## *Preface*

For the sake of the progressive development in the industry field in the Kingdom of Saudi Arabia, and the continuous development in the Civil engineering field, the **Bachelor of Science in Civil Engineering (BSCE) Program at the College of Engineering in Jazan University** is meticulously redesigned to provide the industry field with scientific and technological qualified cadres. During the redesign of the program and its curriculum, programs of similar ranked engineering institutes, either in the Kingdom of Saudi Arabia or over the world, are reviewed as a term of reference. The developed program involves modifications of some present courses, renewing others, and adding some new courses. This development produces sequential and consistent courses. These courses provide students with the fundamentals of mathematical and scientific subjects upon which engineering subjects depend. Also, students study a broad range of subjects that form the foundation of the civil engineering disciplines for either engineering science or engineering design.

The developed program is prepared to satisfy the university, college, and department requirements. The university requests different topics and highlight different needs, while the college requests involve basic science and other related engineering courses. The department requests include core courses in different civil engineering disciplines. For the sake of quality assessment and academic accreditation, the BSCE program is designed according to both *"The National Commission for Academic Accreditation and Assessment* (*NCAAA*)*"* and *"Accreditation Board for Engineering and Technology* (*ABET*), *Inc*.".

# Table of Contents

Page No.

# 1. The Bachelor of Science in Civil Engineering Program

The Bachelor of Science in Civil Engineering (BSCE) Program at the College of Engineering in Jazan University started in the academic year of 1429/ 1430. The program focuses on student success and preparation for productive careers in industry, government, and business as well as graduate study.

## 1.1 BSCE Program Vision

The BSCE Program at the College of Engineering in Jazan University will educate engineers who are technically competent, professional in practice, and well-rounded with the skills and abilities to become innovative leaders and entrepreneurs. Graduates will be prepared to think creatively and communicate efficiently with respect to the economic, social, and ethical arenas they encounter throughout the course of their careers.

## 1.2 BSCE Program Mission

For the sake of the progressive development in the industrial field in the Kingdom of Saudi Arabia, and the continuous development in the Civil engineering field, the mission of the BSCE Program at the College of Engineering in Jazan University is to deliver an outstanding undergraduate civil engineering program for the students entire the Kingdom of Saudi Arabia. The program will prepare the students for entry into the engineering profession and a path toward professional engineers. It will also prepare students for graduate study in master's engineering programs. It will provide students with a broad technology, science, and social arts background coupled with a strong foundation in engineering theory, concepts, and practical applications.

## 1.3 BSCE Program Objectives

The main strategic objectives of the BSCE Program at the College of Engineering in Jazan University are:

1- Providing the industry communities at Jazan region in particular and Kingdom of Saudi Arabia in general with qualified graduates in the field of the civil engineering.

2- Achieving high quality of worldwide standards in higher education.

Besides the strategic goals, the BSCE Program at the college of engineering in Jazan University satisfies the following important educational objectives for students:

1- Real-world experience in the analysis, design, and simulation of civil engineering systems and components, experimentation and testing, manufacturing, and technical services.

2- Solid communication skills for effectiveness in the workplace, including the ability to lead and participate in multidisciplinary, multicultural groups and teams.

3- Recognition of the ethical, societal, and economic implications of their work.

4- Awareness about the importance of lifelong learning for continued professional development and career advancement.

5- Provision beneficial services to the national industries and communities via educational, technical, entrepreneurial, and professional activities.

6- Preparation to pursue postgraduate studies and scientific research in the field of Civil engineering.

## 1.4 BSCEProgram Outcomes

The BSCE Program educational objectives will be measured through the satisfaction of the following NCAAA and ABET student outcomes:

**Outcome a:** Students shall have an ability to apply knowledge of mathematics, science, and fundamental engineering to civil engineering problems.

**Outcome b:** Students shall have an ability to design and conduct experiments to study different Civil engineering systems and analyze and interpret data.

**Outcome c:** Students shall have an ability to design civil components, processes and systems to meet desired realistic constrains such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

**Outcome d**: Students shall have an ability to work effectively in multidisciplinary teams, to solve engineering problems relevant to civil engineering.

**Outcome e:** Students shall have an ability to identify, formulate, and solve practical civil engineering problems.

**Outcome f:** Students shall have an understanding of the professional and ethical responsibilities of civil engineers.

**Outcome g:** Students shall have an ability to communicate effectively in written, oral, and graphical forms, including the use of professional-quality visual aids.

**Outcome h:** Students shall have an understanding of the impact of Civil engineering on the society, environment, and global economy.

**Outcome i:** Students shall have recognition of the need to engage in lifelong learning.

**Outcome j:** Students shall have an ability to continuously update their knowledge and skills related to contemporary issues.

**Outcome k:** Students shall have an ability to use modern tools, techniques and skills necessary for practicing civil engineering, including computational tools, and instrumentation.

## 2. The Bachelor of Science in Civil Engineering Program Plan

The studying plan of the BSCE Program at the College of Engineering in Jazan University involves different requirements for the university, the college, and the department, as well as courses which satisfy these requirements. The study plan also includes the credit units for all courses and the distribution of these credit units on the ten studying levels (terms).

### 2.1 BSCE Program Plan Requirements

The study plan for the civil engineering department is designed to satisfy three main needs. The first one is the university requirement which includes different topics highlighting different needs in the academic and real life. The second is the college requirement involves the basic science courses and other courses related to civil and other engineering fields. The last one is the department requirement which includes the core courses in the civil engineering field with its different disciplines. Table (1) displays a general prospective of the study plan illustrating all requests, courses, credit units, and contact hours for these requirements.

**Table (1) Requirements, Credit units, and contact hours**

| Requirement | | Courses | Credit Units | | Contact Hours |
|---|---|---|---|---|---|
| | | Number | Number | % | Number |
| University | | 6 | 12 | 7.5 | 12 |
| College | English Language | 3 | 15 | 9.38 | 33 |
| | Computer Science | 2 | 6 | 3.75 | 9 |
| | Mathematics and Basic Science | 11 | 35 | 21.88 | 41 |
| | Engineering Courses | 5 | 14 | 8.75 | 21 |
| University and College | | 27 | 82 | 51.25 | 116 |
| Department | | 29 conv. | 78 | 48.75 | 115 |
| | | 26 co-op | 78 | 48.75 | 106 |
| Total | | 56 conv. | 160 | | 231 |
| | | 53 co-op | 160 | | 222 |

## 2.2 BSCE Program Credit Units-Levels-Requirements

Table (2) illustrates the distribution of the credit units for the university, college and department requirements on the ten studying levels. This table includes the summer training with zero credit units while the co-op with credit units. This summer training is held at the end of the eighth level. Furthermore, the table shows the distribution of the credit units of the basic science courses starting at the first level and ending at the sixth level.

**Table (2) Distribution of the credit units on the plan levels**

| Req. / Level | University | College | Department | Level Sum | Year Sum |
|---|---|---|---|---|---|
| **First** | 2 | 12 | 0 | 14 | **29** |
| **Second** | 2 | 13 | 0 | 15 | |
| **Third** | 2 | 16 | 0 | 18 | **35** |
| **Fourth** | 2 | 12 | 3 | 17 | |
| **Fifth** | 2 | 6 | 11 | 19 | **37** |
| **Sixth** | 2 | 3 | 13 | 18 | |
| **Seventh** | 0 | 3 | 14 | 17 | **34** |
| **Eighth (Conventional)** | 0 | 5 | 12 | 17 | |
| **Eighth (Co-op)** | 0 | 5 | 13 | 18 | 35 |
| **Summer Term** | 0 | 0 | Summer Training | 0 | **0** |
| | 0 | 0 | Co-op begins | 0 | **0** |
| **Ninth (Conventional)** | 0 | 0 | 13 | 13 | **13** |
| **Ninth (Co-op)** | 0 | 0 | 9 | 9 | **9** |
| **Tenth (Conventional)** | 0 | 0 | 12 | 12 | 25 |
| **Tenth (Co-op)** | 0 | 0 | 15 | 15 | 24 |
| **Total** | **12** | **70** | **78** | **160** | |

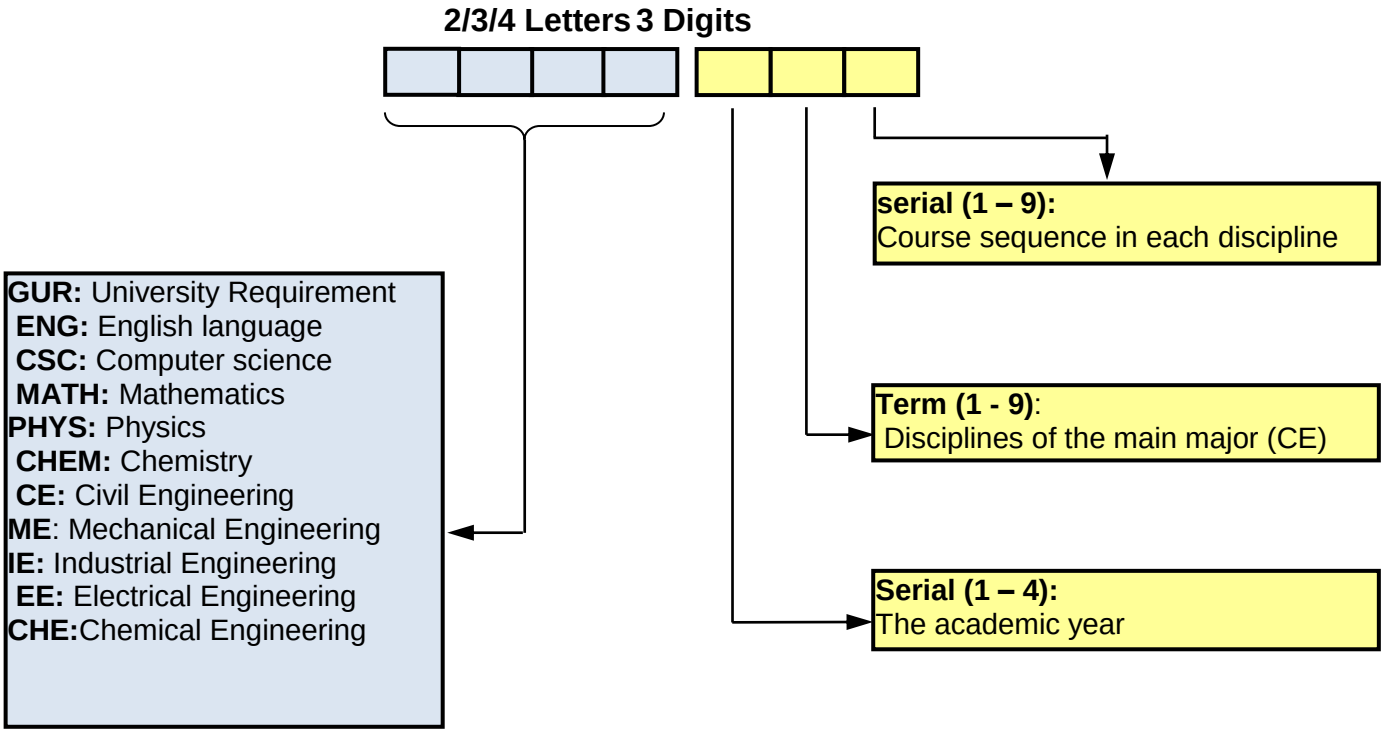
## 2.3 Course Coding System

The course code is composed of two to four letters and three digits. The letters indicate the major of the course. The first digit indicates the year, 1, 2, 3, or 4. The second digit between 1 and 9 displays the discipline in the major. Table (3) and Fig. 1 show the disciplines in civil engineering. The third digit is the course sequence in each discipline.

**Table (3) Disciplines of Civil Engineering**

| Disciplines | The second Digit |
|---|---|
| Structural | **1,2** |
| Geotechnical | **3** |
| Transportation | **4** |
| Water Resources | **5** |
| Environmental | **6** |
| Construction | **7** |
| Surveying | **8** |
| Training and Senior Projects | **9** |

The following Figure shows the courses coding system that obeyed throughout the studying plan.




This coding system is applied only to the civil engineering core courses, engineering course from other engineering department and taught in the civil engineering departmental courses, and basic science courses belonging to other colleges but the courses are described according the requirements of the Civil engineering department. Other courses are not following this coding system.

## 2.4 BSCE Program Courses

Tables (4), (5), (6) and (7) illustrate the courses, their credit units and weekly contact hours for the university, college, and department. The core courses are classified according to the discipline in the civil engineering. The distribution of the courses includes; 12 credit units for the university requirements, 70 credit units for the college requirements, and 78 credit units as requirements for the civil engineering. The total credit units for the BSCE are 160.

**Table (4) The University Requirements**

| Discipline | No. | Course code | Course Name | Credit Units | Contact Hours |
|---|---|---|---|---|---|
| University Requirements | 1 | SLM 101 | Islamic Culture (1) | 2 | 2 |
| | 2 | SLM 102 | Islamic Culture (2) | 2 | 2 |
| | 3 | SLM 103 | Islamic Culture (3) | 2 | 2 |
| | 4 | SLM 104 | Islamic Culture (4) | 2 | 2 |
| | 5 | ARB 101 | Arabic Language Skills | 2 | 2 |
| | 6 | ARB 102 | Arabic Editing | 2 | 2 |
| **Total** | **6 Courses** | | | **12 Credit** | |

## Table (5) The College Requirements

| Discipline | No. | Course code | Course Name | Credit Units | Contact Hours |
|---|---|---|---|---|---|
| English Language | 1 | ENG105 | English Language (1) | 6 | 15 |
| | 2 | ENG106 | English Language (2) | 6 | 15 |
| | 3 | ENG 357 | Technical Writing | 3 | 3 |
| | **3 Courses** | | | **15 Credit** | |
| Computer Science | 1 | CSC101 | Introduction to Computer | 3 | 4 |
| | 2 | CSC 011 | Programming Language | 3 | 4 |
| | **2 Courses** | | | **6 Credit** | |
| **Mathematics & Science** | 1 | MATH 101 | Mathematics | 3 | 3 |
| | 2 | MATH 211 | Calculus (1) | 3 | 3 |
| | 3 | MATH 212 | Calculus (2) | 3 | 3 |
| | 4 | MATH 313 | Calculus (3) | 3 | 3 |
| | 5 | MATH 336 | Differential Equations | 3 | 3 |
| | 6 | MATH 410 | Numerical Methods | 3 | 3 |
| | 7 | STAT 354 | Statistics and Probability | 3 | 3 |
| | 8 | CHEM 101 | Chemistry (1) | 4 | 5 |
| | 9 | CHEM 102 | Chemistry (2) | 3 | 4 |
| | 10 | PHYS 101 | Physics (1) | 4 | 6 |
| | 11 | PHYS 102 | Physics (2) | 3 | 5 |
| | **11 Courses** | | | **35 Credit** | |
| **Engineering Courses** | 1 | ME131 | Engineering Drawing | 3 | 6 |
| | 2 | ME 132 | Introduction to Engineering Design | 3 | 4 |
| | 3 | IE 346 | Engineering Economy | 2 | 2 |
| | 4 | EE 111 | Fundamental of Electrical Engineering. | 3 | 5 |
| | 5 | CE111 | Statics | 3 | 4 |
| | **5 Courses** | | | **14 Credit** | |
| **Total** | **21 Courses** | | | **70 Credit** | |

**Table (6) Civil Engineering Requirements (Conventional Approach) Based on Disciplines**

| Discipline | No. | Course code | Course Name | Credit Units | Contact Hours |
|---|---|---|---|---|---|
| Mechanical | 1 | ME 133 | Dynamics | 3 | 4 |
| | 2 | ME 211 | Thermodynamics (1) | 3 | 3 |
| | **2 Course** | | | **6 Credit** | |
| Structural | 1 | CE 212 | Civil Engineering Drawing | 2 | 4 |
| | 2 | CE 213 | Strength of Materials | 3 | 5 |
| | 3 | CE 214 | Materials of Construction | 3 | 5 |
| | 4 | CE 215 | Structural Analysis (1) | 3 | 4 |
| | 5 | CE 316 | Design of Steel Structures | 3 | 4 |
| | 6 | CE 317 | Reinforced Concrete Design (1) | 3 | 4 |
| | 7 | CE 318 | Reinforced Concrete Design (2) | 3 | 4 |
| | **7 Courses** | | | **20 Credit** | |
| Geotechnical | 1 | CE 231 | Geotechnical Engineering (1) | 2 | 3 |
| | 2 | CE 332 | Geotechnical Engineering (2) | 3 | 5 |
| | 3 | CE 433 | Foundation Engineering | 3 | 4 |
| | **3 Courses** | | | **8 Credit** | |
| Transportation | 1 | CE 341 | Transportation Engineering (1) | 3 | 4 |
| | 2 | CE 342 | Transportation Engineering (2) | 3 | 4 |
| | 3 | CE 443 | Pavement Design | 3 | 4 |
| | **3 Courses** | | | **9 Credit** | |
| Water Resources | 1 | CE 251 | Fluid Mechanics | 3 | 5 |
| | 2 | CE 352 | Hydrology and Water Resources | 3 | 4 |
| | **2 Courses** | | | **6 Credit** | |
| Environmental | 1 | CE 261 | Environmental Microbiology | 3 | 3 |
| | 2 | CE 462 | Sanitary Engineering | 3 | 4 |
| | **2 Courses** | | | **6 Credit** | |
| Construction | 1 | CE 371 | Construction Engineering | 3 | 4 |
| | 2 | CE 472 | Construction Management | 3 | 4 |
| | **2 Courses** | | | **6 Credit** | |
| Surveying | 1 | CE 281 | Surveying (1) | 2 | 4 |
| | 2 | CE 382 | Surveying (2) | 2 | 4 |
| | **2 Courses** | | | **4 Credit** | |
| Training & Project | 1 | CE 496 | Summer Training | 0 | - |
| | 2 | CE 498 | Senior Design Project (1) | 1 | 4 |
| | 3 | CE 499 | Senior Design Project (2) | 3 | 9 |
| | **3 Courses** | | | **4 Credit** | |
| Elective | 1 | CE 4xx | Elective (1) | 3 | 3 |
| | 2 | CE 4xx | Elective (2) | 3 | 3 |
| | 3 | CE 4xx | Elective (3) | 3 | 3 |
| | **3 Courses** | | | **9 Credit** | |
| **Total** | **29 Courses** | | | **78 Credit** | |

**Table (7) Civil Engineering Requirements (Co-op Approach) Based on Disciplines**

| Discipline | No. | Course code | Course Name | Credit Units | Contact Hours |
|---|---|---|---|---|---|
| Mechanical | 1 | ME 133 | Dynamics | 3 | 4 |
| | 2 | ME 211 | Thermodynamics (1) | 3 | 3 |
| | **2 Course** | | | **6 Credit** | |
| Structural | 1 | CE 212 | Civil Engineering Drawing | 2 | 4 |
| | 2 | CE 213 | Strength of Materials | 3 | 5 |
| | 3 | CE 214 | Materials of Construction | 3 | 5 |
| | 4 | CE 215 | Structural Analysis (1) | 3 | 4 |
| | 5 | CE 316 | Design of Steel Structures | 3 | 4 |
| | 6 | CE 317 | Reinforced Concrete Design (1) | 3 | 4 |
| | 7 | CE 318 | Reinforced Concrete Design (2) | 3 | 4 |
| | **7 Courses** | | | **20 Credit** | |
| Geotechnical | 1 | CE 231 | Geotechnical Engineering (1) | 2 | 3 |
| | 2 | CE 332 | Geotechnical Engineering (2) | 3 | 5 |
| | 3 | CE 433 | Foundation Engineering | 3 | 4 |
| | **3 Courses** | | | **8 Credit** | |
| Transportation | 1 | CE 341 | Transportation Engineering (1) | 3 | 4 |
| | 2 | CE 342 | Transportation Engineering (2) | 3 | 4 |
| | 3 | CE 443 | Pavement Design | 3 | 4 |
| | **3 Courses** | | | **9 Credit** | |
| Water Resources | 1 | CE 251 | Fluid Mechanics | 3 | 5 |
| | 2 | CE 352 | Hydrology and Water Resources | 3 | 4 |
| | **2 Courses** | | | **6 Credit** | |
| Environmental | 1 | CE 261 | Environmental Microbiology | 3 | 3 |
| | 2 | CE 462 | Sanitary Engineering | 3 | 4 |
| | **2 Courses** | | | **6 Credit** | |
| Construction | 1 | CE 371 | Construction Engineering | 3 | 4 |
| | 2 | CE 472 | Construction Management | 3 | 4 |
| | **2 Courses** | | | **6 Credit** | |
| Surveying | 1 | CE 281 | Surveying (1) | 2 | 4 |
| | 2 | CE 382 | Surveying (2) | 2 | 4 |
| | **2 Courses** | | | **4 Credit** | |
| Training & Project | 1 | CE 497 | Co-op | 9 | - |
| | 2 | CE 498 | Senior Design Project (1) | 1 | 4 |
| | 3 | CE 499 | Senior Design Project (2) | 3 | 9 |
| | **3 Courses** | | | **13 Credit** | |
| **Total** | **26 Courses** | | | **78 Credit** | |

## 2.5 BSCE Program Curriculum

Following is the BSCE program curriculum of the Civil engineering department. The BSCE is accomplished in five academic years having two levels an academic year. The five academic years involve one preparatory year with no core courses and four years in the civil engineering field. The curriculum presents the credit units and weekly contact hours, either for lectures or for practical work for all courses. The curriculum also presents summer training which starts at the end of the eighth level, and senior project which begins at the ninth level and continues to the end of the tenth level. Also, the program presents the concept of conventional and co-op approaches and the distribution of courses after the seventh level for both approaches. The main difference between the two approaches is that in the conventional approach the students take 9 credits as elective courses while in the co-op approach they cover the 9 credits in 28 weeks of training.

