban drainage, wetland and mangrove management, ecological aspects of lakes and reservoirs. All these challenges and concerns facing the water sector world-wide and more specifically in Egypt and neighboring countries called for concerted effort of all stakeholders in the water sector.

Therefore, the Faculty of Engineering of Cairo University established a new bachelor program in Civil Engineering based on the credit hours system (CHS) with a major emphasis on "Water Engineering and Environment"; termed below as: WEE. This program will prepare its graduates for specialized training in hydrology, hydraulics, irrigation, water resources, coastal engineering, environmental and soil science among other subjects. Graduates of WEE will be well prepared to address critical environmental issues involving interconnections between the earth, water, and environment, as well as the interaction between these applied sciences and human activities. Hence, the program will help forming human resources equipped with technical capabilities to better manage the future limited water resources not only in Egypt but also in the Arab world and the Nile river basin countries. Both regions are naturally of great importance to Egypt's national interests and prosperity.

2. PROGRAM MISSION

The mission of the WEE program is to serve the future development of Egypt, Arab countries and, the Nile river basin countries by disseminating and developing technical expertise capable of improving the physical infrastructure and addressing environmental issues related to water resources development and utilization. This will support sustainable water resources management to meet the present and future water challenges. The Program aims at providing a well-rounded and superior university engineering education with talented graduates and creative engineers. The program also aims at preparing its graduates for broad and dynamic career paths in civil engineering at large with a major specialty in environmental water engineering.

3. EDUCATIONAL OBJECTIVES

The WEE Program's mission infers the following set of educational objectives:

- Preparing graduates capable of applying science and engineering fundamentals and logical thinking to solve engineering problems

- Providing graduates with the ability to discover, apply, and disseminate the knowledge required to solve increasingly complex environmental engineering problems
- Preparing graduates capable of planning, designing, operating and managing water projects through their deep understanding of available water resources, appropriate technology, as well as the socioeconomic and environmental aspects of the water projects
- 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
- Enhance graduate design expertise by offering curricular design experiences that include term projects, industrial training and graduation projects with higher involvement with the professional community
- Provide appropriate technical proficiency in the water and environmental engineering, and
- Foster a respect for the educational process that is manifested by a lifelong pursuit of learning

These objectives reflect both the WEE PROGRAM mission as well as the mission of Cairo University.

4. PROGRAM LEARNING OUTCOMES

The WEE 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 WEE 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 photogrammetry.
(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 and 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) Plan, design, construct, operate, control and carry out maintenance of all types of water related projects.
(P17) Prepare quantity surveying reports

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 above mentioned goal, a 4 year curriculum is proposed following the initial “freshman” year. The curriculum is planned to offer instructions in the “Civil Engineering Discipline” in addition to numerous topics in “Water Resources” as the specialty major area. The necessary fundamental background in structures, materials, mechanics, soil, fluid mechanics, urban planning as well as some other engineering disciplines is also covered. At the end of these courses, students are expected to gain

knowledge in design and analysis of advanced water supply systems, exploitation and preservation of surface and groundwater resources, design and performance of pipelines, design of irrigation/drainage systems and related hydraulic structures, design of drainage and sewer systems, water and waste water treatment systems, maritime structures, quality of the coastal and marine environment, remediation of contaminated soils and groundwater environments.

As the curriculum is totally based on the credit hours system, a total of 180 credit hours should be successfully completed by a student to earn the degree over a period of 10 main semesters, the Fall and Spring semesters per academic year. A total of 36 credit hours are required for the freshman year which leaves 144 credits for the subsequent years of the study program. During these subsequent years, the student is gradually exposed to fundamental and applied courses pertinent to civil Engineering, and to courses dealing with water resources and environmental management issues.

5.1 Curriculum Overview

The curriculum of the WEE program consists of 180 credits spread over 73 courses covering topics in Humanities and Social Sciences (HSS), Basic Sciences (BS), Engineering Sciences (ES), and Applied Engineering Sciences (AS) as required by the Supreme Council of Universities (SCU). Sample Courses in each category are presented as follows.

5.1.1 Humanities and Social Sciences Courses

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

5.1.2 Basic Sciences Courses

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

5.1.3 Engineering Sciences Courses

- Basic Engineering Design
- Basic Architectural Design
- Fundamentals of Manufacturing Engineering

- Statistics and Probability
- Structural Analysis
- Engineering Materials
- Mechanics of Materials
- Fluid Mechanics
- Building Construction and City Planning

5.1.4 Applied Engineering Sciences Courses

- Surface and Subsurface Hydrology
- Water Resources Engineering
- Water and Wastewater Treatment
- Environmental and Sanitary Engineering
- Irrigation and Drainage Engineering
- Design of Large Irrigation Structures
- Costal and harbor engineering
- Steel Structures Design
- Reinforced Concrete Design
- Open Channel Hydraulics
- Highway Engineering
- Soil Mechanics and Foundation Design

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.

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

	Code	Course Title	Credits
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

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

	Code	Course Title	Credits
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	WEEN280	Seminar-1	1
15	WEEN281	Industrial Training-1	1
16	WEEN380	Seminar-2	1
17	WEEN381	Industrial Training-2	2
18	WEEN480	Graduation Project-1	1
19	WEEN481	Graduation Project-2	3

5.4 Discipline Requirements

The discipline requirements of the WEE bachelor program consist of 62 credits (34.5% of total 180 credits), which are satisfied by completing twenty-five (25) courses in Civil Engineering that cover topics in Structural, Construction, Geotechnical, Environmental, Hydraulic, Public-Works and Transportation Engineering:

1. Twenty-two (22) compulsory courses equivalent to 54 credits (30.0%), 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. Three (3) elective courses equivalent to 8 credits (4.5%), as listed in Table 3b.

Table 3a Compulsory Courses of Discipline Requirements: Civil Engineering (54 credits, 30.0% 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

	Code	Course Title	Credits
6	IHDN202	Open Channel Hydraulics	2
7	INTN203	Mechanical and Electrical Systems	2
8	MECN101	Dynamics of Rigid Bodies	3
9	MTHN103	Differential Equations	3
10	PBWN201	Water and Waste Water Engineering	2
11	PBWN202	Surveying for Engineers	3
12	PBWN301	Highway Engineering	2
13	PBWN302	Soil Mechanics	3
14	PBWN303	Foundations	2
15	STRN101	Structural Analysis-1	3
16	STRN102	Structural Analysis-2	3
17	STRN103	Engineering Materials	3
18	STRN104	Mechanics of Materials	3
19	STRN105	Human Resources Management	2
20	STRN201	Reinforced Concrete Design I	2
21	STRN302	Steel Structures Design I	2
22	STRN303	Reinforced Concrete Design II	3

Table 3b Elective Courses of Discipline Requirements: Civil Engineering (8 credits, 4.5% of total 180 credits)

	Code	Course Title	Credits	Group
1	ARCN211	Urban Planning	2	E-2(1)
2	GENN341	Operation Research	2	
3	GENN342	Decision Support System	2	
1	IHDN355	Non-Conventional Wastewater Treatment Systems	3	E-3(2)
2	IHDN450	Hydrogeology	3	
3	IHDN452	Optimization Techniques	3	
4	IHDN455	Irrigation Design Works-2	3	
5	PBWN441	Advanced Surveying and Digital Mapping	3	
6	PBWN445	GIS and Remote Sensing Applications	3	
7	PBWN446	Deep Excavation and Side Support	3	
8	STRN466	Design and Construction of Water & Wastewater Structures	3	

Remarks:

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

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

5.5 Major Requirements

The program offers a specialty in Water Engineering and Environment. A student who wishes to complete a specialty in Water Engineering and Environment must complete the minimum major requirements of 49 credits (27.2% of total 180 credits), which are satisfied by completing seventeen (17) courses as follows:

1. Fourteen (14) compulsory courses equivalent to 40 credits (22.2%), as listed in Table 4.
2. Three (3) elective courses equivalent to 9 credits (5.0%), as listed in Table 5.

Table 4 Compulsory Courses of Major Requirements: Water Engineering and Environment (40 credits, 22.2% of total 180 credits)

	Code	Course Title	Credits
1	IHDN101	Principals of Irrigation and Drainage	3
2	IHDN203	Water Chemistry and Microbiology	2
3	IHDN204	Computational Water and Wastewater Networks	3
4	IHDN301	Introduction to Water Resources Engineering	3
5	IHDN302	Irrigation Design Works-1	3
6	IHDN303	River Engineering	3
7	IHDN304	International Law of Water and Environment	2
8	IHDN305	Applied Hydrology	3
9	IHDN401	Coastal and Harbor Engineering	3
10	IHDN402	Environmental and Municipal Hydraulics	3
11	IHDN403	Field Measurements and Water Quality Aspects	3
12	IHDN404	EIA for Water, Wastewater and Irrigation Projects	3
13	IHDN405	Integrated Water Resources Management	3
14	IHDN406	On Farm Irrigation Methods	3

Table 5 Elective Courses of Major Requirements: Water Engineering and Environment (9 credits, 5.0% of total 180 credits)