### PREPARATORY YEAR

| First Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 2 | -- | -- | 2 | 2 | ---- | Islamic Culture (1) | SLM 101 |
| 15 | -- | 3 | 12 | 6 | ---- | English Language (1) | ENG 105 |
| 3 | -- | -- | 3 | 3 | ---- | Mathematics | MATH 101 |
| 4 | -- | 2 | 2 | 3 | --- | Introduction to Computer | CSC 101 |
| **24** | **-** | **5** | **19** | **14** | | **4 Courses** | **Sum** |
| **Second Level** | | | | | | | |
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 2 | -- | -- | 2 | 2 | ---- | Islamic Culture (2) | SLM 102 |
| 15 | -- | 3 | 12 | 6 | ENG 105 | English Language (2) | ENG 106 |
| 3 | -- | -- | 3 | 3 | ENG 105<br>MATH 101 | Calculus (1) | MATH 211 |
| **5** | -- | 2 | 3 | 4 | ENG 105 | Chemistry (1) | CHEM 101 |
| **25** | **-** | **5** | **20** | **15** | | **4 Courses** | **Sum** |
| **49** | **-** | **10** | **39** | **29** | | **8 Courses** | **Total** |

# FIRST YEAR

| Third Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 2 | -- | -- | 2 | 2 | ---- | Arabic Language Skills | ARB 101 |
| 6 | 1 | 2 | 3 | 4 | ENG 105<br>MATH 211 | Physics (1) | PHYS 101 |
| 3 | - | - | 3 | 3 | MATH 211 | Calculus (2) | MATH 212 |
| 4 | 2 | - | 2 | 3 | CHEM 101 | Chemistry (2) | CHEM 102 |
| 6 | - | 6 | - | 3 | ENG 106<br>MATH 211 | Engineering Drawing | ME 131 |
| 4 | - | 2 | 2 | 3 | MATH 211 | Introduction to Engineering Design | ME 132 |
| **25** | **3** | **10** | **12** | **18** | | **6 Courses** | **Sum** |
| **Fourth Level** | | | | | | | |
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 2 | | | 2 | 2 | ---- | Islamic culture (3) | SLM 103 |
| 5 | 1 | 2 | 2 | 3 | PHYS 101<br>MATH 211 | Physics (2) | PHYS 102 |
| 3 | - | - | 3 | 3 | MATH 212 | Calculus (3) | MATH 313 |
| 5 | 1 | 2 | 2 | 3 | ENG 106<br>PHYS 101 | Fundamental of Electrical Engineering | EE 111 |
| 4 | 2 | - | 2 | 3 | ENG 106<br>PHYS 101 | Statics | CE 111 |
| 4 | 2 | - | 2 | 3 | MATH 211<br>PHYS 101 | Dynamics | ME 133 |
| **23** | **6** | **4** | **13** | **17** | | **6 Courses** | **Sum** |
| **48** | **9** | **14** | **25** | **35** | | **12 Courses** | **Total** |

# SECOND YEAR

| Fifth Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 2 | -- | -- | 2 | 2 | ---- | Arabic Editing | ARB 102 |
| 3 | - | - | 3 | 3 | MATH 212 | Differential Equations | MATH 336 |
| 4 | - | 2 | 2 | 3 | CSC 101<br>MATH 211 | Programming Language | CSC 011 |
| 4 | - | 3 | 1 | 2 | ME 131 | Civil Engineering Drawing | CE 212 |
| 5 | 2 | 1 | 2 | 3 | CE 111 | Strength of Materials | CE 213 |
| 5 | 1 | 2 | 2 | 3 | PHYS 102 | Fluid Mechanics | CE 251 |
| 3 | - | - | 3 | 3 | PHYS 102 | Thermodynamics (1) | ME 211 |
| **26** | **3** | **8** | **15** | **19** | | **7 Courses** | **Sum** |
| **Sixth Level** | | | | | | | |
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 2 | -- | -- | 2 | 2 | ---- | Islamic culture (4) | SLM 104 |
| 3 | - | - | 3 | 3 | MATH 212 | Statistics and Probability | STAT 354 |
| 5 | 1 | 2 | 2 | 3 | CE 213 | Materials of Construction | CE 214 |
| 4 | 2 | - | 2 | 3 | CE 213 | Structural Analysis (1) | CE 215 |
| 3 | - | 1 | 2 | 2 | CE 213 | Geotechnical Engineering (1) | CE 231 |
| 3 | - | - | 3 | 3 | CHEM 101 | Environmental Microbiology | CE 261 |
| 4 | 1 | 2 | 1 | 2 | MATH 212 | Surveying (1) | CE 281 |
| **24** | **4** | **5** | **15** | **18** | | **7 Courses** | **Sum** |
| **50** | **7** | **13** | **30** | **37** | | **14 Courses** | **Total** |

## THIRD YEAR

| Seventh Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 3 | - | - | 3 | 3 | ME 132<br>MATH 211 | Technical Writing | ENG 357 |
| 4 | 2 | - | 2 | 3 | CE 214<br>CE 215 | Design of Steel Structures. | CE 316 |
| 4 | 2 | - | 2 | 3 | CE 214<br>CE 215 | Reinforced Concrete Design (1) | CE 317 |
| 5 | - | 3 | 2 | 3 | CE 231 | Geotechnical Engineering (2) | CE 332 |
| 4 | - | 1 | 3 | 3 | CE 281 | Transportation Engineering (1) | CE 341 |
| 4 | 1 | 2 | 1 | 2 | CE 281 | Surveying (2) | CE 382 |
| **24** | **5** | **6** | **13** | **17** | | **6 Courses** | **Sum** |

# Conventional Path

| Eighth Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 3 | - | - | 3 | 3 | MATH 313 | Numerical Methods | MATH 410 |
| 4 | 2 | - | 2 | 3 | CE 317 | Reinforced Concrete Design (2) | CE 318 |
| 4 | 2 | - | 2 | 3 | CE 317 | Construction Engineering | CE 371 |
| 4 | - | 1 | 3 | 3 | CE 341 | Transportation Engineering (2) | CE 342 |
| 4 | - | 1 | 3 | 3 | CE 251 | Hydrology and Water Resources | CE 352 |
| 2 | - | - | 2 | 2 | STAT 354 | Engineering Economics | IE 346 |
| **21** | **4** | **2** | **15** | **17** | | **6 Courses** | **Sum** |
| **45** | **9** | **8** | **28** | **34** | | **12 Courses** | **Total** |

## Summer Term

| Course Code | Course Name | Prerequisites | Credit Units |
|---|---|---|---|
| CE 496 | Summer training | ENG 357<br>Pass 116 Credit | 0 |

# FOURTH YEAR

| Ninth Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 4 | 2 | - | 2 | 3 | CE 317<br>CE 332 | Foundation Engineering | CE 433 |
| 4 | 1 | 1 | 2 | 3 | CE 342 | Pavement Design | CE 443 |
| 3 | - | - | 3 | 3 | - | Elective (1) | CE 4xx |
| 3 | - | - | 3 | 3 | Co-requisite<br>Elective (1) | Elective (2) | CE 4xx |
| 4 | - | 3 | 1 | 1 | ENG 357<br>CE 261<br>CE 282<br>CE 316<br>CE 317<br>CE 332<br>CE 342 | Senior Design Project (1) | CE 498 |
| **18** | **3** | **4** | **11** | **13** | | **5 Courses** | **Sum** |
| **Tenth Level** | | | | | | | |
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 4 | 2 | - | 2 | 3 | CE 261 | Sanitary Engineering | CE 462 |
| 4 | 2 | - | 2 | 3 | CE 371 | Construction Management | CE 472 |
| 3 | - | - | 3 | 3 | Elective (2) | Elective (3) | CE 4xx |
| 9 | - | 9 | - | 3 | CE 498 | Senior Design Project (2) | CE 499 |
| **20** | **4** | **9** | **7** | **12** | | **4 Courses** | **Sum** |
| **38** | **7** | **13** | **18** | **25** | | **9 Courses** | **Total** |

## Elective Courses

| Weekly Contact Hours | | | | Credit Units | Prerequisite | Elective ( 1 ) | CE 4xx |
|---|---|---|---|---|---|---|---|
| Sum | Tut | Lab | Lec | | | | |
| **3** | - | - | 3 | 3 | CE 215 | Structural Analysis (2) | CE 421 |
| 3 | - | - | 3 | 3 | CE 332 | Soil Stabilization | CE 436 |
| 3 | - | - | 3 | 3 | CE 342 | Pavement Evaluation | CE 446 |
| 3 | - | - | 3 | 3 | CE3 352 | Groundwater Engineering | CE456 |
| 3 | - | - | 3 | 3 | CE 352 | Water and Wastewater Treatment | CE 466 |
| 3 | - | - | 3 | 3 | CE 371 | Advanced Methods of Construction | CE 476 |
| 3 | 3 | - | - | 3 | CE 382 | Survey measurements adjustment. | CE 486 |

| Weekly Contact Hours | | | | Credit Units | Prerequisite | Elective ( 2) | CE 4xx |
|---|---|---|---|---|---|---|---|
| Sum | Lab | Tut | Lec | | | | |
| 3 | - | - | 3 | **3** | CE 421 | Structural Analysis (3) | CE 422 |
| 3 | - | - | 3 | 3 | CE 421 | Advanced R.C. Design | CE423 |
| 3 | - | - | 3 | 3 | CE 421 | Advanced Steel Structures Design | CE 424 |
| 3 | - | - | 3 | 3 | CE 436 | Soil Dynamics | CE 437 |
| 3 | - | - | 3 | 3 | CE 446 | Construction and Maintenance of Highways | CE 447 |
| 3 | - | - | 3 | 3 | CE 456 | Harbor & Coastal Engineering | CE 457 |
| 3 | - | - | 3 | 3 | CE 466 | Water and Wastewater Treatment Plants | CE 467 |
| 3 | - | - | 3 | 3 | CE 476 | Construction Planning | CE 477 |
| 3 | - | - | 3 | 3 | CE 486 | Geodesy and Geomatics | CE 487 |

| Weekly Contact Hours | | | | Credit Units | Prerequisite | Elective ( 3) | CE 4xx |
|---|---|---|---|---|---|---|---|
| Lec | Lab | Tut | Sum | | | | |
| 3 | - | - | 3 | **3** | CE 421 | Rehabilitation of Structures | CE 425 |
| 3 | - | - | 3 | 3 | CE 421 | Structural Dynamics | CE 426 |
| | - | - | 3 | 3 | CE 436 | Foundation and Earth Structures Design | CE 438 |
| 3 | - | - | 3 | 3 | CE 446 | Traffic Engineering & Roadway Safety | CE 448 |
| 3 | - | - | 3 | 3 | CE 456 | Water Resources Planning and Management | CE 458 |
| 3 | - | - | 3 | 3 | CE 466 | Municipal Solid Waste Management | CE 468 |
| 3 | - | - | 3 | 3 | CE 486 | Remote Sensing. | CE 488 |

# Co-op Path

| Eighth Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| Weekly Contact Hours | | | | Credit Units | Prerequisites | Course Name | Course Code |
| Sum | Tut | Lab | Lec | | | | |
| 3 | - | - | 3 | 3 | MATH 313 | Numerical Methods | MATH 410 |
| 4 | 2 | - | 2 | 3 | CE 317 | Reinforced Concrete Design (2) | CE 318 |
| 4 | - | 1 | 3 | 3 | CE 341 | Transportation Engineering (2) | CE 342 |
| 4 | - | 1 | 3 | 3 | CE 251 | Hydrology and Water Resources | CE 352 |
| 4 | 2 | - | 2 | 3 | CE 317 | Construction Engineering | CE 371 |
| 4 | - | 3 | 1 | 1 | ENG 357<br>CE 261<br>CE 282<br>CE 316<br>CE 317<br>CE 332<br>CE 341 | Senior Design Project (1) | CE 398 |
| 2 | - | - | 2 | 2 | STAT 354 | Engineering Economics | IE 346 |
| **25** | **4** | **5** | **16** | **18** | | **7 Courses** | **Sum** |
| **49** | **9** | **11** | **29** | **35** | | **13 Courses** | **Total** |

## Summer Term

| Course Code | Course Name | Prerequisites | Credit Units |
|---|---|---|---|
| **CE 497** | **Co-op** | **ENG 357<br>Pass 116 Credit** | **9** |

# FOURTH YEAR

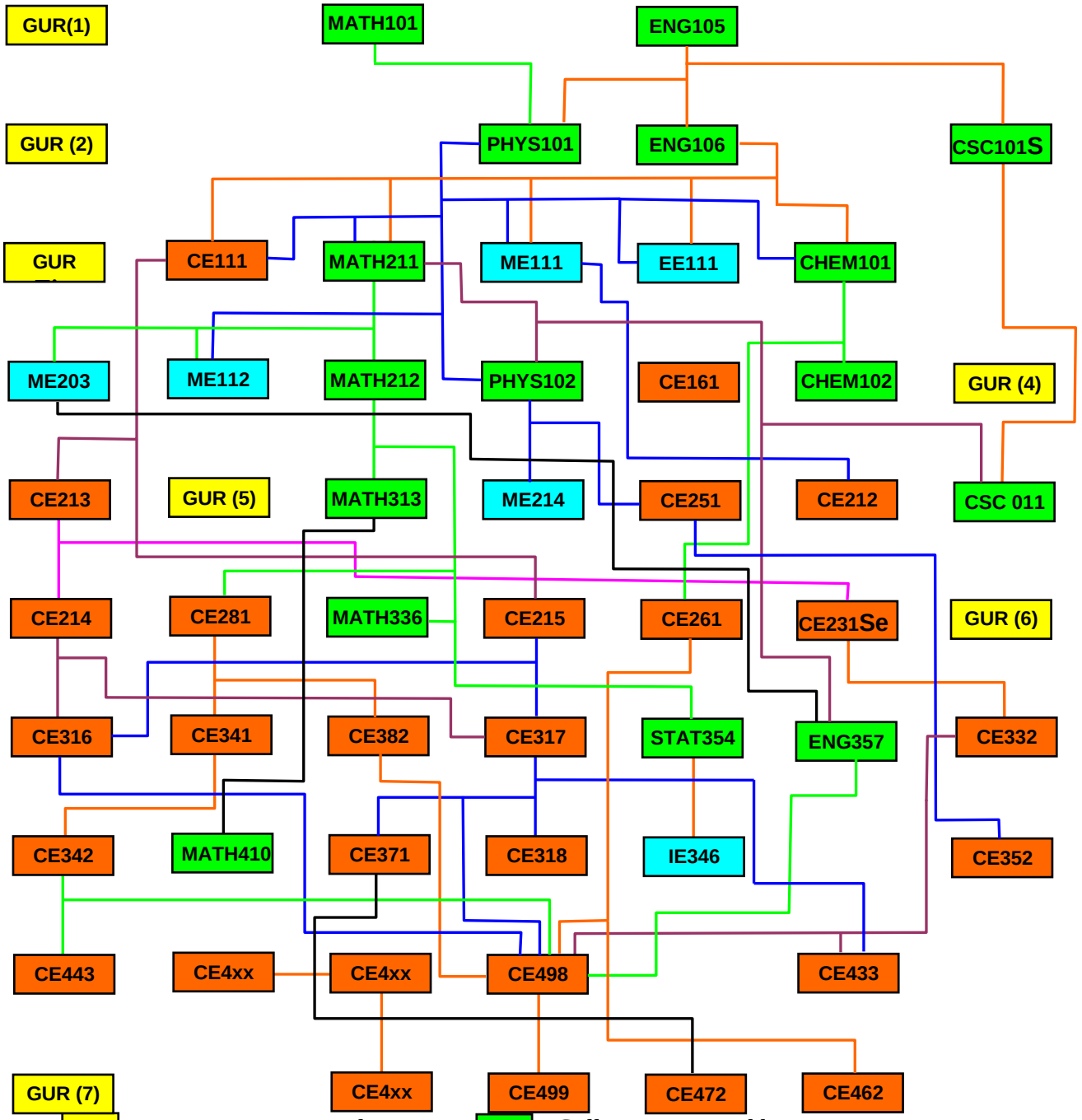
| Ninth Level | | |
|---|---|---|
| **Remark** | **Course Name** | **Course Code** |
| Continuation for the Co-op Program | Co-op | CE 497 |

| Tenth Level | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Weekly Contact Hours** | | | | **Credit Units** | **Prerequisites** | **Course Name** | **Course Code** |
| **Sum** | **Tut** | **Lab** | **Lec** | | | | |
| 4 | 2 | - | 2 | 3 | CE 317<br>CE 332 | Foundation Engineering | CE 433 |
| 4 | 1 | 1 | 2 | 3 | CE 342 | Pavement Design | CE 443 |
| 4 | 2 | - | 2 | 3 | CE 261 | Sanitary Engineering | CE 462 |
| 4 | 2 | - | 2 | 3 | CE 371 | Construction Management | CE 472 |
| 9 | - | 9 | - | 3 | CE 498 | Senior Design Project (2) | CE 499 |
| **25** | **7** | **10** | **8** | **15** | | **5 Courses** | **Sum** |
| **25** | **7** | **10** | **8** | **24** | | **6 Courses** | **Total** |

The following statistics can be drawn from the BSCE program curriculum. Table (8) shows the distribution of the number of courses, credit units, and weekly contact hours in each level and academic year. Finally, Figure (2) illustrates the prerequisites requirement for the courses.