	Code	Course Title	Credits	Group
1	IHDN350	Participatory Irrigation Water Management	3	E-4(1)
2	IHDN351	Water in the Arab Region and Africa	3	
3	IHDN352	Non-Conventional Water Resources	3	
4	IHDN353	Drainage Engineering	3	
5	IHDN354	Water Resources Assessment	3	
6	IHDN356	Advanced Fluid Mechanics	3	
7	IHDN357	Applied Hydrology Statistics	3	
8	IHDN358	Design of Pipelines and Pumping Stations	3	

	Code	Course Title	Credits	Group
9	IHDN451	Computational Hydraulics	3	E-4(1)
10	IHDN453	Advanced River Engineering	3	
11	IHDN454	Wadi Hydrology	3	
12	IHDN456	Design of Large Irrigation Structures	3	
13	IHDN458	Design of Coastal Protection Works	3	
14	IHDN459	Design of Water and Wastewater Treatment Plants	3	

Remarks:

(1) Student selects at least three (3) courses from group E-4 equivalent to 9 credits

5.6 Conformity to SCU Requirements

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

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

Table 6 Conformity to Supreme Council Criterion

Category	Freshman	Sophomore	Junior	Senior-1	Senior-2	Total Credits	%
Humanities and Social Sciences	6	6	7	9	0	28	15.6
Basic Sciences	22	9	5	0	0	36	20.0
Engineering Sciences	8	18	14	3	3	46	25.5
Applied Engineering Sciences	0	3	11	25	31	70	38.9
Total	36	36	37	37	34	180	100
University Requirements	6	4	8	6	0	24	13.3
College Requirements	30	3	5	3	4	45	25.0
Discipline Requirements	0	26	16	14	6	62	34.5
Major Requirements	0	3	8	14	24	49	27.2
Total	36	36	37	37	34	180	100

The Water Engineering and Environment program consists of 73 courses: 64 compulsory courses (157 credits) and 9 elective courses (23 credits). The total 180 credits of the WEE 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 WEE program is presented as one recommended sequence to complete the graduation requirements over 10 main semesters, the Fall and Spring semesters per academic year. Since the program is based on the credit hours system of education, the student does not have to take the courses during the semester indicated in the study plan as long as the course prerequisites are satisfied. The WEE curriculum encourages students to interact with the industrial sector and government agencies by offering two industrial training courses in at least two summer sessions. Additionally, the students are encouraged to participate in research through independent study projects, and they will be exposed to large water related 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

WEE Program Study Plan

	Semester-3: Fall		Semester-4: Spring		Semester-5: Fall		Semester-6: Spring	
	Course Code	CR	Course Code	CR	Course Code	CR	Course Code	CR
1.	ARCN106	2	ARCN110	2	ARCN201	2	GENN204	2
2.	GENN101	2	STRN105	2	GENN201	2	GENN210	2
3.	GENN102	2	MECN101	3	GENN221	2	IHDN202	2
4.	IHDN104	2	MTHN103	3	PBWN201	2	INTN203	2
5.	MTHN102	3	STRN102	3	IHDN203	2	IHDN301	3
6.	STRN101	3	STRN104	3	MTHN203	3	IHDN204	3
7.	STRN103	3	IHDN101	3	PBWN202	3	WEEN280	1
8.	----------	------	----------	------	IHDN201	3	XXXNXXX(2)	2
9.	----------	------	----------	------	----------	------	WEEN281(0)	1
Semester Credit Hrs		17		19		19		17+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.	STRN201	2	PBWN301	2	IHDN401	3	IHDN404	3
2.	STRN302	2	PBWN303	2	IHDN402	3	IHDN405	3
3.	IHDN302	3	IHDN304	2	IHDN403	3	IHDN406	3
4.	IHDN305	3	IHDN303	3	WEEN480	1	WEEN481	3
5.	PBWN302	3	STRN303	3	IHDNXXX(4)	3	IHDNXXX(4)	3
6.	GENN3XX(1)	2	WEEN380	1	XXXNXXX(3)	3	XXXNXXX(3)	3
7.	GENN3XX(1)	2	GENN3XX(1)	2	----------	-----	----------	------
8.	----------	------	IHDNXXX(4)	3	----------	-----	----------	------
9.	----------	------	WEEN381(0)	2	----------	-----	----------	------
Semester Credit Hrs		17		18+2(0)		16		18

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

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

(3) Discipline elective course (group E-3, 3 credits per course): IHDN355, IHDN450, IHDN452, IHDN455, PBWN441, PBWN445, PBWN446, STRN466

(4) Major elective course (group E-4, 3 credits per course): IHDN350, IHDN351, IHDN352, IHDN353, IHDN354, IHDN356, IHDN357, IHDN358, IHDN451, IHDN453, IHDN454, IHDN456, IHDN458, IHDN459