**Table (8)The Distribution of the Courses**

| Weekly Contact Hours | | | | Credit Units | | No. of Courses | | Level | Academic Year |
|---|---|---|---|---|---|---|---|---|---|
| Year Sum | Level Sum | Lab. | Lec. & Tut. | Year | Level | Year | Level | | |
| 50 | 24 | 5 | 19 | 29 | 14 | 8 | 4 | 1 | Preparatory |
| | 26 | 5 | 21 | | 15 | | 4 | 2 | |
| 47 | 25 | 10 | 15 | 35 | 18 | 12 | 6 | 3 | First |
| | 22 | 4 | 18 | | 17 | | 6 | 4 | |
| 51 | 27 | 9 | 18 | 37 | 19 | 14 | 7 | 5 | Second |
| | 24 | 5 | 19 | | 18 | | 7 | 6 | |
| 45 | 24 | 6 | 18 | 34 | 17 | 12 | 6 | 7 | Third |
| | 21 | 2 | 19 | | 17 | | 6 | 8 conv. | |
| 49 | 25 | 5 | 20 | 35 | 18 | 13 | 7 | 8 co-op | |
| | | | | 0 | Summer Training | | | | |
| | | | | 9 | Co-op | | | | |
| 38 | 18 | 3 | 15 | 25 | 13 | 9 | 5 | 9 conv. | Fourth |
| | 20 | 9 | 11 | | 12 | | 4 | 10 conv. | |
| 25 | 0 | 0 | 0 | 17 | 0 | 7 | 1 | 9 co-op | |
| | 25 | 9 | 16 | | 17 | | 6 | 10 co-op | |
| **231** | | **58** | **173** | **160** | | | | | **Total** |
| **222 co-op** | | **58 co-op** | **164 Co-op** | | | | | | |




University Requested course

College Requested basic science course

Department Requested course

College Requested engineering science course

**GUR:** University Requirement
**ENG:** English language
**CSC:** Computer science
**MATH:** Mathematics
**PHYS:** Physics
**CHEM:** Chemistry
**CE:** Civil Engineering
**ME**: Mechanical Engineering
**IE:** Industrial Engineering
**EE:** Electrical Engineering

Figure (2) Flow chart for the program

**3. Bachelor of Science in Civil Engineering Program Course Syllabi**

The course syllabus for the core courses within these disciplines is designed according to the international academic accreditation rules. The course syllabus includes the following items:

1- Course code, name, credit units, contact hours, and prerequisites,
2- Course description,
3- Text book and references,
4- Course learning objectives,
5- Descriptive course contents, either theoretical or practical,
6- Design activities and course projects,
7- Teaching procedures and evaluation methods,
8- Course outcomes in relation to the course objectives, and
9- Course contribution to both engineering science and engineering design.

Following are the course syllabi for all core courses involved in the BSCE program.

# Course Syllabus

| Course Code | CE 111 | | | |
|---|---|---|---|---|
| Course Title | Statics | | | |
| Year / Level | 1 / 4 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | - | 2 |
| Prerequisites | ENG 102 - PHYS 101 | | | |

| | |
|---|---|
| **Course Description** | Basic concepts and principles of mechanics; algebraic vector operations on actionand reaction vectors; equilibrium of particles in two and three dimensions; definitions of moment and couple; reduction of system of forces; equilibrium of rigid bodies; statically determinate structures including beams and trusses; analysis of internal forces; shear and bending moment diagram for beams; center of gravity of masses, and centroid of lines, areas, and volumes; area moment of inertia and radius of gyration. |
| **Textbook** | 1. Handout Notes, prepared by the lecturer.<br>2. Hibbeler, R. C., "Engineering Mechanics", Prentic Hall, 10th edition, 2004. |
| **References** | 1. Beer, Johnston, Eisenberg &Mazurek, “Vector Mechanics for Engineers”, 8th EditionMcGraw Hill, 2006 |
| **Course learning Objectives (C.L.O.)** | 1. Identify vectors and scalars and apply the parallelogram laws and use them to add forces and resolve a force into two components.<br>2. Calculate the reactions and the moment using the equilibrium equations for 2-D. and draw the free body diagram (F.B.D.) and solve equations of equilibrium for a particle in 2D and 3D.<br>3. Define and calculate the forces in truss members using method of joints and method of sections and recognize the zero force members in trusses.<br>4. Analysis of bodies to evaluate center of gravity of masses, centroid of lines and areas.<br>5. Calculate moments of inertia for a single area, and the utilization of parallel axes theorem to compute centroidal moments of inertia for composite areas. |

| | |
|---|---|
| **Descriptive Course Topics** | 1. General Principles<br>2. Introduction to basic operations of vector algebra and forces' vectors.<br>3. Free body diagram representation of a rigid body, and equilibrium analysis of particle(s) in 2D & 3D.<br>4. Moment of a force, force-couple systems.<br>5. Equilibrium analysis of rigid bodies in 2D & 3D.<br>6. Structural analysis of plane trusses.<br>7. Analysis of internal actions, and drawing the shear force and bending moment diagrams.<br>8. Geometric analysis of for center of gravity of masses and centroids of single or composite area.<br>9. Computations of moment of inertia for composite areas. |
| **Experimental Work** | Experimental works does not include. |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | An ability to apply knowledge of mathematics, science, and engineering to identify vectors. | [ a ] |
| Course learning objective-2 | An ability to identify, formulate and solve engineering problems using equilibrium equations to calculate reactions, shear forces and moments. | [ e ] |
| Course learning objective-3 | An ability to identify, formulate and solve structural analysis of trusses. | [ e ] |
| Course learning objective-4 | An ability to identify, formulate and solve structural engineering problems to evaluate center of gravity of masses and centroid of lines and areas. | [ e ] |
| Course learning objective-5 | An ability to identify, formulate and solve structural analysis problems to compute centroidal moments of inertia. | [ e ] |

| | | |
|---|---|---|
| **Course Contribution to Professional Branches** | Engineering Science | **100 %** |
| | Engineering Design | **0 %** |

## Course Syllabus

| Course Code | CE 212 | | | |
|---|---|---|---|---|
| Course Title | Civil Engineering Drawing | | | |
| Year / Level | 2 / 5 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 2 | 1 | 3 | - |
| Prerequisites | ME 131 | | | |

| | |
|---|---|
| **Course Description** | This course is intended to introduce the fundamentals of civil engineering drawing. Drawing of a structural plan from an architectural plan of R.C. buildings. Drawing of the dimensions and detail of reinforcements for R.C. elements, such as foundations, columns, beams and slabs. Estimating of dimensions before the design stage is included. Drawing of projections and sections of some connections of steel members. Connection of beam-to-column, connection of beam –to-beam, connection of truss members at a gusset plate, connection of bracing members with a column, and connection at the base of column. |
| **Textbook** | Handout Notes, prepared by the instructor. |
| **References** | 1- Drawing for Civil Engineering"by J. A. Van Der Westhuizen, (Paperback - Jan 1, 2000).<br>2- "Civil Engineering *Drawing", Ahmed Aijaz*,Amazon ed. |
| **Course learning Objectives (C.L.O.)** | 1- Understand basics and fundamentals of civil engineering drawing and its skills.<br>2- Practice the use of hand drawing tools and drawing sheets.<br>3- Acquirement of the imaginary skills to understand civil engineering drawings.<br>4- Understand how reinforcements are distributed inside R.C. elements.<br>5- Recognize details of connections and splices of steel members.<br>6- Imagining of projections of common sections of steel and their connections.<br>7- Estimating dimensions of sections and members during preliminary design. |

| | |
|---|---|
| **Descriptive Course Topics** | 1- Introduction to Civil Engineering Drawing.<br>2- Drawing of the structural plan according to the architectural plan.<br>**3-** Dimensioning and drawing of strip, isolated and raft foundations.<br>4- Dimensioning and drawing of R.C. columns. Drawing of reinforcements inside the columns and locations of splices are performed.<br><br>5- Dimensioning and drawing of R.C. beams and solid slab with the steel reinforcement.<br>6- Introduction to steel constructions and drawing of projections and sections for common steel sections.<br>7- Drawing of bolted connection of truss members at the gusset plate.<br>8- Drawing of three projections of beam –to- column connection.<br>9- Drawing of three projections of beam –to- beam connection.<br>10- Drawing of connections of bracing members with the columns.<br>11- Drawing of connections at the base of steel column. |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| **C.L.O. (1)** | Understanding of fundamentals of civil engineering drawing. | [ a, i, k ] |
| **C.L.O. (2)** | Acquirement of skills of imagining in reading civil engineering drawings. | [ a, k ] |
| **C.L.O. (3)** | Gaining of skills to prepare workshop drawings. | [ a, k ] |
| **C.L.O. (4)** | Understanding of the distribution of steel reinforcements in R.C. members and positions of splices. | [ a, i ] |
| **C.L.O. (5)** | Recognizing and practicing steel drawings. | [ a, i, k ] |
| **C.L.O. (6)** | Acquirement of skill of imagining in reading details of steel drawings. | [ a, i, k ] |
| **C.L.O. (7)** | Creating of engineering sense to estimate proper dimensions of steel and R.C. sections | [ a, k ] |

| | | |
|---|---|---|
| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

## Course Syllabus

| Course Code | CE 213 | | | |
|---|---|---|---|---|
| Course Title | Strength of Materials | | | |
| Year / Level | 2 / 5 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | 1 | 2 |
| Prerequisites | CE 111 | | | |

| | |
|---|---|
| **Course Description** | Review of basic principles of statics. Review of properties of plane sections. Simple stress and strain and their relations. Bending stresses in beams. Torsion of circular members. Normal force, Shear force and bending moment diagrams for beams and frames. Relation between load, shear force and bending moment. Deflection of beams, buckling in columns, Laboratory experiments. |
| **Textbook** | 3. Handout Notes, prepared by the lecturer.<br>4. Beer, F.P, Johnston, E.R., and DeWof, J.T., "Mechanics of Materials", 4th edition, Mc Graw Hill, 2006. |
| **References** | 1. William Nash, Merle Potter, “Strength of Materials”, Schaum's Outline Series , Fifth Edition, McGraw Hill Professional, 2010 |
| **Course learning Objectives (C.L.O.)** | 1. Determine the internal resultant loadings including axial, shear, bending and torsion and draw their distribution diagrams.<br>2. Evaluate stress and strain due to individual and combined loads.<br>3. Determine the state of stress of transformed sections and calculate principal normal and shear stresses and determine their planes mathematically and graphically (using Mohr's circle).<br>4. Determine shear stresses and shear flow due to transverse loads.<br>5. Calculate beam deflection.<br>6. Study the behavior of columns under buckling. |

| | |
|---|---|
| **Descriptive Course Topics** | 10. Introduction and Overview of Statics<br>11. Stress & Strain Axial Loading<br>12. Analysis of Beams for Bending<br>13. Pure Bending, Asymmetric Bending, Eccentric Axial load<br>14. Torsion, Shearing Stresses in Beams.<br>15. Transformation of Stresses &Strains to different planes mathematically and graphically.<br>16. Deflections of Beams.<br>17. Buckling in columns. |
| **Experimental Work** | Experimental works include: (Tension Test, Torsion Test, Poisson's Ration and Modulus of Elasticity, Flexural Stress Distribution Test.) |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | An ability to apply knowledge of mathematics, science, and engineering and an ability to identify, formulate and solve engineering problems to determine the internal forces. | [ a,e] |
| Course learning objective-2 | An ability to identify, formulate and solve engineering problems to calculate the stress and strain due to various load. | [ e ] |
| Course learning objective-3 | An ability to apply knowledge of mathematics, science, and engineering and an ability to identify, formulate and solve engineering problems to solve and transform the stress in different planes. | [ a,e ] |
| Course learning objective-4 | An ability to identify, formulate and solve structural engineering problems to determine the shear flow in beams. | [ e ] |
| Course learning objective-5 | An ability to identify, formulate and solve structural engineering problems to calculate deflection. | [ e ] |
| Course learning objective-6 | An ability to identify, formulate and solve structural engineering problems to study the behavior of columns under buckling. | [ e ] |

| | | |
|---|---|---|
| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

Course Syllabus

| | | | | |
|---|---|---|---|---|
| Course Code | CE214 | | | |
| Course Title | Materials of construction | | | |
| Year / Level | 2 / 6 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | 2 | 1 |
| Prerequisites | CE 213 | | | |

| | |
|---|---|
| Course Description | This course provides an introductory overview of the various materials used in construction. After receiving an introduction into fundamental principles of structural, physical and long-term performance, students learn about material and product manufacturing techniques and how they relate to mechanical and non-mechanical properties of the various materials. Common construction methods are introduced and building details are explored.<br><br>Students have the opportunity to experience material capacity and behavior as well as construction methods in demonstrations and lab experiments. Furthermore, material applications and detailing in structural and non-structural building components are explored. Resulting from this course, students will gain a comparative knowledge of material properties and possible applications in construction and architecture. |
| Textbook | Mamlouk, Michael S. and Zaniewski John P. M, "Materials for Civil and Construction Engineers", 2nd edition, Pearson and Printice Hall, USA, 2006. |
| References | 1. Onouye, Kane, "Statics and Strength of Materials for Architecture and Building Construction". Pearson Education, Prentice Hall – This will be the required text for BCT 530 "Mechanics of Building Materials for Construction".<br>2. Mamlouk, Zaniewski, "Materials for Civil and Construction Engineers". Addison Wesley – A more technical materials book.<br>3. Simmons, Olin, "Construction – Principles, Materials and Methods". J. Wiley & Sons – This is less a textbook but rather a very good |

| | |
|---|---|
| | reference for "later in life".<br>4. Ramsey, Sleeper "Architectural Graphic Standards – Student Edition". J. Wiley & Sons – A great detail reference for any architectural planning. Get one as a desk reference! |
| Course learning Objectives (C.L.O.) | 1-Describe manufacturing process, types, and utilization of metals (steel and aluminum), aggregate, Portland cement, Asphalt, masonry, wood, and plastics.<br>2. Interpret materials of construction concepts such as behavior, by identifying physical, chemical, and mechanical properties of metals (steel and aluminum),<br>aggregates, fresh and hardened concrete, Asphalt, masonry, wood, and plastics<br>3. Determine weight - volume relations, and grain size distribution of combined aggregate (Blending of aggregate),<br>4. List factors affecting durability of Portland cement concrete.<br>5. Design of Portland cement concrete and hot asphalt HMA mixtures.<br>6. Practice long life learning through locating sources of information and reporting the results and recognizing contemporary issues related to construction materials. |

| | |
|---|---|
| Descriptive Course Topics | 1. Overview of Materials and Building/Structural Types (Historic, Current)<br>2. Factors Affecting Choice of Materials and Structural Form<br>3. Fundamentals – Mechanical Properties (strength, structural performance)<br>4. Fundamentals – Non-Mechanical Properties (physical properties, durability)<br>5. Individual Building Materials (Manufacturing, Properties, Comparative Behavior, Applications in Construction): Steel, Non-ferrous metals, Concrete, Stone, Brick, Glass, Plastics, Composites<br>6. Relation between Materials and their Applications in Buildings / Case Studies / Structural and Non-Structural Applications (Residential, Commercial, Special Construction) |
| Experimental Work | 1)Tests on Cements<br>Specific Gravity, Fineness, Standard Consistency, Soundness,<br>Setting times, Compressive strength of mortar cubes<br>2) Tests on Aggregates- Gradation, Modulus, Bulking of Sand, water absorption<br>3) Tests on Concrete<br>a) Fresh Concrete: Workability Tests, Setting time, Mix Design by IS guide lines<br>b) Hardened Concrete: Compressive and Tensile strengths, effect of w-c ratio on strength of concrete, ultimate strength of beams<br>4) Non-destructive tests (demonstration only<br>Rebound hammer test and Ultrasonic pulse velocity test on concrete |

| | |
|---|---|
| | Specimens<br>5) Tests on Bricks and Tiles<br>Water absorption, compressive strength and flexural strength |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | 1- Describe manufacturing process, types, and utilization of metals (steel and aluminum), aggregate, Portland cement, Asphalt, masonry, wood, and plastics. | [ a, b, d ] |
| Course learning objective-2 | 2. Interpret materials of construction concepts such as behavior, by identifying physical, chemical, and mechanical properties of metals (steel and aluminum),aggregates, fresh and hardened concrete, Asphalt, masonry, wood, and plastics | [c, d ] |
| Course learning objective-3 | 3. Determine weight - volume relations, and grain size distribution of combined aggregate (Blending of aggregate). | [ b, d ] |
| Course learning objective-4 | 4. List factors affecting durability of Portland cement concrete. | [ a, I ] |
| Course learning objective-5 | 5. Design of Portland cement concrete and hot asphalt HMA mixtures. | [ a, b, i ] |
| Course learning objective-6 | 6. Practice long life learning through locating sources of information and reportingthe results and recognizing contemporary issues related to construction materials. | [ a, d, i ] |

| | | |
|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 80 % |
| | Engineering design | 20 % |

## Course Syllabus

| Course Code | CE 215 | | | |
|---|---|---|---|---|
| Course Title | Structural Analysis I | | | |
| Year / Level | 2 / 6 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | - | 2 |
| Prerequisites | CE 213 | | | |

| | |
|---|---|
| Course Description | Analysis of statically determinate structures (trusses, beams, frames and arches). Determination of forces in structural members (axial force, shear force and bending moment). Draw the influence lines and find maximum forces in simple beams due to the moving loads. Finding the deflection in simple beams, by using moment area method, conjugate beam method and double integration method. |
| Textbook | 5. Handout Notes, prepared by the lecturer.<br>6. Hibbeler R.C.; "Structural Analysis", Eight Edition., Prentice Hall, 2012. |
| References | *1.* AslamKassimali, "Structural Analysis", 4th edition, Cengage Learning, 2011.<br>*2.* MegsonT.H.G. "Structural and Stress Analysis", Butterworth-Heinemann, 2000. |
| Course learning Objectives (C.L.O.) | 1. Review basics of structural analysis include types of structures, types of loads and types of supports and joints.<br>2. Understand the deformations of structures under action of loading.<br>3. Identify stable, unstable determinate structures and introduce the equations of equilibrium for analyze and calculate the internal forces in the statically determinate structures and draw diagrams of shearing force, normal force and bending moment distributions in beams and frames.<br>4. Estimate slope and deflection for various load cases in cantilever and simply supported beams.<br>5. Introduce influence lines for reactions and internal forces under moving load. |

| | |
|---|---|
| Descriptive Course Topics | 1. Basic concepts of structural analysis<br>Revision of Pre-requisite course topics<br>2. Analysis of Statically Determinate Structures<br>Analysis of Trusses, Beams and Frames, Arches and Cables<br>3. Deflections of Beams and Frames<br>Differential equation for elastic curve and its solution.<br>Moment area method. Conjugate beam method.<br>4. Influence Lines for Statically Determinate Structures<br>Influence lines for reaction, shear and bending moment in beams. Use of influence lines to determine the maximum |

| | |
|---|---|
| | values under given moving load. |
| Experimental Work | This course does not include experimental work. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | 1. Classify various determinate structures.<br>2. Classify types and source of loads.<br>3. Recognize various types of support, their restrains and degree of freedom.<br>4. Differentiate between stable-unstable and determinate-indeterminate structures. | [a] |
| Course learning objective-2 | Formulate Load-shear-moment relationship. | [e] |
| Course learning objective-3 | 1. Apply concept of equilibrium using equations of equilibrium for the analysis determinate truss for the estimation of axial forces.<br>2. Apply concept of equilibrium using equations of equilibrium for the analysis of determinate beams, frames, and arches and draw shear force and bending moment diagrams. | [a,e] |
| Course learning objective-4 | Estimate slope and deflection for various load cases in cantilever and simply supported beams. | [e] |
| Course learning objective-5 | Draw influence line for reactions; shear force and bending moment for determinate beams. | [e] |

| | | |
|---|---|---|
| **Course Contribution to Professional Branches** | Engineering science | **75 %** |
| | Engineering design | **25 %** |

## Course Syllabus

| Course Code | CE 316 | | | |
|---|---|---|---|---|
| Course Title | Design of Steel Structures | | | |
| Year / Level | 3 / 7 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | - | 2 |
| Prerequisites | CE 214 - CE 215 | | | |

| | |
|---|---|
| Course Description | Types and properties of structural steel. An introduction to the design using allowable stress design method, (A.S.D). Analysis of steel structures under different cases of loading (D.L, L.L and W.L) and determination of the design forces. Design of tension and compression members and axially loaded columns. Design of bolted and welded connections. Drawing of details of the bolted and connections at different sections. Analysis and design of flexural elements, floor and roof beams. Use of software for design of elements. |
| Textbook | "Lectures in The Design of Steel Structures", prepared by the instructor. |
| References | 1- ASIC Manual of Steel Construction.<br>2- Salmon and Johnson "Steel Structures – Design and Behavior", Harper and Row publishers, Copies 1971 – 1989.<br>3-"Structural Steel Design", (4th Edition) by Jack C. Mc Cormac, (Hardcover - Jun 8, 2007). |
| Course learning Objectives (C.L.O.) | **1. Understand** concepts and assumptions of the allowable stress design method, (A.S.D) used in the design of steel structures.<br>**2. Analyze** tension and compression steel members.<br>**3. Design** oftension and compression steel members.<br>**4. Analyze** flexural members at different cases of loadings.<br>**5. Design** offlexural steel members.<br>**6. Estimate** the proper sections in the preliminary design in order to obtain an economic cost.<br>**7. Design** ofbolted and welded connections.<br>**8. Develop** workshopdrawings of sections and connections with all details.<br>**9. Apply** computer applications in the design. |

| | |
|---|---|
| **Descriptive Course Topics** | 1- Properties of structural steel, Introduction to (A.S.D) method and Common steel sections.<br>2- Loads on buildings.<br>3- Drawing of Layout of an industrial Building with roof and Column bracing.<br>4- Analysis of Steel Truss subjects to Different Cases of Loading and Calculation of the Design Forces.<br>5- Design of Tension Members.<br>6- Design of Compression Members.<br>7- Design of Bolted Connections Subject to Shear Forces.<br>8- Design of Welded Connections Subject to Shear Forces.<br>9- Drawing of details of the connections.<br>10- Design of Floor Beams.<br>11- Design of Roof Beams, (Purlins). |
| **Experimental Work** | This course does not include any experimental work. |
| **Design Activities/Projects** | This course doesn´t include projects. Lectures, Assignments and Home works in design of steel structures prepare students to be able to perform the capstone project. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| **C.L.O. (1)** | Understanding of philosophy of the methods of design. | [ a, c ] |
| **C.L.O. (2)** | An ability to formulate and solve engineering problems. | [ a, e ] |
| **C.L.O. (3)** | An ability to design tension and compression members manually and using computer applications. | [ a, c, k ] |
| **C.L.O. (4)** | An ability to analyze flexural element. | [ a, e ] |
| **C.L.O. (5)** | An ability to design of flexural members. | [ a, c, k ] |
| **C.L.O. (6)** | Acquirement of the engineering sense in selecting safe and economic sections before stage of the design. | [ c, k ] |
| **C.L.O. (7)** | An ability to design bolted and welded connections. | [ a, c, k ] |
| **C.L.O. (8)** | Acquirement of skills to prepare technical drawings. | [ c, k ] |
| **C.L.O. (9)** | An ability to design using new techniques | [ a, c, e, k ] |

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|---|---|---|
| **Course Contribution to Professional Branches** | Engineering science | **20 %** |
| | Engineering design | **80 %** |

Course Syllabus

| Course Code | CIE 317 | | | |
|---|---|---|---|---|
| Course Title | Reinforced Concrete Design (1) | | | |
| Year / Level | 3 / 7 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | - | 2 |
| Prerequisites | CE 214 - CE 215 | | | |

| | |
|---|---|
| Course Description | This course is intended to introduce the fundamentals of reinforced concrete design. The course involves the study of the properties of concrete and reinforcing steel, mechanics and behavior of reinforced concrete, flexure, shear and bond, ultimate strength method of design for beams: rectangular, doubly reinforced, and tee, continuous beams, one-way and two-way solid slabs, working stress design method, development length, splices, and curtailment of reinforcement, design of tied and spiral short columns subjected to axial compression force only. Finally the course includes computer applications and engineering drawings of reinforced concrete details. |
| Textbook | 1- ACI DESIGN HANDBOOK, Design of Structural Reinforced Concrete Elements in Accordance with ACI 318M-05, ACI SP-17M(09), American Concrete Institute.<br>2- DESIGN AIDS, prepared by the instructor in accordance with the Saudi Building Code (Concrete Structures Requirements, SBC 304 and Concrete Structures Commentary, SBC 304C). |
| References | 1- Hasson, M. N., "Structural Concrete- Theory and Design", 3rd Edition, ADDISONWesley, 2005.<br>2- Saudi Building Code, Concrete Structures Requirements, SBC 304.<br>3- Saudi Building Code (Concrete Structures commentary, SBC 304C.<br>4- Saudi Building Code, Loads and Forces Requirements, SBC 301. |
| Course learning Objectives (C.L.O.) | 1- Identify the fundamentals of reinforced concrete design.<br>2- Classify between different types of concrete elements based on internal applied force or moment.<br>3- Design of beams, solid slabs, and short columns.<br>4- Prepare detailed design and workshop drawings to be execute in the field.<br>5- Create small programs or spread sheets for analysis and design of concrete sections and elements. |

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| Descriptive Course Topics | 1- Introduction and revision, materials and properties of concrete<br>and reinforcing bars.<br>2- Analysis and design of singly reinforced concrete beams, ACI and SBC safety code provisions.<br>3- Analysis and Design of doubly reinforced concrete beams.<br>4- Analysis and design of T and L reinforced concrete beams.<br>5- Ultimate strength analysis and design for shear and diagonal<br>tension, design of web reinforcement.<br>6- Analysis and Design of continuous beam for flexure using ACI and SBC moment coefficients method.<br>7- Analysis and design of Reinforced Concrete solid one-way slabs.<br>8- Analysis and design of Reinforced Concrete solid two-way slabs.<br>9- Ultimate strength analysis and design for bond, anchorage length,<br>development length, and splices of Reinforcement.<br>10- Analysis and design of tied short columns subjected to axial compression force only.<br>11- Analysis and design of spiral short columns subjected to axial compression force only.<br>12- Design spread sheets for analysis and design of concrete sections and elements.<br>13- Semester Project |
| Experimental Work | This course does not include experimental work. |
| Design Activities/Projects | A project of design a complete reinforced concrete floor including design of all one way and two way solid slabs, design of beams for flexure and shear, and design of the columns of the building. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | 1- Introduction and revision.<br>2- Materials and properties of concrete and reinforcing bars. | [ a, e ] |
| Course learning objective-2 | 1- Analysis and design of singly reinforced concrete beams, ACI and SBC safety code provisions.<br>2- Analysis and Design of doubly reinforced concrete beams.<br>3- Analysis and design of T and L reinforced concrete beams.<br>4- Ultimate strength analysis and design for shear and diagonal tension, | [ c, i, k ] |

| | | |
|---|---|---|
| | design of web reinforcement. | |
| Course learning objective-3 | 1- Analysis and Design of continuous beam for flexure using ACI and SBC moment coefficients method.<br>2- Analysis and design of Reinforced Concrete solid one-way slabs.<br>3- Analysis and design of Reinforced Concrete solid two-way slabs.<br>4- Analysis and design of tied short columns subjected to axial compression force only.<br>5- Analysis and design of spiral short columns subjected to axial compression force only. | [ c, i, k ] |
| Course learning objective-4 | 1- Ultimate strength analysis and design for bond, anchorage length, development length, and splices of Reinforcement.<br>2- Drawings details for all assignments and project | [ a, i, k ] |
| Course learning objective-5 | Preparing and design spread sheets for analysis and design of concrete sections and elements. | [ a, c, e, i, k ] |

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|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 50 % |
| | Engineering design | 50 % |

Course Syllabus

| Course Code | CE 318 | | | |
|---|---|---|---|---|
| Course Title | Reinforced Concrete Design (2) | | | |
| Year / Level | 3 / 8 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | - | 2 |
| Prerequisites | CE 317 | | | |

| | |
|---|---|
| Course Description | This course is intended to complete the fundamentals of reinforced concrete design. The course involves the study of one-way and two-way ribbed slabs, flat slabs and stairways. It also covers design for torsion and sections subjected to normal force and bending moments. The course involves also the design of braced or unbraced slender columns. Finally the course includes computer applications and engineering drawing of reinforced concrete details. |
| Textbook | 1- ACI DESIGN HANDBOOK, Design of Structural Reinforced Concrete Elements in Accordance with ACI 318M-05, ACI SP-17M(09), American Concrete Institute.<br>2- DESIGN AIDS, prepared by the instructor in accordance with the Saudi Building Code (Concrete Structures Requirements, SBC 304 and Concrete Structures Commentary, SBC 304C). |
| References | 1- Hasson, M. N., “Structural Concrete- Theory and Design”, 3rd Edition, ADDISONWesley, 2005.<br>2- Saudi Building Code, Concrete Structures Requirements, SBC 304.<br>3- Saudi Building Code (Concrete Structures commentary, SBC 304C.<br>4- Saudi Building Code, Loads and Forces Requirements, SBC 301. |
| Course learning Objectives (C.L.O.) | 1- Identify the fundamentals of design of torsion, punching shear, and sections subjected to bending moments and normal forces.<br>2- Classify between different types of concrete elements based on internal applied force or moment.<br>3- Design of stairs, flat slabs, hollow block slabs, and long columns.<br>4- Prepare detailed design and workshop drawings to be execute in the field.<br>5- Create small programs or spread sheets for analysis and design of concrete sections and elements. |

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|---|---|
| Descriptive Course Topics | 1- Analysis and design of reinforced concrete one-way ribbed slabs.<br>2- Analysis and design of reinforced concrete two-way ribbed slabs.<br>3- Analysis and design of reinforced concrete Flat slabs.<br>4- Check of one way and two way (punching) shear in flat slabs.<br>5- Analysis and design for torsion moment and shear force.<br>6- Analysis and design of cantilever stairs.<br>7- Analysis and design of slab type stairs.<br>8- Design of sections subjected to normal forces and bending moments<br>9- Design of sections subjected to normal forces and double bending moments.<br>10- Determination if the column is short or slender and the building is braced or not.<br>11- Analysis and design of braced slender columns.<br>12- Analysis and design of unbraced slender columns.<br>13- Design spread sheets for analysis and design of concrete sections and elements.<br>14- Semester Project |
| Experimental Work | This course does not include experimental work. |
| Design Activities/Projects | A project of design a complete reinforced concrete building including design of all kinds of special slabs, design of stairs, and design of the columns. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | 1- Check of one way and two way (punching) shear in flat slabs.<br>2- Analysis and design for torsion moment and shear force. | [ a, e ] |
| Course learning objective-2 | 1- Design of sections subjected to normal forces and bending moments<br>2- Design of sections subjected to normal forces and double bending moments. | [ c, i, k ] |
| Course learning objective-3 | 1- Analysis and design of reinforced concrete one-way ribbed slabs.<br>2- Analysis and design of reinforced concrete two-way ribbed slabs.<br>3- Analysis and design of reinforced concrete Flat slabs.<br>4- Analysis and design of cantilever stairs.<br>5- Analysis and design of slab type stairs.<br>6- Determination if the column is short or slender and the building is braced or not.<br>7- Analysis and design of braced slender columns.<br>8- Analysis and design of unbraced slender columns. | [ c, i, k ] |
| Course learning objective-4 | Preparing project shop drawings for all concrete elements in plans and cross sections | [ a, i, k ] |
| Course learning objective-5 | Preparing and design spread sheets for analysis and design of concrete sections and elements. | [ a, c, e, i, k ] |

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|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 50 % |
| | Engineering design | 50 % |

Course Syllabus

| Course Code | CE 231 | | | |
|---|---|---|---|---|
| Course Title | Geotechnical Engineering (1) | | | |
| Year / Level | 2 / 6 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 2 | 2 | 1 | - |
| Prerequisites | CE 213 | | | |

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|---|---|
| Course Description | This course is intended to introduce the fundamentals of soil engineering. The course involves the study introduction to geotechnical Engineering; Concepts and fundamentals of soil classification and physical properties. Studying permeability of groundwater in soil. Studying stresses in soil, studying stresses in soil and settlement of soil due to excessive loads. |
| Textbook | 1- Principles of Geotechnical Engineering", by BRAJA M. DAS, FIFTH EDITION.<br>2- Fundamentals of Soil Mechanics", by Amr Radwan, 2007.<br>3- Handout Notes, prepared by the instructor. |
| References | 1- "Geotechnical Engineering: Principles and Practices", by Donald P. Coduto, (Hardcover - Jul 24, 1998).<br>2- Applied Analysis in Geotechnics", by FethiAzizi 2000, E&FN Spon, Taylor and Francis, London and New York. |
| Course learning Objectives (C.L.O.) | 1- Identification of Geotechnical Engineering.<br>2- Definition of the physical and mechanical properties of soil and discussing their relations.<br>3- Definition of soil classifications regarding different authorities and institutions.<br>4- Calculation of effective stresses and porewater pressure for deciding the excavation depth.<br>5- Determination of water Permeability and water seepage.<br>6- Permeability determination at field and laboratory.<br>7- Stresses in soil due to different types of load-bearing.<br>8- Calculation of settlement under concentrated loading and under the corner of flexible and rigid rectangular foundation. |

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|---|---|
| Descriptive Course Topics | 1- Introduction to Geotechnical Engineering.<br>2- Preliminary Definitions and Relations of soil.<br>3- Index Properties of soil<br>4- Concepts and fundamentals of soil classification and physical properties of soil.<br>5- Studying Water in Soil. Effective stresses and neutral stresses<br>6- Studying permeability of groundwater in soil.<br>7- Studying the aquifers<br>8- Studying stresses in soil<br>9- Studying settlement of soil due to excessive loads. |
| Experimental Work | Laboratory practice is performed at the rate of once a week (50 min per class). |
| Design Activities/Projects | Lectures, Laboratory. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Identification of Geotechnical Engineering. | [ a, k ] |
| Course learning objective-2 | Definition of the physical and mechanical properties of soil and discussing their relations. | [ k ] |
| Course learning objective-3 | Definition of soil classifications regarding different authorities and institutions. | [ a, k ] |
| Course learning objective-4 | Calculation of effective stresses and porewater pressure for deciding the excavation depth. | [ a, e, k ] |
| Course learning objective-5 | 1- Determination of water Permeability and water seepage.<br>2- Permeability determination at field and laboratory | [ a, b, e, k ] |
| Course learning objective-6 | Stresses in soil due to different types of load-bearing. | [ a, b, e, k ] |
| Course learning objective-7 | Calculation of settlement under concentrated loading and under the corner of flexible and rigid rectangular foundation. | [ a, b, e, k ] |

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|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 80 % |
| | Engineering design | 20 % |

Course Syllabus

| Course Code | CE 332 | | | |
|---|---|---|---|---|
| Course Title | Geotechnical Engineering (2) | | | |
| Year / Level | 3 / 7 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | 3 | - |
| Prerequisites | CE 231 | | | |

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|---|---|
| Course Description | This course provides the essential items to evaluate the shear strength of soil and its practical application for some civil works such as: Lateral earth pressure, Bearing capacity, stability of slopes, that is besides, the site investigation. |
| Textbook | 4- Principles of Geotechnical Engineering", by BRAJA M. DAS, FIFTH EDITION.<br>5- Fundamentals of Soil Mechanics", by Amr Radwan, 2007.<br>6- Handout Notes, prepared by the instructor. |
| References | 3- Applied Analysis in Geotechnics", by FethiAzizi 2000, E&FN Spon, Taylor and Francis, London.<br>4- Rheology and Soil Mechanics, by Keedwell, M.J., (ElSevier Applied science publishers, 1984). |
| Course learning Objectives (C.L.O.) | 9- Knowledge and understanding the meaning of shear strength.<br>10- Understanding the methods of determining the soil shear strength parameters.<br>11- Evaluation the shear strength of soil under various loading conditions.<br>12- Discussing the overall view of effect shear principals on various practical civil engineering problems.<br>13- Understanding the lateral earth pressure.<br>14- Analytical and graphical methods for lateral earth pressures<br>15- Introduction to site investigation and understanding the bearing capacity.<br>16- Methods of soil exploration and boring works<br>17- Determination the bearing capacity of soil.<br>18- Evaluation of plate load data.<br>19- Studying the analysis of stability of slopes.<br>20- Evaluation of slope satiability.<br>21- Lateral earth pressure practical applications.<br>22- Transform the skillful of evaluating the relationship between the distress of various civil engineering works and the soil shear strength under various loading conditions. |

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|---|---|
| Descriptive Course Topics | 1- Introduction to shear failures and determination of the soil shear strength parameters.<br>2- Shear strength of soil under various loading conditions.<br>3- Lateral earth pressure.<br>4- Analytical and graphical methods for lateral earth pressures<br>5- Introduction to site investigation and understanding the bearing capacity.<br>6- Methods of soil exploration and boring works<br>7- Determination the bearing capacity of soil.<br>8- Plate load test.<br>9- Analysis of stability of slopes.<br>10- Lateral earth pressure practical applications. |
| Experimental Work | Laboratory practice is performed at the rate of three times a week (180 min per class). |
| Design Activities/Projects | Lectures, Laboratory. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Understanding of the meaning of shear strength. | [ a, k ] |
| Course learning objective-2 | Understanding the methods of determining the soil shear strength parameters. | [ a, b ] |
| Course learning objective-3 | Evaluation the shear strength of soil under various loading conditions. | [ a, k ] |
| Course learning objective-4 | Discussing the overall view of effect shear principals on various practical civil engineering problems. | [ a, e, k ] |
| objective-5 | Understanding the lateral earth pressure. | [ a, b ] |
| Course learning objective-6 | Analytical and graphical methods for lateral earth pressures | [ a, b, e, k ] |
| Course learning objective-7 | Introduction to site investigation and understanding the bearing capacity. | [ a, b, e, k ] |
| Course learning objective-8 | Methods of soil exploration and boring works | [ a, b] |
| objective-9 | Determination the bearing capacity of soil. | [ a, b, e, k ] |
| objective-10 | Evaluation of plate load data. | [ a, b, e, k ] |
| Course learning objective-11 | Studying the analysis of stability of slopes. | [ a, b, e, k ] |
| objective-12 | Evaluation of slope satiability. | [ a, b, e, k ] |
| objective-13 | Lateral earth pressure practical applications. | [ a, b, e, k ] |
| Course learning objective-14 | Transform the skillful of evaluating the relationship between the distress of various civil engineering works and the soil shear strength under various loading conditions. | [ a, b, e, k ] |

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|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 80 % |
| | Engineering design | 20 % |

Course Syllabus

| Course Code | CE 433 | | | |
|---|---|---|---|---|
| Course Title | Foundation Engineering | | | |
| Year / Level | 3 / 8 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | - | 2 |
| Prerequisites | CIE 317 & CIE 332 | | | |

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|---|---|
| Course Description | This course is intended to introduce the fundamentals of Foundation Engineering. The course involves introduction to Foundation Engineering types; Concepts and fundamentals of shallow and deep foundations. Bearing capacity of shallow foundations in addition to studying the factors affecting bearing capacity; immediate and consolidation settlement of shallow foundations; mat foundations; analysis, design, and installation of pile foundations; capacity and settlement of single piles and pile groups; drilled piers and caissons. |
| Textbook | 7- "Foundation Design", by Abd El-Rahman Omar Hindi, 2008 |
| References | 5- "Principles of foundation engineering", by Das B.M., 2006<br>6- "Foundations of Engineering", by Mark Holtzapple and W. Reece. |
| Course learning Objectives (C.L.O.) | 23- Understanding the site exploration and geotechnical engineering report.<br>24- Calculation of bearing capacity of soil.<br>25- Studying the factors affecting the bearing capacity of soil.<br>26- Determination of immediate settlement of shallow foundations.<br>27- Definition of shallow foundations; isolated, combined, mat, and strip footing, analysis and design them.<br>28- Definition of deep foundations; single piles, pile groups, analysis and design them.<br>29- Design the mat foundations<br>30- Studying the installation of pile foundations<br>31- Calculation of capacity and settlement of single piles and pile groups<br>32- Understanding the drilled piers and caissons. |

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|---|---|
| Descriptive Course Topics | 1- Soil Exploration<br>2- Bearing capacity and settlement<br>3- Shallow Foundations<br>4- Footing subjecting to moment<br>5- Combined footing<br>6- Pile foundation<br>7- Pile deriving<br>8- Pier and caisson foundation |
| Experimental Work | This course does not include experimental work. |
| Design Activities/Projects | Lectures, Tutorials. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Understanding the site exploration and geotechnical engineering report. | [ a, e, k ] |
| Course learning objective-2 | Calculation of bearing capacity of soil. | [ a, k ] |
| Course learning objective-3 | Studying the factors affecting the bearing capacity of soil. | [ a, k ] |
| Course learning objective-4 | Determination of immediate settlement of shallow foundations. | [ a, e, k ] |
| Course learning objective-5 | Definition of shallow foundations; isolated, combined, mat, and strip footing, analysis and design them. | [ a, e, k ] |
| Course learning objective-6 | Definition of deep foundations; single piles, pile groups, analysis and design them. | [ a, b, k ] |
| Course learning objective-7 | Design the mat foundations | [ a, b, k ] |
| Course learning objective-8 | Studying the installation of pile foundations | [ a, b, k ] |
| Course learning objective-9 | Calculation of capacity and settlement of single piles and pile groups | [ a, b, k ] |
| Course learning objective-10 | Understanding the drilled piers and caissons. | [ a, b, k ] |