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.
WEEN280	**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.*
WEEN380	**Seminar-2** **Compulsory, Credits: 1 (1+0+0)** **Prerequisite(s): WEEN280 + 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.*
WEEN281	**Industrial Training-1** **Compulsory, Credits: 1 (0+0+3)** **Prerequisite(s): 72 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.*
WEEN381	**Industrial Training-2** **Compulsory, Credits: 2 (0+0+6)** **Prerequisite(s): WEEN281 + 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.*
WEEN480	**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.*

WEEN481	**Graduation Project-2** **Compulsory, Credits: 3 (1+0+6)** **Prerequisite(s): WEEN480 + AA Approval** All students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement the appropriate concepts and techniques to a particular design. A dissertation on the project is submitted on which the student is examined orally.

7.3 Discipline Courses

ARCN106	**Introduction to CAD Systems** **Compulsory, Credits: 2 (1+0+3)** **Prerequisite(s): GENN004 + MDPN001** The aim of this course is to explore current CAD technologies and develop skills in the use of specialist CAD software to produce 2D and 3D design specifications, to transform CAD drawings into photo realistic virtual products and to gain an awareness of CAD data and how such information can be transformed to engineering drawings. At the end of the course, the students will understand a variety of terms and terminology as applied to CAD technology; demonstrate the use of an industry standard operating system to create standard CAD packages for 2D and 3D design drawings.
ARCN110	**Basic Architectural Design** **Compulsory, Credits: 2 (1+1+2)** **Prerequisite(s): GENN003 + MDPN001** Introduction to design, Design as a goal Directed Activity, The Management of Architectural Information, Architectural Design and Decision Making, Basic Elements of Architectural Design, The Architectural Design Matrix, Form and Form Generation, Space and Compositions, The Building Matrix.
ARCN201	**Building Construction and City Planning** **Compulsory, Credits: 2 (1+2+1)** **Prerequisite(s): ARCN110** Introduction; Aim and definitions; Building construction stages; Wall bearing structures: stone construction, masonry-raw bricks and brick masonry; Vertical circulation element; Stairs detailing, Complementary and finishing materials; Construction building types; Urban and city planning approaches and basic guidelines of the field.
IHDN104	**Civil Engineering Drawing** **Compulsory, Credits: 2 (1+1+2)** **Prerequisite(s): MDPN001** Introduction to civil engineering projects, General Concepts, Legend and symbols, Scales and drawing size, General layout and plans,

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

	HVAC components and systems; Plumbing elements and features; Essential mechanical systems used in residential & institutional projects.
MECN101	**Dynamics of Rigid Bodies** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MECN002** Planar kinematics of rigid bodies- center of mass- moment of inertia - planar kinetics of rigid body: linear and angular equations – application of the equations of motion of rigid body, translation, rotation about a fixed axis, and general plane motion - Principle of Work and Kinetic Energy- Conservation of Mechanical Energy- Principle of Impulse and Momentum – Introduction to Vibrations.
MTHN103	**Differential Equations** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MTHN003** First-order differential equations, separable, exact, linear, homogeneous and Bernoulli equations; modeling with first order differential equations; higher-order differential equations; method of undetermined coefficients; variation of parameters; modeling with higher order differential equations; series solutions; Laplace transform; properties and applications, shifting theorems, convolution theorem; solutions of differential equations using Laplace transform; Fourier series; Fourier transform.
PBWN201	**Water and Waste Water Engineering** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): 54 credits** Introduction – Definitions – Fields of Environmental Engineering – Environmental system – Waste cycles – Main Environmental problems – Global problems – Water pollution – Water supply Engineering – Water purification works – Water distribution system and Storage tanks – Sanitary Drainage – Sewerage System – Wastewater Treatment Works.
PBWN202	**Surveying for Engineers** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): MTHN003** Engineering principles and applications of surveying sciences (with emphasis on plane surveying) are presented in relation to engineering. Popular techniques and engineering uses of distance, angles and height difference measurements are studied and practiced. Applications in detail mapping, earthwork computations, and setting out engineering structures are covered in this course. Integrated digital surveying and mapping using total station are introduced.
PBWN301	**Highway Engineering** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): 90 credits** Introduction to transport planning and traffic engineering – route study and reconnaissance – functional classification of road network – criteria of geometric design – design of road horizontal and vertical alignments –