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|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 70 % |
| | Engineering design | 30 % |

Course Syllabus

| Course Code | CE 341 | | | |
|---|---|---|---|---|
| Course Title | Transportation Engineering (1) | | | |
| Year / Level | 3/7 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | 1 | - |
| Prerequisites | CE 282 | | | |

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|---|---|
| Course Description | Transportation as a system; human and vehicle characteristics; traffic flow characteristics; highway capacity analysis; highway control devices; public transportation; urban transportation planning; parking facilities; transportation safety; intelligent transportation system and computer applications; introduction to railway, waterway, airport and pipeline. |
| Textbook | Transportation Engineering- An Introduction C. JotinKhisty and B. Kent Lall, 3rd Edition, Prentice Hall, 2003. |
| References | 1- Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, 2nd Edition, PWS Publishing Company, 1997.<br>2- Transportation Research Board, 2000. |
| Course learning Objectives (C.L.O.) | 1. Recognize the function and scope of Transportation Engineering<br>2. Identify Driver, User, vehicle and Roadway characteristics and Analyze the interaction among the parameters.<br>3. Analyze Speed-Volume-Density, Perform Highway Capacity Analysis and Describe Traffic Control System Components and Devices<br>4. Recognize problems and issues of Parking, Accident, Public Transport and ITS<br>5. Describe Transportation Planning Process and apply Traffic Forecasting Methods. Prepare Transportation Impact Analysis Report.<br>6. Describe basic components of Railway, Waterway, Airport and Pipeline. |

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|---|---|
| Descriptive Course Topics | 1 - Introduction, Transportation system components, Transport modes, specialties in transportation engineering.<br>2 - Characteristics of drivers and vehicles<br>3 - Traffic flow theory<br>4- Highway Capacity Analysis<br>5 - Intersection control and design |

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|---|---|
| | 6 - Parking Study<br>7 - Public transportation<br>8 - Transportation planning<br>9 - Transportation safety<br>10 - Intelligent transportation system<br>11 - Computer application<br>12- Introduction to Railway, Waterway, Airport and Pipeline |
| Experimental Work | This course does not include experimental work. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Recognize the function and scope of Transportation Engineering | [ a, e , g ] |
| Course learning objective-2 | Identify Driver, User, vehicle and Roadway characteristics and Analyze the interaction among the parameters. | [ g ] |
| Course learning objective-3 | Analyze Speed-Volume-Density, Perform Highway Capacity Analysis and Describe Traffic Control | [ a, e ] |
| Course learning objective-4 | Recognize problems and issues of Parking, Accident, Public Transport and ITS | [ a, j, k ] |
| Course learning objective-5 | Describe Transportation Planning Process and apply Traffic Forecasting Methods. Prepare Transportation Impact Analysis Report | [ f , j, k ] |
| Course learning objective-6 | Describe basic components of Railway, Waterway ,Airport and Pipeline. | [ g , j, k ] |

| | | |
|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 80 % |
| | Engineering design | 20 % |

## Course Syllabus

| Course Code | CE 342 | | | |
|---|---|---|---|---|
| Course Title | Transportation Engineering (2) | | | |
| Year / Level | 3/8 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | - | 2 |
| Prerequisites | CE 341 | | | |

| | |
|---|---|
| **Course Description** | Highway location. Characteristics of driver. Vehicle. Road and traffic. Geometric design. Pavement design. |
| **Textbook** | **Transportation Engineering- An Introduction C. JotinKhisty and B. Kent Lall, 3rd Edition, Prentice Hall, 2003.** |
| **References** | 1- Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, 2nd Edition, PWS Publishing Company, 1997.<br>2- Transportation Research Board, 2000.<br>3- "Highway Engineering" PaulH. Wright and Karen K.Dixon, 7th Edition, Johm Wiley & Sons, Inc. |
| **Course learning Objectives (C.L.O.)** | 1. Understand driver characteristics that influence the highway design.<br>2. Recognize vehicles performance elements influencing highway design.<br>3. Understand traffic characteristics that influence traffic volume and level of service.<br>4. Determine the required number of traffic lane for a given traffic volume.<br>5. Recognize the importance of right-of-way for urban and rural highways.<br>6. Introduce the important highway geometric design characteristics.<br>7. Design of horizontal and vertical alignment elements.<br>8. Implementing the safety requirement in designing the elements of horizontal and vertical alignment.<br>9.Recognize the functional and operational characteristics of intersections and interchanges.<br>10. Understand the importance of parking facility and recognize the effect of parking arrangement in utilizing available space.<br>11. Recognize the importance of service drainage and identify methods used to control erosion in highway drainage. |

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| Descriptive Course Topics | 1. Driver, Pedestrian, and Vehicle Characteristics<br>2. Traffic Flow Characteristics<br>3. Geometric Design of Highways<br>4. Intersections, Interchanges, and Parking Facilities<br>5. Highway Drainage |
| Experimental Work | This course does not include experimental work. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Understand driver characteristics that influence the highway design. | [ a, e , g ] |
| Course learning objective-2 | Determine the required number of traffic lane for a given traffic volume. | [ a , g ] |
| Course learning objective-3 | Design of horizontal and vertical alignment elements. Implementing the safety requirement in designing the elements of horizontal and vertical alignment. | [ a, j , e ] |
| Course learning objective-4 | Recognize the functional and operational characteristics of intersections and interchanges | [ a, j, k ] |
| Course learning objective-5 | Understand the importance of parking facility and recognize the effect of parking arrangement in utilizing available space. | [ f , j, k ] |
| Course learning objective-6 | Recognize the importance of service drainage and identify methods used to control erosion in highway drainage. | [ g , j, k ] |

| | | |
|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 60 % |
| | Engineering design | 40 % |

Course Syllabus

| | | | | |
|---|---|---|---|---|
| Course Code | CE 443 | | | |
| Course Title | Pavement Design | | | |
| Year / Level | 4/9 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | 1 | 1 |
| Prerequisites | CE 342 | | | |

| | |
|---|---|
| Course Description | Pavement design. Highway materials. Construction. Drainage and soil improvement. Highway maintenance. Operation and road safety. Pavement management system. Computer applications. |
| Textbook | "Highway Engineering" PaulH. Wright and Karen K.Dixon, 7th Edition, Johm Wiley & Sons, Inc. |
| References | 1- Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, 2nd Edition, PWS Publishing Company, 1997. |
| Course learning Objectives (C.L.O.) | 1. Recognize the required aggregate properties to produce high quality paving material.<br>2. Conduct standard tests on asphalt binder to verify compliance with specification.<br>3. Design paving mixture according to local design practice.<br>4. Design flexile pavement structure using AASHTO design method.<br>5. Design Rigid pavement structure.<br>6. Recognize the different activities and methods used in highway construction.<br>7. Identify common cause of some pavement distresses and corrective activities. |

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|---|---|
| Descriptive Course Topics | 1.Design of High Quality Paving Materials<br>2. Design of Flexible Pavements<br>3. Design of Rigid Pavements<br>4. Highway Construction<br>5. Highway Maintenance and Rehabilitation |
| Experimental Work | 1. Carry out the quality of mineral aggregates through laboratory experiments such as flakiness tests, crushing value tests, hardness test,<br>impact test, angularity number of aggregation.<br>2. Perform bitumen tests to determine bitumen quality, type and grades.<br>3. Produce trial mixes of plastic concrete.<br>4. Carry out Marshall stability and flow tests.<br>5. Carry out Super pave tests. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Recognize the required aggregate properties to produce high quality paving material | [ a, b , c ] |
| Course learning objective-2 | Conduct standard tests on asphalt binder to verify compliance with specification. | [ b ] |
| Course learning objective-3 | Design paving mixture according to local design practice. | [ a, b ] |
| Course learning objective-4 | Design Rigid pavement structure. | [ a, e, k ] |
| Course learning objective-5 | Recognize the different activities and methods used in highway construction. | [ a , e, k ] |
| Course learning objective-6 | Identify common cause of some pavement distresses and corrective activities. | [ a , b, k ] |

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|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 60 % |
| | Engineering design | 40 % |

Course Syllabus

| Course Code | CE 251 | | | |
|---|---|---|---|---|
| Course Title | Fluid Mechanics | | | |
| Year / Level | 2 / 5 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | 2 | 1 |
| Prerequisites | PHYS 102 | | | |

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|---|---|
| Course Description | This course introduces an introduction to fluid mechanics. Through this course student will be able to emphasize the fundamental concepts and problem solving techniques. This course will cover fluid properties, fluid statics, fluid kinematics, control volume analysis, dimensional analysis, Flow through Pipes, and the applications of continuity, energy, and momentum equations. The student will be able to carry out the dimensional analysis to problems and able to use the similarities techniques. in addition, design of open channel cross section for different shapes, best hydraulic sections, specific energy, critical flow, hydraulic jump, flow measurements, gradually varied flow, pump and turbines will be covered. |
| Textbook | Munson, Young, and Okiishi, Fundamentals of Fluid Mechanics 6, Ed., Wiley, 2009, ISBN 9780470262849. |
| References | 1. J.A. Roberson and C.T. Crowe, Engineering Fluid Mechanics, 7th Ed.,Houghton Mifflin<br>2. Open Channel Hydraulics, V.T. Chow, Mc-Graw Hill, ISBN 978-0670107762.<br>3. 2. D.F. Young, B.R. Munson, T.H. Okiishi, A Brief Introduction to Fluid Mechanics, 2nd Ed., John Wiley & Sons, Inc |
| Course learning Objectives (C.L.O.) | 1. To Discover fluid properties, dimensions, and units[a,k] Application<br>2. To Describe hydraulic pressure devices exerted by non-compressible fluid on a submerged object, and the location and magnitude of the resultant force of the fluid on the object [a,b,e,k] (Evaluation)<br>3. To create Buoyancy principle and accelerated masses (b, a) (Synthesis)<br>4. To develop the principles of continuity, momentum and energy equations [e, b, a] (Synthesis)<br>5. To develop experiments to measure fluid properties in a actual environmental problem [b,e,g] (Synthesis)<br>6. To apply dimensional analysis and similarity techniques to different problems [a,k], (Synthesis)<br>7. Classification of flow and computation of velocity in open channel (a, k) |

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|---|---|
| | 8. Derivation of most economical channel sections of different geometry[a, k]<br>9. Calculation of specific energy head, alternate depths, critical depth, and hydraulic jump [a,k]<br>10. Classification of turbines and pump and analysis of flow within turbines and pumps. [a, k] |

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|---|---|
| Descriptive Course Topics | 1- Fundamental basics (Dimensions and units, Fluid properties- density- specific weight- specific gravity)<br>2- Pressure devices measurements - Hydrostatic pressure force- buoyancy force- Introduction to fluid kinematics )<br>3- Continuity equations, energy equation and momentum equation and applications<br>4- Dimensional analysis – methods for dimensional analysis- Hydraulic modeling – advantage , disadvantages, type of similarity, application.<br>5- Open Channel Flow- Different types of channels, different types of flow (uniform/non-uniform, steady/unsteady), computation of velocity, most economical channel section, specific energy, critical flow, hydraulic jump, gauging flumes, Non-uniform flow equation, back water and draw down curve<br>6- Hydraulic Measurement- Stage or water level measurements, velocity measurement and discharge measurement by area velocity method and dilution technique, Stage discharge relationship, shifting control.<br>7- Flow Through Pipes- Flow through Pipes mainly emphasized on head-loss in pipe flow, flow through parallel and series connection and pipe network analysis.<br>8- Hydraulic Pumps and Turbines- different types of turbines (inward flow, outward flow and axial flow) and pumps (centrifugal pumps), different inlet and outlet vector diagrams of flow, and hydraulic efficiency. |
| Experimental Work | Fluid Properties- Calibration of Burdon Gauge- hydrostatic pressure force- momentum force- pipe losses- specific energy- hydraulic jump- pumps |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | To Discover fluid properties, dimensions, and units | [ a, k ] |
| C.L.O.2 | To Describe hydraulic pressure devices exerted by non-compressible fluid on a submerged object, and the location and magnitude of the resultant force of the fluid on the object | [ a, b, e, k ] |
| C.L.O.3 | To create Buoyancy principle and accelerated masses | [ a, b ] |
| C.L.O.4 | To develop the principles of continuity, momentum and energy equations | [ a, b, e ] |
| C.L.O.5 | To develop experiments to measure fluid properties in a actual environmental problem | [ b, e, g] |
| C.L.O.6 | To apply dimensional analysis and similarity techniques to different problems | [ a, k ] |
| C.L.O.7 | Classification of flow and computation of velocity in open channel | [ a, k ] |
| C.L.O.8 | Derivation of most economical channel sections of different geometry | [ a, k ] |
| C.L.O9 | Calculation of specific energy head, alternate depths, critical depth, and hydraulic jump | [ a,k] |
| C.L.O.10 | Classification of turbines and pump and analysis of flow within turbines and pumps | [ a, k ] |

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|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 80 % |
| | Engineering design | 20 % |

Course Syllabus

| Course Code | CE 352 | | | |
|---|---|---|---|---|
| Course Title | Hydrology and Water Resources Engineering | | | |
| Year / Level | 3 / 8 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | 2 | 1 |
| Prerequisites | CE 251 | | | |

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| Course Description | The course has been presented with six chapters. The hydrologic Cycle and World Water Balance are covered in Chapter 1. Chapter 2 is dealt with Measurement and Analysis of Precipitation. Chapter 3 covers Losses from the Precipitation- Infiltration, Evaporation and Evapo-transpiration. In Chapter 4, Surface Flow Yield from a Catchment is covered. Development of Direct Run-off Hydrograph and Unit Hydrograph are dealt in Chapter 5. Ground Water and Conjunctive use of Ground and Surface Water covered in Chapter 6. |
| Textbook | Subramanya, K., Engineering Hydrology, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., ISBN 978 0070107762 |
| References | 1. Applied Hydrology, V.T.Chow, International Edition, ISBN 978-0071001748<br>2. Handbook of Hydrology, David Maidment, International Edition,ISBN 978-0070397323 |
| Course learning Objectives (C.L.O.) | 1. Analysis of Hydrologic Cycle, Water budget equation and water balance studies.<br>2. Computation of average rainfall and depth-area-duration relationship,<br>3. Calculation of infiltration, infiltration capacity values and infiltration indices<br>4. Methods of Evaporation estimation and Measurement of reservoir evaporation<br>5. Computation of Evapotranspiration<br>6. Development of flow duration curve and flow mass curve.<br>7. Estimation of Direct Runoff and Direct Runoff hydrograph<br>8. Derivation of Unit Hydrograph<br>9. Computation of ground water yield from a well in confined and unconfined aquifer.<br>10. Conjunctive use of ground and surface water for an irrigation project. |

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|---|---|
| Descriptive Course Topics | 1- Hydrologic Cycle and World Water Budget- Introduction, Hydrologic Cycle, World water Inventory, History of Hydrology, Applications in Engineering<br>2- Measurement and Analysis of Precipitation- Forms of precipitation, Measurement, Raingauge Network, Preparation of Data, Mean Precipitation over an area, Depth-area-duration relationships<br>3- Losses from Precipitation- (1) Evaporation:- Evaporation process, Emperical Evaporation Formula, Reservoir Evaporation. (2) Evapotranspiration:- Transpiration, Evapotranspiration, Measurement of Evapotranspiration (3) Infiltration:- Infiltration Process, Infiltration Capacity, Measurement of Infiltration, Infiltration Indices.<br>4- Surface Flow Yield- Hydrograph, Yield (Annual Runoff Volume), Flow duration Curve, Flow Mass Curve<br>5- Development of Direct Run-off Hydrograph and Unit Hydrograph –<br>Factors affecting Flood Hydrograph, Components of Hydrograph, Base Flow Separation, Effective Rainfall, Unit Hydrograph, Derivation of Unit Hydrograph.<br>6- Ground Water and Conjunctive Use of Surface and Ground Water- Introduction, Forms of Subsurface Water, Aquifer Properties, Wells, Yields through Well, Conjunctive use, Estimation and use of Surface and Ground Water Potential. |
| Experimental Work | No laboratory. Require to Develop. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | 1. Analysis of Hydrologic Cycle, Water budget equation and water balance studies. | [ a, k ] |
| C.L.O.2 | 2. Computation of average rainfall and depth-area-duration relationship | [ a,k ] |
| C.L.O.3 | 3. Calculation of infiltration, infiltration capacity values and infiltration indices. | [ a, k ] |
| C.L.O.4 | 4. Methods of Evaporation estimation and Measurement of reservoir evaporation . | [ a, e ] |
| C.L.O.5 | 5.Computation of Evapotranspiration | [ a, e ] |
| C.L.O.6 | 6. Development of flow duration curve and flow mass curve. | [ a,b,k ] |
| C.L.O.7 | 7. Estimation of Direct Runoff and Direct Runoff hydrograph | [ a,e ] |
| C.L.O.8 | 8. Derivation of Unit Hydrograph . | [ b,e,k ] |
| C.L.O9 | 9. Computation of ground water yield from a well in confined and unconfined aquifer. | [ a,e] |
| C.L.O.10 | 10. Conjunctive use of ground and surface water for an irrigation project. | [ b,e,k ] |

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|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 80 % |
| | Engineering design | 20 % |

Course Syllabus

| Course Code | CE 261 | | | |
|---|---|---|---|---|
| Course Title | Environnemental Microbiology | | | |
| Year / Level | 2/6 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | ENG 102 - CHEM 101 | | | |

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|---|---|
| Course Description | This class provides a general introduction to the diverse roles of microorganisms in natural and artificial environments. It will cover topics including: cellular architecture, energetics, and growth; evolution and gene flow; population and community dynamics; water and soil microbiology; biogeochemical cycling; and microorganisms in biodeterioration and bioremediation..The course has been presented in five chapters as below:<br>Chapter 1 : Introduction to Environmental microbiology<br>Chapter 2 : Microbial diversity, Growth & Metabolism<br>Chapter 3 : Industrial microbiology<br>Chapter 4 : Contaminant biodegradation<br>Chapter 5 : Microbiology of Engineered Environmental Systems |
| Textbook | Madigan, M., J. Martinko, and J. Parker. *Brock Biology of Microorganisms*. 10th ed. New York: Prentice Hall, 2002. ISBN: 0130662712. |
| References | • 1. Brock Biology Of Microorganisms, 13th Ed, by Madigan et al., Prentice Hall, 2012.<br>• 2. MICROBIOLOGY: An Evolving Science, 2nd Ed. By Slonczewski and Foster, Norton Publishing, 2011 |
| Course learning Objectives (C.L.O.) | 1. Scope of microbiology. Microbial characterization : prokaryotes and<br>eukaryotes cell structure.<br>2.Microbial nutrition and cultivation, Microbial growth control : principles, physical and chemical agents<br>3. Microbial ecology : air, water, and soil microbiology<br>4.Microbial metabolisms. Microbial genetics : inheritance and variability, genetics engineering, Work mechanism and inhibition of enzymatic molecules, control of enzyme activities, enzyme kinetics<br>5.Microbiological application in food processing industries, beverages industries etc.<br>6. Aerobic respirations, diversity of aerobic metabolism, fermentation, anaerobic respirations, anaerobic food chains, autotrophy, regulation of activity.<br>7. Detoxification of inorganic and organic pollutants by microorganisms<br>8.Biodeterioration, solid and liquid wastes, bioremediation, |

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|---|---|
| | biodegradation, biological pest control.<br>9.Microbes and diseases : resistance, host-parasite interactions, immune response, antibiotics and other chemical agents.<br>10.Evaluate the feasibility of bioremediation strategies to mitigate adverse ecological/health impacts of organic pollutants in environmental media and engineer appropriate controls to prevent undesired microbial infestation. |

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| Descriptive Course Topics | 1: Introduction to Environmental microbiology- Scope, syllabus, requirements, history of (environmental) microbiology.<br>2: Microbial diversity, Growth & Metabolism- Aerobic respirations, diversity of aerobic metabolism, fermentation, anaerobic respirations, anaerobic food chains, autotrophy, regulation of activity.<br>3: Industrial microbiology -microbiological application for industries, food microbiology.<br>4: Contaminant biodegradation-Biodeterioration, solid and liquid wastes, bioremediation, biodegradation, biological pest control.<br>5: Microbiology of Engineered Environmental Systems- Predict long-term sequence of microbially-mediated transformation reactions following release of an organic material into an environmental system. |
| Experimental Work | No laboratory. |
| Design Activities/Projects | This course include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | 1. Metabolism, anabolism, key enzymes, biosynthesis, nutrient assimilation, fuelling reactions, energetics. | [ a,k ] |
| C.L.O.2 | 2. Chemical composition of microbial cells, cell structure, | [ a,k ] |
| C.L.O.3 | 3. Genetic elements, mutation and genetic exchange, | [ a, k ] |
| C.L.O.4 | 4. Use of tables and nomograms for Hydraulic computations for the Design of sewers | [ a, k ] |
| C.L.O.5 | 5. Microbiological industry development, scope of microbiological industries, | [ a, e ] |
| C.L.O.6 | 6. Microbes in mine industries, microbes in waste treatment industries. | [ a,k ] |
| C.L.O.7 | 7. Role of microorganisms in petroleum biodegradation | [ a,e,k ] |
| C.L.O.8 | 8. Geochemical cycling of elements, climate control, detoxification of pollutants | [ a,e,k ] |
| C.L.O9 | 9. Different methods for the characterization of microbial communities (microscopic, molecular, biochemical) and decide which one to apply in order to attempt at solving major open problems such as reducing drug resistance in biofilms, | [ a,e] |
| C.L.O.10 | 10. Optimizing landfills degradation of waste and use of landfill byproducts such as methane as alternative energy. | [e,k ] |

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| Course Contribution to Professional Branches | Engineering science | 80 % |
| | Engineering design | 20 % |

Course Syllabus

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|---|---|---|---|---|
| Course Code | CE 462 | | | |
| Course Title | Sanitary Engineering | | | |
| Year / Level | 4/10 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | | 2 |
| Prerequisites | CE 261 | | | |

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|---|---|
| Course Description | Water quality - sources of water - water collection - water purification - water distribution - water desalination - sewerage works - sources of sewage - sewerage collection works sewerage - treatment works - disposal of sewage |
| Textbook | Mines,R., Lackey,L.,"Introduction to Environmental Engineering", Prentice-Hall,2009 |
| References | 1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw- Hill Publication,, International Edition, ISBN 0070418780<br>2. Municipal and Rural Sanitation. By Victor M. Ehlers and Ernest W. Steel. New York: McGraw Hill Book Company, 1927. Pp. xi, 448 |
| Course learning Objectives (C.L.O.) | 1. Understanding of basics of sanitary engineering, water supply and pollution<br>2. Ability to calculate water usage and predict future usage based on population forecast<br>3. Analyze and design water distribution system and sewer system<br>4. Design water purification and waste water treatment systems |

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| Descriptive Course Topics | Definition of environmental engineering and pollution of water - water sources - water quality - water consumption - design period of water works - population studies and forecasting - water collection - ground water - surface water - purification of water - sedimentation - coagulation - filtration - water disinfection - demineralization of water - water desalination - water distribution works - High lift pumping station - pipe networks - elevated storage tanks - sewer works - sewer systems - collection of wastewater composition and characteristics of sewage - treatment works - primary treatment works - biological treatment –trickling filters - activated sludge treatment - sewage disposal works - sludge treatment and disposal . |
| Experimental Work | No Lab |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | Understanding of basics of sanitary engineering, water supply and pollution | a,e,k |
| C.L.O.2 | Ability to calculate water usage and predict future usage based on population forecast | a,e,k |
| C.L.O.3 | Analyze and design water distribution system and sewer system | c, e |
| C.L.O.4 | Design water purification and waste water treatment systems | c, e |

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|---|---|---|
| Course Contribution to Professional Branches | Engineering science | 60 % |
| | Engineering design | 40 % |

Course Syllabus

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|---|---|---|---|---|
| Course Code | CE 371 | | | |
| Course Title | Construction Engineering | | | |
| Year / Level | 3 / 8 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | - | 2 |
| Prerequisites | CE 317 | | | |

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|---|---|
| Course Description | Types, selection, utilization, and unit cost of construction equipment regarding soil compaction and stabilization, excavation and earthmoving operations. Formwork design. detailed cost estimation for civil works. project control. |
| Textbook | - "Construction Planning, Equipment, and Methods. 7th edition. By R.L. Peurify and C. J. Schexnayder. McGraw Hill, 2006. |
| References | - Construction Estimating Using Excel. Steven J. Peterson, Prentice Hall, 2007. |
| Course learning Objectives (C.L.O.) | 1) Describe the characteristics of certain construction equipment e.g. Dozers, Scrapers, Compactors, Excavating equipment, and Trucks.<br>2) Calculate the productivity and unit cost of using certain construction equipment e.g. Dozers, Scrapers, Compactors, Excavating equipment, and Trucks.<br>3) Design a wooden formwork system for a slab, wall and column.<br>4) Prepare detailed cost estimation for civil works.<br>5) Evaluate the performance of a project using Earned Value metrics.<br>6) Practice long life learning through identifying new course topics, locating sources of information, and reporting the results. |

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| Descriptive Course Topics | 1- Construction Productivity<br>2-Labor & EQP cost<br>3. Compaction and Stabilization Equipment<br>4. Machine Equipment Power Requirements<br>5. Dozers, Excavators, Compactors, Graders & Hauling<br>6. Q.S & detailed estimate of Civil Works<br>7. Project Control<br>8. Formwork Design<br>9. Life Long Learning |
| Experimental Work | This course does not include experimental work. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Describe the characteristics of certain construction equipment e.g. Dozers, Scrapers, Compactors, Excavating equipment, and Trucks | [ e, i, k ] |
| Course learning objective-2 | Calculate the productivity and unit cost of using certain construction equipment e.g. Dozers, Scrapers, Compactors, Excavating equipment, and Trucks | [ k ] |
| Course learning objective-3 | Design a wooden formwork system for a slab, wall and column | [ b, k ] |
| Course learning objective-4 | Prepare detailed cost estimation for civil works. | [ i, k ] |
| Course learning objective-5 | Evaluate the performance of a project using Earned Value metrics. | [ i, k ] |
| Course learning objective-6 | Practice long life learning through identifying new course topics, locating sources of information, and reporting the results. | [ a, i ] |

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| Course Contribution to Professional Branches | Engineering science | 90 % |
| | Engineering design | 10 % |

Course Syllabus

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|---|---|---|---|---|
| Course Code | CE 472 | | | |
| Course Title | Construction Management | | | |
| Year / Level | 4 / 10 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 2 | - | 2 |
| Prerequisites | CE 371 | | | |

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|---|---|
| Course Description | Characteristics of Construction Industry; project delivery systems. the design and construction process. construction contracting. construction planning. cash flow. Conceptual cost estimation. Quality and Safety Management.. |
| Textbook | "Construction Management", Daniel W. Halpin, 3rd Edition, 2006, John Wiley & Sons, New York. |
| References | 1-Ghalot, P.S., Dhir,D.M., Construction Planning and Management, Wiley Eastern<br>.Limited,1992<br>2- Chitkara,K.K., Construction Project Management¸ Tata McGraw Hill .<br>‹..Publishing Co, Ltd New Delhi,998<br>3 -Punmia,B,C., Project Planning and Control with PERT and CPM, Laxmi .<br>‹PublicationsNew Delhi,1987 |
| Course learning Objectives (C.L.O.) | 1. Recognize the construction industry environment including its characteristics, parties involved, legal structure, functions of management and the different types of construction projects.<br>2.Recognize the different activities involved in the development stages of construction projects.<br>3. Develop schedules and cash flow for construction projects using the critical path method (CPM).<br>4. Recognize types of construction estimates.<br>5.Recognize professional issues such as quality management, material management process, construction safety, and Value Engineering Technique.<br>6. Understand professional and ethical responsibility. |

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| Descriptive Course Topics | 1. The Construction Environment<br>2. Legal Structure and Functions of Management<br>3. Design phase<br>4. Bidding phase<br>5. Saudi Tender Regulation<br>6. Construction Phase<br>7. Quality Management, Construction Safety, and Value Engineering<br>8. Engineering Ethics<br>9. Project planning<br>10. Project Scheduling using CPM<br>11. Resource Management<br>12. Project Cash Flow |
| Experimental Work | This course does not include experimental work. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | 1.Recognize the construction industry environment including its characteristics, parties involved, legal structure, functions of management and the different types of construction projects. | [ a, f, k ] |
| Course learning objective-2 | 2.Recognize the different activities involved in the development stages of construction projects. | [ a,k ] |
| Course learning objective-3 | 3.Develop schedules and cash flow for construction projects using the critical path method (CPM). | [ a, k ] |
| Course learning objective-4 | 4. Recognize types of construction estimates. | [ a, f, k ] |
| Course learning objective-5 | 5. Recognize professional issues such as quality management, material management process, construction safety, and Value Engineering Technique. | [ a, f ] |
| Course learning objective-6 | 6.Understand professional and ethical responsibility. | [ a, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **100 %** |
| | Engineering design | **00 %** |

Course Syllabus

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|---|---|---|---|---|
| Course Code | CE 281 | | | |
| Course Title | Surveying (1) | | | |
| Year / Level | 2 / 6 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 2 | 1 | 2 | 1 |
| Prerequisites | MATH 212 | | | |

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|---|---|
| Course Description | This course presents the fundamentals of surveying with particular emphasis on instrumental procedures and simple computation methods. Methods employed for distance measurement, vertical and horizontal control, leveling, and measurement of angles, bearing determination, traverse closure, area determination, and construction layout are considered. |
| Textbook | Elementary Surveying: An Introduction to Geomatics", (12th Edition) by Charles D. Ghilani and Paul R. Wolf (Hardcover - Jan 10, 2008). |
| References | 1- Surveying (5th edition), McCormacm Jack C., Jack C. McCormac, 2003, Publisher: John Wiley & Sons Inc.<br>2- Surveying: With Construction Applications (6th edition), Barry F. Kavanagh, 2008, Publisher: Prentice Hall. |
| Course learning Objectives (C.L.O.) | 1. Identify the fundamental principles of land surveying science.<br>2. Classify sources and types of errors in surveying measurements.<br>3. Apply the correction formulae to the measured distances using the tape.<br>4. Compute the unknown survey parameters such as points coordinates , the reduced levels of the ground points, the area of a closed traverse and the related volumes and earthworks.<br>5. Operate the automatic and digital level and digital Theodolite in field measurements.<br>6. Measure the horizontal and vertical angles in a closed traverse using digital Theodolite.<br>7. Evaluate the horizontal and vertical distance using stadia method. |

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| Descriptive Course Topics | 1- Basic and Fundamental of Surveying.<br>Introduction - Units of Measurement - International System of Units (SI) - Types and Branches of Surveying - Maps scales.<br><br>2- Theory of Errors in Observations<br>Direct and Indirect Observations - Errors in Measurements - Mistakes - Sources of Errors in Making Observations - Types of Errors - Precision and Accuracy - Eliminating Mistakes and Systematic Errors - Probability - Most Probable Value - Residuals - Measures of Precision - Interpretation of Standard Deviation - Weights of Observations. |

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|---|---|
| | 3- Distance Measurements<br>Introduction - Pacing - Odometer Readings - Optical Rangefinders - Tacheometry - Subtense Bar - Taping Equipment and Accessories - Taping on Level Ground - Horizontal Measurements on Sloping Ground - Slope Measurements - Sources of Error in Taping - Combined Corrections in a Taping Problem.<br><br>4- Angles, Azimuths and Bearings<br>Introduction - Units of Angle Measurement - Kinds of Horizontal Angles - Direction of a Line - Azimuths - Bearings - Comparison of Azimuths and Bearings - Computing Azimuths - Computing Bearings.<br><br>5- Leveling Survey<br>Definitions - Curvature and Refraction - Methods for Determining Differences in Elevation - Categories of Levels - Telescopes - Level Vials - Tilting Levels - Automatic Levels - Digital Levels - Tripods - Hand Level - Level Rods – Field Procedures and Computations - Carrying and Setting Up a Level - Differential Leveling - Profile Leveling - Grid, Cross-Section, or Borrow-Pit Leveling - Sources of Error in Leveling.<br><br>6- Theodolite Survey<br>Characteristics of Theodolites - Handling, Setting up, and Using a Theodolite - Observation of Horizontal and vertical Angles - Observation of Traverse Lengths - Selection of Traverse Stations - Traverse Field Notes - Referencing Traverse Stations - Angle Misclosure - Radial Traversing - Sources of Error in Traversing.<br><br>7- Traverse Computations<br>Balancing Angles - Computation of Preliminary Azimuths or Bearings - Departures and Latitudes - Departure and Latitude Closure Conditions - Traverse Linear Misclosure and Relative Precision - Traverse Adjustment - Rectangular Coordinates - Computing Final Adjusted Traverse Lengths and Directions - Mistakes in Traverse Computations.<br><br>8- Area Calculations<br>Introduction - Methods of Measuring Area - Area by Division Into Simple Figures - Area by Offsets from Straight Lines - Area by Coordinates - Area by Double-Meridian Distance Method - Area of Parcels with Circular Boundaries - Partitioning of Lands - Area by Measurements from Maps - Sources of Error in Determining Areas. |
| Experimental | 1- Alignment of a line on the ground. |

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| Work | 2- Measuring slope and horizontal distance by the tape.<br>3- Setting up the automatic and digital levels.<br>4- Differential and profile levelling using the method of collimation.<br>5- Measuring the height difference between survey points.<br>6- Setting up the digital Theodolite.<br>7- Measuring Horizontal angle by digital Theodolite.<br>8- Measuring Vertical angle by digital Theodolite.<br>9- Linear measurement using stadia method.<br>10- Gradient between two survey points (A & B).<br>11- Closed traverse.<br>12- Elevation of a high inaccessible point. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Identify the fundamental principles of land surveying science. | [ a, e ] |
| Course learning objective-2 | Classify sources and types of errors in surveying measurements. | [ a, e ] |
| Course learning objective-3 | Apply the correction formulae to the measured distances using the tape. | [ a, b, e ] |
| Course learning objective-4 | Compute the unknown survey parameters such as points coordinates the reduced levels of the ground points, the area of a closed traverse and the related volumes and earthworks. | [ a, e, k ] |
| Course learning objective-5 | Operate the automatic and digital level and digital Theodolite in field measurements. | [ a, b, k ] |
| Course learning objective-6 | Measure the horizontal and vertical angles in a closed traverse using digital Theodolite. | [ a, b, e ] |
| Course learning objective-7 | Evaluate the horizontal and vertical distance using stadia method. | [ a, e, k ] |

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| Course Contribution to Professional Branches | Engineering science | 75 % |
| | Engineering design | 25 % |

Course Syllabus

| Course Code | CE 382 | | | |
|---|---|---|---|---|
| Course Title | Surveying (2) | | | |
| Year / Level | 3 / 7 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 2 | 1 | 2 | 1 |
| Prerequisites | CE 281 | | | |

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| Course Description | In this course the main subject of study will be the calculation and methods for the layout of individual control points for the construction of roads and highways based on design requirements. It covers the calculation and layouts of simple circular curves, compound and reverse curves, and vertical curves. This course also presents the fundamental principles of photogrammetry. It covers the photogrammetric optics metric camera calibration, geometry of aerial photographs; photo coordinates measurements and transformation, stereoscopic viewing, parallax and orientations. Flight planning and cost estimation in aerial mapping work are considered. This course also presents the fundamental principles of GPS positioning. |
| Textbook | Elementary Surveying: An Introduction to Geomatics", (12th Edition) by Charles D. Ghilani and Paul R. Wolf (2008). |
| References | 1- Surveying (5th edition), McCormacm Jack C., Jack C. McCormac, 2003, Publisher: John Wiley & Sons Inc.<br>2- Surveying: With Construction Applications (6th edition), Barry F. Kavanagh, Publisher: Prentice Hall,(2010). |
| Course learning Objectives (C.L.O.) | By the completion of the course, the students should be able to:-<br>1- Explain the principles of angles and distances measurements by using Total station instrument.<br>2- Calculate the elements of the horizontal and vertical curves.<br>3- Operate Total Station to obtain survey measurements in the field.<br>4- Compute the positions of survey points forming a horizontal and vertical curves.<br>5- Perform the calculations related to volumes and earthworks.<br>6- Apply the correction formulae to the measured data to obtain the corrected values.<br>7- Explain the principles of aerial photographs and satellite positioning. |

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| Descriptive Course Topics | 1- Total Station Instruments<br>Characteristics of Total Station Instruments – Functions Performed by Total Station Instruments – Parts of a Total Station Instrument – Handling and Setting Up a Total Station Instrument – Angle Observations – Elevation Differences – Traversing with Total Station Instruments – Computing Horizontal Lengths from Slope Distances – Sources of Error in Total Station Work.<br>2- Horizontal Curves<br>Degree of Circular Curve – Definitions and Derivation of Circular Curve Formulas – Circular Curve Stationing – General Procedure of Circular Curve Layout by Deflection Angles – Computing Deflection Angles and Chords – Detailed Procedures for Circular Curve Layout by Deflection Angles – Circular Curve Layout by Coordinates Total Stations – Circular Curve Layout by Offsets – Compound and Reverse Curves – Sight Distance on Horizontal Curves – Sources of Error in Laying Out Circular Curves.<br>3- Vertical Curves<br>General Equation of a Vertical Parabolic Curve – High or Low Point on a Vertical Curve – Vertical Curve Computations Using the Tangent Offset Equation – Curve Computations by Proportion – Staking a Vertical Parabolic Curve – Computations for an Unequal Tangent Vertical Curve – Designing a Curve to Pass Through a Fixed Point – Sight Distance – Sources of Error in Laying Out Vertical Curves.<br>4- Volumes and Earthworks<br>Methods of Volume Measurement – The Cross-Section Method – Types of Cross Sections – Average-End-Area Formula – Determining End Areas - Computing Slope Intercepts - Prismoidal Formula – Volume Computations – Unit-Area, or Borrow-Pit, Method – Contour-Area Method – Measuring Volumes of Water Discharge – Sources of Error in Determining Volumes – Mistakes.<br>5- Construction Survey<br>Specialized Equipment for Construction Surveys – Horizontal and Vertical Control – Staking Out a Pipeline – Staking Pipeline Grades – Staking Out a Building – Staking Out Highways – Other Construction Surveys – Construction Surveys Using Total Station Instruments – 23.13 Sources of Error in Construction Surveys.<br>6- Photogrammetry<br>Aerial Cameras – Types of Aerial Photographs – Vertical Aerial Photographs – Scale of a Vertical Photograph – Ground Coordinates from a Single Vertical Photograph – Relief Displacement on a Vertical Photograph – Flying Height of a Vertical Photograph – Stereoscopic Parallax - Stereoscopic Viewing – Orthophotos – Ground Control for Photogrammetry – Flight Planning – Sources of Error in Photogrammetry.<br>7- Introduction to Global Satellite Systems<br>Overview of GPS – The GPS Signal – Reference Coordinate Systems – Fundamentals of Satellite Positioning – Errors in |