	cross section elements – type of road pavement – vehicle – load and stresses – construction equipments – method statement and quality control – pavement management and rehabilitation – traffic control during road construction and maintenance. Use of computer simulation for selection of equipment.
PBWN302	**Soil Mechanics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): STRN102 + STRN104** Basic properties of soil, Soil classification, Compaction, Permeability, Soil stresses, Consolidation, Shear strength, and Lateral earth pressure.
PBWN303	**Foundations** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): PBWN302** Basics of soil investigations, Soil bearing capacity, Designs of shallow foundations: wall footings, isolated footings, combined footings and strip footings, Design of retaining walls, Design of deep foundations: pile construction methods, estimation of pile bearing capacity, pile load tests, design of group piles. Considerations for selection of types of foundations.
STRN101	**Structural Analysis-1** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): MECN001** Types of structures; Loads; Supports and Reactions; Internal Forces; Analysis of Beams, Frames, and Trusses. Influence lines of Statically Determinate Structures, Moving Loads.
STRN102	**Structural Analysis-2** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN101** Deformations: differential equations, virtual work. Indeterminate structures: consistent deformations, moment distribution. Buckling of columns.
STRN103	**Engineering Materials** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): PHYN001 + MECN001** Classification of types of materials - Concrete and asphalt concrete; constituent materials and their properties, mix design, manufacture, properties, and standard and quality control testing - Steel, Building stones - Bricks - Timber - Heat insulating and acoustic materials. Laboratory: Testing for QC.
STRN104	**Mechanics of Materials** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN103** Analysis of stress, strain, and deformation of sections subjected to tension, compression, bending, shear, and torsion - Buckling - Theories of failure - Laboratory: Lab Testing of materials for strength evaluation;

	the definition of the mechanical properties (elasticity - plasticity - stiffness - strength - ductility - brittleness - resilience - toughness) and their determination in different loading cases. The load and deformation diagram is to be plotted. The different properties are to be determined.
STRN105	**Human Resources Management** **Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s): GENN102** HR planning: Job analysis, demand for HR, Supply of HR – Staffing: Recruitment, Selection – Training and development – Performance Appraisal – Compensation: Type of equity, Designing the pay structure, employee benefits – Labour/management relations – Motivation – Leadership – Communication
STRN201	**Reinforced Concrete Design I** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): STRN102 + STRN104** Methods of design; Codes; Structural systems and load distribution; Design using limit states method; Section subjected to bending moments; Section subjected to shear and torsion; Reinforcement details for beams; Limit state of deflection, Working stress design method.
STRN302	**Steel Structures Design I** **Compulsory, Credits: 2 (1+3+0)** **Prerequisite(s): STRN102 + STRN104** Introduction to structural steel design – Design criteria (materials, loads, and systems) – General layout – Design of tension members – Design of compression members – Design of beams – Design of beam-columns.
STRN303	**Reinforced Concrete Design II** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): STRN201** Design and reinforcement details: solid slabs, ribbed slabs, paneled beams slab, flat slabs (beamless slabs), stairs; Design of sections under axial forces; Design of sections under eccentric forces; Design and reinforcement details of concrete columns.
ARCN211	**Urban Planning** **Elective (group E-2), Credits: 2 (1+3+0)** **Prerequisite(s): ARCN201** This course examines the evolving structure of cities and the way that cities, suburbs, and metropolitan areas can be designed and developed. International cities studied to see how physical, social, political and economic forces interact to shape and reshape cities over time.
GENN341	**Operation Research** **Elective (group E-2), Credits: 2 (1+3+0)** **Prerequisite(s): none** Introduction - Linear programming, Network analysis, Decision analysis, Random processes, Queuing models, Inventory analysis, Simulation,