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| | Observations – Differential Positioning – Kinematic Methods – Relative Positioning – Other Satellite Navigation Systems. |
| Experimental Work | 13- Setting up the Total Station.<br>14- Measuring Horizontal angle using Total Station.<br>15- Measuring Vertical angle using Total Station.<br>16- Measuring the height difference between survey points.<br>17- Measuring the slope and horizontal distances using Total Station.<br>18- Setting out the simple circular curve using Total Station.<br>19- Setting out the compound circular curve using Total Station.<br>20- Setting out the vertical curve using Total Station.<br>21- Elevation of a high inaccessible point.<br>22- Measuring the angles and side lengths of the closed traverse. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | • Explain the principles of angles and distances measurements by using Total station instrument.<br>• Explain the principles of aerial photographs and satellite positioning. | [ a, b, k ] |
| Course learning objective-2 | Calculate the elements of the horizontal and vertical curves. | [ a, e ] |
| Course learning objective-3 | Operate Total Station to obtain survey measurements in the field and staking out construction survey. | [ a, b, k ] |
| Course learning objective-4 | Compute the positions of survey points forming a horizontal and vertical curves. | [ a, b, e ] |
| Course learning objective-5 | Perform the calculations related to volumes and earthworks. | [ a, e ] |
| Course learning objective-6 | Apply the correction formulae to the measured data to obtain the corrected values. | [ a, e ] |

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| Course Contribution to Professional Branches | Engineering science | 75 % |
| | Engineering design | 25 % |

# Elective Courses

## Course Syllabus

| Course Code | CE 421 | | | |
|---|---|---|---|---|
| Course Title | Structural Analysis II | | | |
| Year / Level | 4 / 9 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CE 215 | | | |

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|---|---|
| **Course Description** | Analysis of statically indeterminate structures by classical methods such as: method of slope-deflection, moment distribution and three moment equation. Calculation of deflection for determinate beams and frames by using unit load method. Analysis of tow hinged arches. Influence lines for statically indeterminate structures. Introduction to matrix methods of structural analysis. Computer applications |
| **Textbook** | 7. Handout Notes, prepared by the lecturer.<br>8. Hibbeler R.C.; "Structural Analysis", Eight Edition., Prentice Hall, 2012. |
| **References** | *3.* Aslam Kassimali, "Structural Analysis", 4th edition, Cengage Learning, 2011.<br>*4.* Wang, C.K, Intermediate Structural Analysis**,** 7th Ed., Mc Graw Hill, 2008.<br>*5.* MegsonT.H.G. "Structural and Stress Analysis", Butterworth-Heinemann, 2000. |
| **Course learning Objectives (C.L.O.)** | 1. Understand indeterminate structure and methods of analysis.<br>2. Analysis of indeterminate beams and frames by slope deflection method<br>3. Analysis of indeterminate beams and frames without and with side-sway by using moment distribution method.<br>4. Calculation the deflection of trusses, beams and frames by using unit load method.<br>5. Analysis of two pinned arches.<br>6. Apply influence line for indeterminate beams.<br>7. Understand matrix method and its application for computer-based analysis of structure. |

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| **Descriptive Course Topics** | 1. Review about determinate structures.<br>2. Concept of Static and Kinematic Indeterminacy, Degree of Freedom.<br>3. Methods of the Analysis for Indeterminate structures.<br>4. Slope-Deflection Method<br>5. Moment Distribution Method. |

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| | 6. Deflection by unit load method.<br>7. Analysis of two pinned arches.<br>8. Influence Line for Indeterminate Structures.<br>9. Introduction to Matrix Method<br>10. Computer Application. |
| **Experimental Work** | experimental work includes |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | An ability to apply knowledge of mathematics, science, and engineering to understand indeterminate structure | [ a ] |
| Course learning objective-2 | An ability to identify, formulate and solve engineering problems using slope deflection method. | [ e ] |
| Course learning objective-3 | An ability to identify, formulate and solve structural analysis problems using moment distribution method | [ e ] |
| Course learning objective-4 | An ability to identify, formulate and solve structural engineering problems to calculate deflection of trusses, beams and frames using unit load method | [ e ] |
| Course learning objective-5 | An ability to identify, formulate and solve structural analysis problems involving analysis of two pinned arches. | [ e ] |
| Course learning objective-6 | An ability to identify, formulate and solve structural analysis problems involving moving loads | [ e ] |
| Course learning objective-7 | An ability to use the techniques, skills, and modern engineering tools like stiffness method necessary for engineering practice. | [ k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **75 %** |
| | Engineering design | **25 %** |

# Course Syllabus

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|---|---|---|---|---|
| **Course Code** | **CE 422** | | | |
| **Course Title** | **Advanced Structural Analysis** | | | |
| **Year / Level** | **4/9** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **3** | **-** | **-** |
| **Prerequisites** | **CE 421** | | | |

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|---|---|
| **Course Description** | Analysis of indeterminate structures by using numerical methods, flexibility method and stiffness method, finite difference method, introduction to finite element method and computer application. |
| **Textbook** | 1. Kenneth M. Leet, Chia-Ming Uang, Anne M. Gilbert, Fundamentals of Structural Analysis, Third Edition, McGrawHill |
| **References** | 1. Harry H. West, Louis F. Geschwindner, Fundamentals of Structural Analysis, Second Edition, Wiley<br>2. R. C. Coates, M. g. Coutie, F. K. Kong, Structural Analysis, Third Edition, Chapman and Hall. |
| **Course learning Objectives (C.L.O.)** | 1. Introduce flexibility method for analysis of statically indeterminate structures.<br>2. Introduce stiffness method for analysis of statically indeterminate structures.<br>3. Introduce finite difference method for analysis of slabs<br>4. Introduce introduction to finite element method for analysis of statically indeterminate structures |

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| **Descriptive Course Topics** | 1. flexibility method for analysis of statically indeterminate structures.<br>2. Introduce stiffness method for analysis of statically indeterminate truss, beams and frames.<br>3. Introduce finite difference method for analysis of slabs<br>4. Introduce introduction to finite element method for analysis of statically indeterminate structures.<br>5. Computer application. |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | An ability to apply knowledge of mathematics, science, and engineering to understand indeterminate structure determinate-indeterminate structures, an ability to identify, formulate and solve engineering problems using slope deflection method and an ability to use the techniques, skills, and modern engineering tools like stiffness method necessary for engineering practice. | [a, e, k] |
| Course learning objective-2 | | |
| Course learning objective-3 | | |
| Course learning objective-4 | | |

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| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

## Course Syllabus

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|---|---|---|---|---|
| **Course Code** | **CE 423** | | | |
| **Course Title** | **Advanced RC Design** | | | |
| **Year / Level** | **4 / 9** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **3** | **-** | **-** |
| **Prerequisites** | **CE 421** | | | |

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| **Course Description** | This course is intended to complete the topics of reinforced concrete design not covered in compulsory courses. The course involves the study of check of deflection in flexural elements. An introduction to Prestressed concrete is also involved. This course focuses also on the seismic design of reinforced concrete structures. Finally the course includes computer applications and engineering drawing of reinforced concrete details. |
| **Textbook** | **1- ACI DESIGN HANDBOOK,** Design of Structural Reinforced Concrete Elements in Accordance with ACI 318M-05, ACI SP-17M(09), American Concrete Institute.<br>**2- DESIGN AIDS,** prepared by the instructor in accordance with the Saudi Building Code (Concrete Structures Requirements, SBC 304 and Concrete Structures Commentary, SBC 304C). |
| **References** | 1- Hasson, M. N., "Structural Concrete- Theory and Design", 3rd Edition, ADDISONWesley, 2005.<br>2- Saudi Building Code, Concrete Structures Requirements, SBC 304.<br>3- Saudi Building Code (Concrete Structures commentary, SBC 304C.<br>4- Saudi Building Code, Loads and Forces Requirements, SBC 301. |
| **Course learning Objectives (C.L.O.)** | 1- Identify the fundamentals of serviceability limit state, especially, deflection control.<br>2- Classify between different types of concrete elements based on internal applied force or moment.<br>3- Design of prestressed concrete beams and estimation of prestressing losses<br>4- Prepare detailed design and workshop drawings to be execute in the field.<br>5- Create small programs or spread sheets for analysis and design of concrete sections and elements. |

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| **Descriptive Course Topics** | **1- Calculation of gross, cracked, and effective moments of inertia.** |

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| | **2- Check of short term deflection according to ACI and SBC codes.**<br>**3- Check of Long term deflection according to ACI and SBC codes.**<br>**4- Introduction to prestressed concrete and allowable stresses.**<br>**5- Analysis of prestressed concrete simple beams.**<br>**6- Losses in prestressing force.**<br>**7- Seismic design of beams for flexure.**<br>**8- Seismic design of beams for shear.**<br>**9- Seismic design of columns.**<br>**10 Seismic design of beam-column joints.**<br>**11- Design spread sheets for analysis and design of concrete sections and elements.**<br>**12- Semester Project** |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | A project of a seismic design for a reinforced concrete building. . |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | 1- Calculation of gross, cracked, and effective moments of inertia.<br>2- Check of short term deflection according to ACI and SBC codes.<br>3- Check of Long term deflection according to ACI and SBC codes. | [ a, e ] |
| Course learning objective-2 | 1- Seismic design of beams for flexure.<br>2- Seismic design of beams for shear.<br>3- Seismic design of columns.<br>4- Seismic design of beam-column joints. | [ c, i, k ] |
| Course learning objective-3 | 1- Introduction to prestressed concrete and allowable stresses.<br>2- Analysis of prestressed concrete simple beams.<br>3- Losses in prestressing force. | [ c, i, k ] |
| Course learning objective-4 | Preparing project shop drawings for all concrete elements in plans and cross sections | [ a, i, k ] |
| Course learning objective-5 | Preparing and design spread sheets for analysis and design of concrete sections and elements. | [ a, c, e, i, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **50 %** |
| | Engineering design | **50 %** |

# Course Syllabus

| Course Code | CE 424 | | | |
|---|---|---|---|---|
| Course Title | Advanced Steel Structures Design | | | |
| Year / Level | 4 / 9 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CE 421 | | | |

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| **Course Description** | Analyze and design crane track girders and roof beams (purlins). Design of sections subjected to bending moment and normal force (frame elements). Design of bolted connections subject to different types of straining actions, (shear, tension, bending moment, individually and combination of these forces and moments). Design of hinged and fixed steel bases. Drawing of all details of members and connections. Computer application is used in the design. |
| **Textbook** | "Lectures in The Design of Steel Structures", prepared by the instructor. |
| **References** | 1- ASIC Manual of Steel Construction.<br>2- Salmon and Johnson "Steel Structures – Design and Behavior", Harper and Row publishers, Copies 1971 – 1989.<br>3-"Structural Steel Design", (4th Edition) by Jack C. McCormac, (Hardcover - Jun 8, 2007). |
| **Course learning Objectives (C.L.O.)** | **1. Analyze** roof beams and crane track girders.<br>2. **Design** of beams subject to static and moving loads, such as; floor beams, roof beams and crane track girders.<br>**3. Design** of frame elements, (sections subject to normal force and bending moment).<br>**4. Design** of bolted connections subject to an individual shearing force, tension, bending moment, torsion and combinations of these forces and moments.<br>**5.Design** of hinged and fixed steel bases.<br>**6. Develop** complete workshop drawings of steel structures including all details of sections and connections.<br>**7. Design** of roof and column bracing members<br>**8. Apply** computer applications in the design. |

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| **Descriptive Course Topics** | 1- Design of roof beams, (purlines).<br>2- Design of crane track girder.<br>3- Design of frame elements, (beam-column elements).<br>4- Introduction to types of the bolted connections with their concepts and assumptions.<br>5- Design of connections subject to shearing forces.<br>6- Design of connections subject to eccentric shearing forces, (the case of |

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| | shearing force and torsion)..<br>7- Design of connections subject to tensile forces.<br>8- Design of connections subject to combined shearing and tension forces.<br>9- Design of connections subject to bending moment.<br>10- Design of connections subject to combined shearing and tension forces and bending moment.<br>11- Design of hinged base of column.<br>12- Design of fixed base of column.<br>13- Drawing of the details of members, connections, bases, ……etc..<br>14- Design of roof and column bracing members. |
| **Experimental Work** | This course does not include any experimental work. |
| **Design Activities/Projects** | This course does not include projects. Lectures, assignments and home works in the design prepare students to be able to perform the capstone project. |

**Grade Distribution:**

| Final Term | Second Mid-Term | First Mid-Term | Quiz | Homework | Work |
|---|---|---|---|---|---|
| 50% | 15% | 15% | 8% | 12% | Maximum Grade |

**Relationship of course to Program Outcomes (PO):**

| Program Outcomes | | | | | | | | | | | | | | CIE 312 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Program Criteria | | | | ABET Outcomes | | | | | | | | | | |
| o | n | m | l | k | j | i | h | g | f | e | d | c | b | a |
| | | | | 5 | - | - | - | - | - | 6 | - | 8 | - | 7 |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O. (1) | An ability to analyze beams in the cases of static and moving loads. | [ a, e, c ] |
| C.L.O. (2) | An ability to design beams in the cases of static and moving loads. | [ a, e, c ] |
| C.L.O. (3) | An ability to design frame elements. | [ a, c, k ] |
| C.L.O. (4) | An ability to design connections at different types of loads and straining actions. | [ c, e ] |
| C.L.O. (5) | An ability to design hinged and fixed steel bases. | [ a, c, k ] |
| C.L.O. (6) | An ability to develop technical workshop drawings. | [ a, k ] |
| C.L.O. (7) | An ability to analyze and design bracing members. | [ a, c ] |
| C.L.O. (8) | An ability to use computer applications in the design. | [ a, c, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **20 %** |
| | Engineering design | **80 %** |

## Course Syllabus

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|---|---|---|---|---|
| **Course Code** | **CE 436** | | | |
| **Course Title** | **Soil Stabilization** | | | |
| **Year / Level** | **4 / 9** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **3** | **-** | **-** |
| **Prerequisites** | **CE 332** | | | |

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| **Course Description** | This course is intended to introduce the principles of soil improvement. The course involves the study the types of improvement and factors influencing them. Concepts of mechanical and hydro improvements. Fundamentals of physical and chemical improvements. Shallow and deep mechanical improvements. Improvements by admixture and grouting. The use of geosynthetic materials. Stabilization of soil by granular stone piles and other different piles. |
| **Textbook** | 8- "Engineering Principles of Ground Modification", by Hausmann, Manfred R, McGraw hill publishing company, N.Y., USA, 1990 |
| **References** | 7- "Geotechnical Engineering: Principles and Practices", by Donald P. Coduto, (Hardcover - Jul 24, 1998).<br>8- Applied Analysis in Geotechnics", by Fethi Azizi 2000, E&FN Spon, Taylor and Francis, London and New York. |
| **Course learning Objectives (C.L.O.)** | 1- Identification of the principles of soil improvements.<br>2- Studying the types of improvements and factors influencing them.<br>3- Studying the concepts of mechanical and hydro improvements.<br>4- Studying the fundamentals of physical and chemical improvements of soil.<br>5- Studying shallow and deep mechanical improvements of soil.<br>6- Improvements by admixture and grouting.<br>7- Understanding the use of geosynthetic materials for soil improvement.<br>8- Understanding Stabilization of soil by granular stone piles and other different piles.<br>9- Studying Vacuum and surcharge preloading methods for soft soil improvements.<br>10-Understanding Vertical drains and PVDs applications.<br>11-Studying Using micro-piles and soil nails for soil reinforcement.<br>12-Conducting computer applications. |

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| **Descriptive Course Topics** | **1- Introduction to soil improvements techniques.**<br>**2- Factors influencing soil improvements techniques.**<br>**3- Concepts of mechanical and hydro improvements of soil.** |

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| | **4- Fundamentals of physical and chemical improvements of soil.**<br>**5- Cement stabilization involving mix design.**<br>**6- Lime stabilization of soil and overcome the problem of expansive soil.**<br>**7- Shallow and deep compaction of soil.**<br>**8- Vacuum-surcharge combined preloading methods for soft soil improvements.**<br>**9- Vertical drains and PVDs applications.**<br>**10-Using micro-piles and soil nails for soil reinforcement.**<br>**11-Computer applications.** |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | Lectures. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | Identification of the principles of soil improvements. | [ a, k ] |
| Course learning objective-2 | Studying the types of improvements and factors influencing them. | [a, e, k ] |
| Course learning objective-3 | Studying the concepts of mechanical and hydro improvements. | [ a, b, k ] |
| Course learning objective-4 | Studying the fundamentals of physical and chemical improvements of soil. | [ a, b, e, k ] |
| Course learning objective-5 | Studying shallow and deep mechanical improvements of soil. | [ a, b, e, k ] |
| Course learning objective-6 | Understanding Improvements by admixture and grouting. | [ a, b, e, k ] |
| Course learning objective-7 | Understanding the use of geosynthetic materials for soil improvement. | [ a, b, e, k ] |
| Course learning objective-8 | Understanding Stabilization of soil by granular stone piles and other different piles. | [ a, b, e, k ] |
| Course learning objective-9 | Studying Vacuum and surcharge preloading methods for soft soil improvements. | [ a, b, e, k ] |
| Course learning objective-10 | Understanding Vertical drains and PVDs applications. | [ a, b, e, k ] |
| Course learning objective-11 | Studying Using micro-piles and soil nails for soil reinforcement. | [ a, b, e, k ] |
| Course learning objective-12 | Conducting computer applications. | [ a, b, e, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

## Course Syllabus

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|---|---|---|---|---|
| **Course Code** | **CE 437** | | | |
| **Course Title** | **Soil Dynamics** | | | |
| **Year / Level** | **4 / 9** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **3** | **-** | **-** |
| **Prerequisites** | **CE 436** | | | |

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| **Course Description** | This course is intended to introduce an introduction to soil mechanics and soil dynamics, nature of dynamic loads, stress conditions on soil element under earthquake loading, seismic force for pseudo static analysis. The course involves the theory of vibration: definition, harmonic motion, free and forced vibration of a single degree freedom system with and without damping, vibration isolation. Also the course is concerning the dynamic soil properties: dynamic moduli, dynamic elastic constants. Poisson's ratio, Liquefaction parameters, factors affecting shear modulus, elastic modulus and elastic constants. Studying dynamic earth pressure: pseudo static methods, displacement methods for active and passive case. Behavior of retaining walls during earthquakes. Modification of Coulomb's theory. In addition to studying the liquefaction of soils: definition, mechanism of liquefaction. Evaluation of liquefaction zone in field. Vibration table studies. Factors affecting liquefaction and measures for anti-liquefaction. Computer applications. |
| **Textbook** | **9-** "Hand book of Machine foundations" by Srinivasulu, P. & Vaidyanathan, McGraw-Hill 1996. |
| **References** | 10-"Soil Dynamics and Machine Foundations", by Swamisaran, (Galgotia publications Pvt. Ltd, 1999). |
| **Course learning Objectives (C.L.O.)** | 1- Identification of soil dynamics parameters.<br>2- Definition the nature of dynamic loads, stress conditions on soil element under earthquake loading.<br>3- Definition of the theory of vibration, harmonic motion, free and forced vibration of a single degree freedom system with and without damping, vibration isolation<br>4- Definition factors affecting shear modulus, elastic modulus and elastic constants.<br>5- Calculation the dynamic earth pressure: pseudo static methods, displacement methods for active and passive case.<br>6- Understanding the behavior of retaining walls during earthquakes.<br>7- Understanding the modification of Coulomb's theory.<br>8- Studying the liquefaction of soils and its mechanism.<br>9- Evaluation of liquefaction zone in field.<br>10- Evaluation of liquefaction using Standard Penetration Resistance data.<br>11- Understanding the factors affecting liquefaction and measures for anti-liquefaction. |

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| **Descriptive Course Topics** | 1- Introduction to soil dynamics.<br>2- Theory of vibration.<br>3- Dynamic soil properties<br>4- Factors affecting shear modulus, elastic modulus and elastic constants.<br>5- Dynamic earth pressure<br>6- Behavior of retaining walls during earthquakes.<br>7- Liquefaction mechanism of soils.<br>8- Liquefaction zone.<br>9- Factors affecting liquefaction and measures for antiliquefaction. |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | 1- Identification of soil dynamics parameters. | [ a, k ] |
| Course learning objective-2 | 2- Definition the nature of dynamic loads, stress conditions on soil element under earthquake loading. | [a, e, k ] |
| Course learning objective-3 | 3- Definition of the theory of vibration, harmonic motion, free and forced vibration of a single degree freedom system. | [ a, b, k ] |
| Course learning objective-4 | 4- Definition factors affecting shear modulus, elastic modulus and elastic constants. | [ a, b, e, k ] |
| Course learning objective-5 | 5- Calculation the dynamic earth pressure: pseudo static methods, displacement methods for active and passive case. | [ a, b, e, k ] |
| Course learning objective-6 | 6- Understanding the behavior of retaining walls during earthquakes. | [ a, b, e, k ] |
| Course learning objective-7 | 7- Understanding the modification of Coulomb's theory. | [ a, b, e, k ] |
| Course learning objective-8 | 8- Studying the liquefaction of soils and its mechanism. | [ a, b, e, k ] |
| Course learning objective-9 | 9- Evaluation of liquefaction zone in field. | [ a, b, e, k ] |
| Course learning objective-10 | 10- Evaluation of liquefaction Standard Penetration Resistance data. | [ a, b, e, k ] |
| Course learning objective-11 | 11- Understanding the factors affecting liquefaction | [ a, b, e, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