	Dynamic programming, Nonlinear programming, Game Theory, Waiting line theory.
GENN342	**Decision Support Systems** **Elective (group E-2), Credits: 2 (1+3+0)** **Prerequisite(s): none** Management Support Systems. Decision Making Process: Systems, Models, Sensitivity Analysis, "What-If?" Analysis, Goal Seeking, DSS Characteristics, DSS Components, DSS Hardware and Software, Static and Dynamic Models, Handling Certainty & Uncertainty, Mathematical, Programming, Simulation, Heuristic Programming, Forecasting, Financial and Planning Modeling. Artificial versus Natural Intelligence, Knowledge in AI. Fundamentals of Expert Systems.
IHDN355	**Non-Conventional Wastewater Treatment Systems** **Elective (group E-3), Credits: 3 (2+3+0)** **Prerequisite(s): PBWN201 + IHDN203** Introduction to Non-conventional wastewater treatment, Physico-chemical Treatment Processes. Introduction to Biological Treatment Processes, natural-biological treatment, Natural law, Design of biological treatment systems for the treatment of municipal sewage,
IHDN450	**Hydrogeology** **Elective (group E-3), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN301** Introduction: Hydrology and Hydrogeology, Hydrogeologists, Applied Hydrogeology, Soil Moisture and Groundwater: Porosity of Earth Materials, Specific Yield, Hydraulic Conductivity of Earth Materials, Effective Porosity, Forces Acting on Groundwater, Water Table, Infiltration, Soil Moisture, Theory of Unsaturated Flow, Water-Table Recharge, Aquifers, Aquifer Characteristics, Homogeneity and Isotropy., Principles of Groundwater Flow: Mechanical Energy, Hydraulic Head, Force Potential and Hydraulic Head, Darcy's Law, Permeameters, Equations of Groundwater Flow, Solution of Flow Equations, Gradient of Hydraulic Head, Flow Nets, Refraction of Streamlines, Steady Flow in a Confined Aquifer, Steady Flow in an Unconfined Aquifer, Fresh-Water-Saline-Water Relations, Tidal Effects., Groundwater Flow to Wells: Unsteady Radial Flow, Well Hydraulics in a Completely Confined Areally Extensive Aquifer, Flow in a Semi-Confined Aquifer, Effect of Partial Penetration of Wells, Water-Table Aquifer, Measurement of Aquifer Parameters Using Piezometers, Steady-State Radial Flow, Theis Equations, Intersecting Pumping Cones and Well Interference, Effect of Hydrogeologic Boundaries, Pumping-Test Design
IHDN452	**Optimization Techniques** **Elective (group E-3), Credits: 3 (2+3+0)** **Prerequisite(s): MTHN102** This course is intended to introduce students to an array of optimization techniques. The course will cover fundamental optimization methods;

	linear programming, integer programming, network models, and dynamic programming methods. Some discrete optimization techniques will also be introduced. The theory underlying the various optimization methods is covered. Applications from water resources engineering will be discussed.
IHDN455	**Irrigation Design Works-2** **Elective (group E-3), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN302** Planning and drawing concepts, Basis and procedures for designing control structures. Seepage under structures. Scour downstream of structures. Weirs: types and functions, stepped and flow measuring weirs, accuracy and submergence ratios, Structural design. Barrages: types, functions, structural design, design and operation of gates.
PBWN441	**Advanced Surveying and Digital Mapping** **Elective (group E-3), Credits: 3 (2+3+0)** **Prerequisite(s): PBWN202** Advanced surveying concepts and digital mapping systems are presented in relation to engineering. Geodetic techniques, computations and practices in establishing control points, dealing with coordinate system transformations, deformation monitoring and map projections are studied. Concepts of terrestrial and aerial photogrammetry for mapping are presented. Satellite surveying and mapping systems are overviewed, with emphasis on the Global Positioning System and Remote Sensing uses and applications in engineering.
PBWN445	**GIS and Remote Sensing Applications** **Elective (group E-3), 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-3), 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
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.

7.4 Major Courses: WEE

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.
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 fecal pollution, How to measure coliforms
IHDN204	**Computational Water and Wastewater Networks** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): IHDN201 + PBWN201** Water distribution systems, demands, demand variables, pipe flow, networks, pumps, appurtenances, materials, Design techniques, Modeling of distribution systems, Design problem considerations-

	distribution, Wastewater collection systems, pipe flow, inflows, inflow variables, appurtenances, installation, materials, and Modeling of collection systems
IHDN301	**Introduction to Water Resources Engineering** **Compulsory, 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.
IHDN302	**Irrigation Design Works-1** **Compulsory, 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** **Compulsory, 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.
IHDN304	**International Law of Water and Environment** **Compulsory, Credits: 2 (2+0+0)** **Prerequisite(s): none** Historical background, basis of the international law for water, legal aspects of the international agreements concerning shared water resources, international water laws and agreements, the legal system of the Nile basin (case study).
IHDN305	**Applied Hydrology** **Compulsory, Credits: 3 (2+3+0)** **Prerequisite(s): IHDN301** The course covers two parts: surface and subsurface hydrology. The first part covers the development of runoff hydrographs from rainfall patterns and unit hydrographs (Basin routing), convolution and deconvolotion methods, time-area method, S-Curve method, Instantaneous unit hydrograph, hydrologic routing, reservoir routing,

	river/ stream routing, Muskingum method, peak flow estimation, the rational method, and the SCS curve number method. The second part covers classification of hydro geological strata and its properties, Darcy's equation, Hydraulic conductivity and averaging for multi-aquifer systems, Well hydraulics, pumping test analysis for confined, unconfined and leaky aquifers, general equation of groundwater flow, saturated and unsaturated flow, pollution mechanics and equations, introduction, equations of solute transport, governing equation, solute concentration, analytical solutions of the solute transport equation.
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 - Case studies.
IHDN402	**Environmental and Municipal Hydraulics** **Compulsory, Credits: 3 (2+2+1)** **Prerequisite(s): IHDN203 + IHDN202** Sources of pollution of surface and ground waters, Types and properties of pollutants, Evaluation of hazardous effects of pollutants, Spread and movement of pollutants in surface and ground waters, Motion and mass balance equations, Pollution measurement techniques. Environmental impact of hydraulic structures, Hydraulic methods of industrial and domestic sewage discharge into water bodies, Groundwater pollution and treatment, Water quality control for surface and ground waters.
IHDN403	**Field Measurements and Water Quality Aspects** **Compulsory, Credits: 3 (2+1+2)** **Prerequisite(s): IHDN202 + IHDN203** The objective of the course is to build a fundamental level of competence with instruments, field techniques and basic statistical sampling and data summarization techniques commonly applied in hydrology. It covers; measuring surface and groundwater parameters, stream flow, identifying channel cross section, measuring climatic parameters.
IHDN404	**EIA for Water, Wastewater and Irrigation Projects** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): none** Introduction to EIA, definitions, history, EIA procedures, base line environment, screening, scoping, impact assessment, mitigation measure, environmental management plan, EIA screen in Egypt, environmental impacts on; surface water, ground water, air, noise impact, health impact, culture impact. Impact assessment methods, check list, simple matrix, stepped matrix, loops and networks. Environmental management plan.

IHDN405	**Integrated Water Resources Management** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s):IHDN301** The course introduces the definition, structure, and components of the integrated water management concept. The economic, environmental, social and political aspects in integrated water resources management are addressed. The institutional and legal frameworks of integrated water resources management are introduced. The required coordination and communications among the stakeholders are discussed. The principles of integrated water resources management are illustrated through case study applications. System analysis applications for several integrated water management problems are presented.
IHDN406	**On Farm Irrigation Methods** **Compulsory, Credits: 3 (2+2+0)** **Prerequisite(s): IHDN101** Introduction, Different irrigation methods, Selection of suitable irrigation method, pressurized irrigation systems, Design of fixed, move-stop and continuous move sprinkler systems (center pivots), Emitters, Design of drip irrigation systems, clogging and filtration. Hydraulics of surface irrigation, Design of field surface irrigation networks and structures, Improvement of traditional surface irrigation systems, Concrete ditches, Low pressure pipelines, Pumping requirements.
IHDN350	**Participatory Irrigation Water Management** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN101** The course covers the concept, types and features of PIM. PIM applications in Egypt will be covered at the different levels of the national irrigation system; the mesqa level, branch canal level and irrigation district level. The different types of farmers associations and their role in irrigation water management practices will be addressed. The problem of PIM applications and the gender issue will be discussed and analyzed. A one-day field-trip to one of the PIM applications in Egypt will be organized.
IHDN351	**Water in the Arab Region and Africa** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): none** Global Water Resources, Water Storage on the Earth and the Hydrological Cycle .River Basins, Continental Slopes, and the Inflow to the World Ocean, River Runoff and Ground Water, The Dynamics of Water Use in the World., Water Availability and Water Resources Deficit., The African Water Resources, Rainfall ,Runoff, Recharge, major Basins, Withdrawals, Accessibility, Irrigation Potential and Water Managed Areas, Irrigated Crops, State of the African Environment, Atmosphere, Biodiversity, Coastal and Marine Habitats, Forests, Freshwater, Land, Urbanization, Arab Water Resources: Precipitation - Potential Evaporation - Internal Renewable Water Resources - Total

	Renewable Resources - Non conventional Water Resources (Agricultural drainage reuse, wastewater reuse, desalination) - Groundwater resources- Land use - Sectoral Withdrawals - Food security / water security - IWRM status - Shared Water Resources - Water Quality.
IHDN352	**Non Conventional Water Resources** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): none** This course will focus on potential non-conventional water-resource applications such as; re-use and recycling of (urban waste water and agricultural drainage water) brackish groundwater and seawater desalination (types, reverse osmosis plant configuration, intakes and outfalls, energy requirements, operation and maintenance), cloud seeding, and rain water harvesting (valley tanks, rock catchment, tanks and cisterns), and flood harvesting (sand dams, spate irrigation, and dams).
IHDN353	**Drainage Engineering** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN101** Sources of drainage water, importance of land drainage, clarification of drainage systems (open and pipe drain, moles, and wells). Design of horizontal and vertical drainage systems (Steady and unsteady flow equations, drainage criteria), drainage materials (pipes, envelope and structures), drainage investigation and field measurements of relevant soil properties, drainage system performance, reuse of drainage water.
IHDN354	**Water Resources Assessment** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN301** The earth radiation balance, the hydrologic cycle, global water distribution, spatial variation, temporal variation, precipitation measurements, and forecast, Evapotranspiration, river runoff and forecast, soil holding capacity, recharge estimation, blue water, green water, gray water, global, regional, and national assessment methodologies
IHDN356	**Advanced Fluid Mechanics** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN201** Fluid Dynamics, The Concepts of systems and Control Volume, Euler's Equation of Motion along a Stream Line, The Bernoulli's Equation, Applications of the Energy Equation to Steady Fluid Flow Situations, Discharge Measurements, Quasi-Steady Flow applications, The Momentum Equation, The Linear Momentum), Equation, Applications Of the Linear Momentum Equation, Dynamic Thrust of a Jet, Forces on Pipe Fittings, The Hydraulic Jump, Losses in Sudden Pipe Contractions and Expansions, The Moment of Momentum Equation, Viscous Effects, Fluid Resistance, Laminar Flow between Parallel Plates, Laminar Flow in Pipes, The Reynolds Number, Turbulent Flow, Prandtl Mixing Length,

	Turbulent Flow in Pipes, Friction Losses in Pipes, Navier Stokes Equations, Velocities and Acceleration, The Stress Tensor, The Full Equation of Motion, The Boundary layer, Description of the Boundary Layer, Momentum Integral equations of the Boundary Layer, Laminar' Boundary Layer over a flat Plat, Turbulent Boundary Layer over a flat Plat, Forces on Immersed Bodies, Skin Resistance, form Resistance, Drag and Lift, Real Flow around a Cylinder.
IHDN357	**Applied Hydrology Statistics** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): MTHN203 + IHDN301** This course involves the study of surface and subsurface variability and the interpretation of observations using existing theories. The course will cover: review of probability and statistics, time-series modeling, estimation of static and dynamic hydrologic systems, analysis of spatial hydrologic processes. It incorporates updated techniques and applied statistics and geostatistics, risk analysis, the use of computers in statistical analysis, and the use of statistics in hydrologic and water quality modeling
IHDN358	**Design of Pipelines and Pumping Stations** **Elective (group E-4), 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).
IHDN451	**Computational Hydraulics** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): IHDH202** Introduction to numerical analysis via Matlab, Ordinary differential equations, Partial differential equations: Classifications of partial differential equations (elliptic, parabolic, hyperbolic), Types of boundary conditions- ; Examples of famous pde (Laplace equation, heat equation, wave equation). Introduction to the basics of finite difference techniques; applications: diffusion equation, advection equation, convection-diffusion equation, The de Saint Venant Equations - Numerical approaches: (truncation error and stability analysis); Method of finite elements. 2D-hydrodynamic and transport applications.
IHDN453	**Advanced River Engineering** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN303** Introduction, River morphology, Hydraulics of flow in river channels, Local scour around piers, Local scour around embankments, Flow in curved river channels, Analytical river morphology, River meanders,

	Physical modeling, Mathematical modeling for erodible channels, River training works, Field visits, Case studies.
IHDN454	**Wadi Hydrology** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN305** Introduction, wadi definition, types of wadi, characteristics of wadi. Rainfall analysis; statistical and frequency analysis, design storm analysis, probable maximum precipitation. Runoff-rainfall relation, infiltration analysis, catchment losses, transmission losses, runoff computation methods for ungauged wadis, unit hydrograph, SCS method, curve number methods, empirical equation and formula. Runoff computation for gauged wadi, frequency analysis of flow, frequency analysis of runoff volume. Hydraulic design of wadi section, conventional computation methods, computer model. Wadi recharge, conventional computation methods, computer model. Wadi environmental aspects
IHDN456	**Design of large Irrigation Structures** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): IHDN302** Locks: Horizontal alignment, types, hydraulics of filling and emptying systems, expansion joints locations, design of walls and floor, Dams: types, purposes, annual and long term storage, design and operation of reservoirs, gravity concrete dams, analysis of seismic forces using psedo-static methods, earth-fill and rock-fill dams, precautions against seepage, stability of earth - fill and rock-fill dams, spillways.
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.
IHDN459	**Design of Water and Wastewater Treatment Plants** **Elective (group E-4), Credits: 3 (2+3+0)** **Prerequisite(s): PBWN201** This course familiarizes students with appropriate design criteria and the design process for water and wastewater treatment plants. This includes Introduction to wastewater treatment plant design - design flow rates, design mass loadings, process selection, and elements of conceptual process design, Physical unit operations - flow measurement, flow equalization, mixing, Design of physical treatment units - bar racks and screens, communitors & grit chambers, Design of physical treatment units - primary sedimentation tanks and dissolved air flotation, Design of biological treatment units - activated sludge processes, Design of aeration systems, Design of sludge disposal/treatment facilities - Solids and sludge sources, characteristics, & quantities, regulations, thickening, and dewatering.