# Course Syllabus

| Course Code | CE 438 | | | |
|---|---|---|---|---|
| Course Title | Advance Foundation Engineering | | | |
| Year / Level | 4/10 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CE 436 | | | |

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|---|---|
| Course Description | This Course of advance foundation engineering help students to understand in depth the procedure of site construction and ground improvement techniques includes: constructions of stone columns, retaining walls, sheet piles and method of reinforcing earth. |
| Textbook | 1- Principles of Foundation Engineering, Braja M. Das |
| References | 6. Foundation Analysis and Design, Joseph E. Bowels. Reinforced Earth, Ingold T.S., Tomas Telford, London. |
| Course learning Objectives (C.L.O.) | 1. General knowledge about the interaction between soil and structure and understanding how to design and construct different types of ground improvement techniques.<br>2. Familiarity to know the methods of dewatering and drainage in the field and methods of supporting soil by using sheet piles.<br>3. Knowing about deep foundations, types, materials and different technologies concern constructions.<br>4. Understand the methods of calculating lateral earth pressures and analyzing stability of retaining walls.<br>5. Familiarity with different types of stone columns and knowing the methods of design.<br>6. Awareness of methods of reinforcing earth structures. |

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| Descriptive Course Topics | 1. **Drainage and dewatering :** Types and methods of construction<br>2. **Sheet piles**<br>Anchored sheet piles<br>3. **Well foundation**<br>Types (open end & closed or box, pneumatic, drilled) and shapes<br>4. **Retaining walls**<br>Types, Lateral earth pressure, Analysis for stability, design of cantilever<br>5. **Reinforced Soil Structure**<br>Definition, Mechanism, Applications, Design of reinforced earth wall |
| Experimental Work | This course does not include experimental work. |
| Design Activities/Projects | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | General knowledge about the interaction between soil and structure and understanding how to design and construct different types of ground improvement techniques. | [a] |
| Course learning objective-2 | Familiarity to know the methods of dewatering and drainage in the field and methods of supporting soil by using sheet piles. | [a,e] |
| Course learning objective-3 | Knowing about deep foundations, types, materials and different technologies concern constructions. | [a,c,e] |
| Course learning objective-4 | Understand the methods of calculating lateral earth pressures and analyzing stability of retaining walls. | [a,c,e] |
| Course learning objective-5 | Familiarity with different types of stone columns and knowing the methods of construction and design. | [a,c,e] |
| Course learning objective-6 | Awareness of methods of reinforcing earth structures. | [a,e] |

| Course Contribution to Professional Branches | | |
|---|---|---|
| | Engineering science | **50 %** |
| | Engineering design | **50 %** |

# Course Syllabus

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|---|---|---|---|---|
| **Course Code** | **CE 446** | | | |
| **Course Title** | **Pavement Evaluation** | | | |
| **Year / Level** | **4/9** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **3** | **-** | **-** |
| **Prerequisites** | **CE 342** | | | |

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|---|---|
| **Course Description** | Highway paving materials; design of asphalt paving mixtures; pavement design; highway construction and supervision; categorize common pavement surface distress and associated correction activates; introduction to Planning and Design of Airports. |
| **Textbook** | **Highway Engineering. Paul H. Wright and Karen K. Dixon, 7th Edition, John Wiley & Sons, Inc.** |
| **References** | 1. Association of State Highway and Transportation Officials (AASHTO) Specifications and Guides, 2002.<br>2. Y. H. Huang, Pavement Analysis and Design, Prentice Hall, 1993.<br>3. R. Horonjeff and F. X. Mckelvey, Planning and Design of Airports, McGraw Hill, Inc., 4th Edition, 1994. |
| **Course learning Objectives (C.L.O.)** | 1. To understand pavement engineering, terminology, and concepts.<br>2. To understand the different types of pavements.<br>3. To recognize the different types of flexible pavements as well as rigid pavements.<br>4. To get to know and understand the engineering properties and characteristics of the different materials that concern the pavement engineer.<br>5. To understand testing and evaluation of soil, granular, and bituminous materials for pavement analysis and design.<br>6. To understand the different Super pave aggregate tests and requirements.<br>7. To be familiar with the Super pave asphalt binder tests and specifications.<br>8. To conduct analysis of flexible pavements for stresses, strains, and deflections in one-, two-, and three-layered systems.<br>9. To conduct analysis of rigid pavements for stresses, strains, and deflections. |

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| **Descriptive Course Topics** | 1. Introduction<br>2. Soils and Base Materials in Pavement Design.<br>3. Super pave Aggregate Tests.<br>4. Asphalt Binder Testing and Evaluation .<br>5. Super pave Asphalt Binder Tests.<br>6. Marshall Mix Design Method.<br>7. Planning and Design of Airports. |

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| **Experimental Work** | None |
| **Design Activities/Projects** | Group Design Projects and Presentations. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | To understand testing and evaluation of soil, granular, and bituminous materials for pavement . | [ a, b , c ] |
| Course learning objective-2 | To be familiar with the Super pave asphalt binder tests and specifications. | [ a, ,k, b ] |
| Course learning objective-3 | To conduct analysis of flexible pavements for stresses, strains, and deflections in one-, two- , and three-layered systems. | [ a ,k, b ] |
| Course learning objective-4 | To conduct analysis of rigid pavements for stresses, strains, and deflections. | [ a, e, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **60 %** |
| | Engineering design | **40 %** |

# Course Syllabus

| Course Code | CE 447 | | | |
|---|---|---|---|---|
| Course Title | Construction and Maintenance of Highway | | | |
| Year / Level | 4/ 9 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CIE 446 | | | |

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|---|---|
| **Course Description** | Essential terminologies and concepts of preservation existing highway asphalt pavements; characterizing flexible pavement distresses and identifying possible cause of distresses; relating pavement distress types and distress severity to cost-effective repair alternatives; simple procedure to inventory pavement conditions and select maintenance methods |
| **Textbook** | **Highway Engineering. Paul H. Wright and Karen K. Dixon, 7th Edition, John Wiley & Sons, Inc.** |
| **References** | 1. Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, 2nd Edition, PWS Publishing Company, 1997.<br>2. Highway Capacity Manual, Special Report 209, Transportation Research Board, 2000. |
| **Course learning Objectives (C.L.O.)** | 1. Define the common. terminologies used in pavement maintenance and rehabilitation<br>2. Identify various types of maintenance activates and explain the major differences between corrective maintenance activities and rehabilitation concepts<br>3. Accrue practical information on the subject of surface treatments overview including of crack sealing materials and application methods; and pothole patching decisions<br>4. Accrue essential information on milling, recycling; and constructing non-structural overlays<br>5. Accrue practical knowledge on surface treatments for low-volume roads and parking facilities<br>6. Implement simple procedure to inventory pavement conditions and select maintenance methods |

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| **Descriptive Course Topics** | INTRODUCTION<br>1.Definition of Flexible Pavement Maintenance and the concept of serviceability Definition of Preventive Maintenance VS Rehabilitation<br>2. Identification of pavement distresses and Severity<br>3. Characterization of Flexible Pavement Distresses<br>4. Identification of Possible Causes of Flexible Pavement Distresses<br>5.Categorization of Maintenance Activates<br>6 .Recommended Treatment Practices For Pothole Patching and |

| | |
|---|---|
| | Repair Crack Treatments for Surface Defects<br>7. Milling and surface leveling treatments<br>8.Design of overlays to restore the pavement structural capacity |
| **Experimental Work** | None |
| **Design Activities/Projects** | Group Design Projects and Presentations. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | Identify various types of maintenance activates and explain the major differences between corrective maintenance activities and rehabilitation concepts | [ a, b , c ] |
| Course learning objective-2 | Accrue practical information on the subject of surface treatments overview including of crack sealing materials and application methods; and pothole patching decisions . | [ a, b ] |
| Course learning objective-3 | Accrue essential information on milling, recycling; and constructing non-structural overlays . | [ a, b ] |
| Course learning objective-4 | Implement simple procedure to inventory pavement conditions and select maintenance methods. | [ a, e, k ] |

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|---|---|---|
| **Course Contribution to Professional Branches** | Engineering science | **60 %** |
| | Engineering design | **40 %** |

# Course Syllabus

| Course Code | CE 448 | | | |
|---|---|---|---|---|
| Course Title | Traffic Safety | | | |
| Year / Level | 4/10 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CE 446 | | | |

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|---|---|
| **Course Description** | Traffic Engineering studies and measurement; traffic flow theory and queuing theory; highway capacity analysis; parking analysis and layout design; traffic signs, marking and channelization; signalized intersection design and operation; roundabout design and management; ITS applications in traffic engineering; computer application in traffic engineering. |
| **Textbook** | **Traffic Engineering, 3rd Edition, Roger P. Roess, Elena S. Prassas, and William R. McShane, Prentice Hall, 2004.** |
| **References** | 3. Traffic and Highway Engineering, Nicholas Garber and Lester Hoel, 2nd Edition, PWS Publishing Company, 1997.<br>4. Highway Capacity Manual, Special Report 209, Transportation Research Board, 2000. |
| **Course learning Objectives (C.L.O.)** | 1.Explain traffic system components and functions. Describe the characteristics of traffic stream parameters and analyze their functional implications on traffic operation.<br>2. Identify different traffic flow parameters and queue characteristics, Explain macroscopic and microscopic relationships among the parameters.<br>3. Analyze highway capacity for urban and rural roads, Apply the capacity and level of service concepts highway performance analysis, planning and design.<br>4.Perform speed, volume and delay studies, parking study and Analyze traffic data. Prepare Traffic Study Reports.<br>5.Describe functional parameters of signalized intersection and, Design signal phases and roundabout.<br>6. Define application of Intelligent Transport System (ITS) and Demonstrate expertise on usage of computer models in Traffic operation and management. |

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| **Descriptive Course Topics** | 1. Introduction, scope and responsibilities of Traffic Engineering .<br>2. Characteristics of traffic stream parameters .<br>3. Analysis of Traffic flow parameters, application of traffic flow theory and queuing theory .<br>4.Highway Capacity Analysis and application in planning and design.<br>5. Traffic Study: Speed-Flow-Density data collection and analysis.<br>6. Parking Study- Demand assessment and facility design .<br>7. Signalized intersection design and performance analysis. |

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| | 8. Roundabout design and traffic operation management<br>9.ITS Application in Traffic Engineering.<br>10. Application of computer models. (HCS, SIDRA ,SYNCHRO) |
| **Experimental Work** | Traffic Study: Speed-Flow-Density data collection and analysis. |
| **Design Activities/Projects** | Prepare Traffic Study Reports. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | Describe the characteristics of traffic stream parameters and analyze their functional implications on traffic operation. | [ a, b , c ] |
| Course learning objective-2 | Identify different traffic flow parameters and queue characteristics. | [ b ] |
| Course learning objective-3 | Analyze highway capacity for urban and rural roads. | [ a, b ] |
| Course learning objective-4 | Perform speed, volume and delay studies, parking study and Analyze traffic data. | [ a, e, k ] |
| Course learning objective-5 | Describe functional parameters of signalized intersection and, Design signal phases and roundabout. | [ a , e, k ] |
| Course learning objective-6 | Define application of Intelligent Transport System (ITS) and Demonstrate expertise on usage of computer models in Traffic operation and management. | [ a , b, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

# Course Syllabus

| Course Code | CE 456 | | | |
|---|---|---|---|---|
| Course Title | Ground water | | | |
| Year / Level | 4/9 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CIE 352 | | | |

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| **Course Description** | The objective of the course is to provide to the students a quantitative understanding of the hydraulics of subsurface fluid flow. The theoretical concepts will be reinforced through solving real-world design and analysis problems. The importance of study of subsurface flow will be emphasized since about one-third of the world's fresh water resources exist in the form of groundwater. Further, the subsurface water forms a critical input for the sustenance of life and vegetation in arid zones. The course will cover various aspects of groundwater related to its exploration, development, and utilization. |
| **Textbook** | Todd, D, K, Larry W. M. Groundwater Hydrology, John Wiley & Sons, 2004 |
| **References** | 1. Bauwer, H. Groundwater Hydrology. Mc-Graw Hill, Kogakusha, Tokyo. 1978<br>2. Bear, J. Hydraulics of Groundwater, Mc-Graw Hill, New York, 1979<br>3. Davis, S. N., and DeWiest, R.J.M. Hydrogeology, John Wiley and Sons, New York<br>4. Fetter Jr., C.W. Applied Hydrogeology (4th Edition), Prentice Hall, 2000. |
| **Course learning Objectives (C.L.O.)** | 1. Qualitatively categorize the various forms of subsurface water<br>2. Understand the types of aquifers and their properties<br>3. Understand the porous media properties that control groundwater flow and transport, including porosity, hydraulic conductivity, and compressibility<br>4. Appreciate the importance of groundwater in the management and augmentation of water resources of a region<br>5. Understand and apply Darcy's law for solving groundwater movement problems<br>6. Identify geological formations as potential aquifers for groundwater development<br>7. Solve basic problems related to confined and unconfined aquifers<br>8. Understand the concept of continuity of motion governing unsteady and steady groundwater flow in a homogeneous isotropic confined aquifer<br>9. Understand expressions for the steady state radial flow into a well under both confined and unconfined aquifer conditions<br>10. Understand different types of pump tests, and analyze pump test data to determine aquifer properties |

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| **Descriptive Course Topics** | **Introduction to hydrogeology**, forms and classification of subsurface water, Characteristics of porous media, types of aquifers and their properties, porosity, specific yield, specific retention-Flow hydraulics, Darcy's law, coefficient of permeability, transmissibility, constant head and falling head permeameters, stratification-<br>**Geological formations as aquifers**, compressibility of aquifers, specific storage, storage coefficient- Equations of flow, confined groundwater flow between two water bodies, diffusion equation, Laplace equation- Unconfined flow by Dupuit's assumptions, One dimensional Dupuit's flow with and without recharge-<br>**Wells,** steady flow into a well – confined flow and unconfined flow, Thiem's equation, pumping tests, determination of aquifer properties through pumping tests –Recuperation test for open well, drawdown test, recovery test, well loss, artificial and natural recharge, estimation of recharge |
| **Experimental Work** | No Lab |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | Qualitatively categorize the various forms of subsurface water | [ a, k ] |
| C.L.O.2 | Understand the types of aquifers and their properties | [ a, k ] |
| C.L.O.3 | Understand the porous media properties that control groundwater flow and transport, including porosity, hydraulic conductivity, and compressibility | [ a, k ] |
| C.L.O.4 | Appreciate the importance of groundwater in the management and augmentation of water resources of a region | [ a, k ] |
| C.L.O.5 | Understand and apply Darcy's law for solving groundwater movement problems | [ a, e] |
| C.L.O.6 | Identify geological formations as potential aquifers for groundwater development | [ a, e ] |
| C.L.O.7 | Solve basic problems related to confined and unconfined aquifers | [ a, e ] |
| C.L.O.8 | Understand the concept of continuity of motion governing unsteady and steady groundwater flow in a homogeneous isotropic confined aquifer | [ a, e , k] |
| C.L.O.9 | Understand expressions for the steady state radial flow into a well under both confined and unconfined aquifer conditions | [ a, e ] |
| C.L.O.10 | Understand different types of pump tests, and analyze pump test data to determine aquifer properties | [ a, e, k] |

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| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

# Course Syllabus

| Course Code | CE457 | | | |
|---|---|---|---|---|
| Course Title | Harbor and Coastal Engineering | | | |
| Year / Level | 4/9 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CE 456 | | | |

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| **Course Description** | This course deals with planning and design of harbors elements. It includes the hydrodynamics of waves, wind, tidal, and the wave forces on the coastal structures. Design of breakwaters, berths is presented through the course |
| **Textbook** | Harbors, Navigational Channels, Estuaries, and Environmental Effects: Handbook of Coastal & Ocean Engineering, *by John B. Herbich (Hardcover Jan 27, 1992* |
| **References** | 1- Source and distribution of sediments at Brunswick Harbor & vicinity", Georgia (Technical memorandum United States Coastal Engineering Research Center) by James Neiheisel (Unknown Binding - 1965).<br>2- Handbook of Coastal and Ocean Engineering", Vol. I, II, III, John Herbich, Gulf Publishing Company,1990 |
| **Course learning Objectives (C.L.O.)** | 1- To learn and review fundamentals of wave mechanics wave forces, and tidal on the coastal structure.<br>2- To become familiar with the use of statistical and probability analysis for wave forecasting<br>3- To understand the processes of coastal wave transformation, and the effects of these transformations on the nearshore environment<br>4- Planning and designing harbors.<br>5- Design the coastal structures |

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| **Descriptive Course Topics** | Harbor planning and construction. Theory of periodic waves. Wave energy. Power. Refraction, diffraction and reflection. Winds. Tides and waves. Wave-structure interaction. Wave forces on structures. Design of coastal structures. Coastal zone processes. Long shore sediment transport. Computer applications. |
| **Experimental Work** | No Lab |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | To learn and review fundamentals of wave mechanics wave forces, and tidal on the coastal structure | a, k |
| C.L.O.2 | To become familiar with the use of statistical and probability analysis for wave forecasting | a, k |
| C.L.O.3 | To understand the processes of coastal wave transformation, and the effects of these transformations on the near shore environment | a, e |
| C.L.O.4 | Planning and designing harbors | k, g, e |
| C.L.O.5 | Design the coastal structures | c, g, e |
| C.L.O.5 | Design the coastal structures | c, g, e |

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|---|---|---|
| **Course Contribution to Professional Branches** | Engineering science | **75%** |
| | Engineering design | **25 %** |

# Course Syllabus

| Course Code | CE458 | | | |
|---|---|---|---|---|
| Course Title | Water Resources Planning | | | |
| Year / Level | 4/10 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CE456 | | | |

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| **Course Description** | This course is designed to provide an up-to-date broad coverage of pertinent topics concerning water resource planning and management. Modern computer-based modeling and analysis methods that have greatly increased capabilities for solving water resources engineering problems will be discussed. Water resources engineering concepts and methods will be addressed from the perspective of practical applications in water management and associated environmental and infrastructure management. Simulation and optimization models for the management and planning of water resource systems will be discussed. Design and analysis of water distribution as well as hydropower systems will be an important component of the course. |
| **Textbook** | Wurbs, Ralph, James, W. P., Water Resources Engineering, Prentice Hall, 2001 |
| **References** | 1. Mays, L. W. Water Resources Engineering, Wiley, 2010<br>2. Swamee, P . K., and Sharma, A. K. Design of Water Supply Pipe Networks, John Wiley & Sons, 2008 |
| **Course learning Objectives (C.L.O.)** | 1. To familiarize students with sustainable management of water resources especially under the impacts of climate change<br>2. To prepare students to protect, develop, and manage available water resources effectively<br>3. To familiarize students with modern techniques for effective water resources management<br>4. To impart knowledge that would enable students to design and analyze water distribution systems<br>5. To focus on state-of-the-art computer-based methods for the design of water distribution systems<br>6. To create awareness among students regarding energy-related environmental issues<br>7. To impart knowledge related to application of optimization models in the management, design, and operation of water resource systems<br>8. To prepare students for professional practice in the field with unlimited challenges and opportunities for serving society<br>9. To provide comprehensive coverage of fundamental concepts and techniques that lays the foundation for life-long learning<br>10. To enhance the student's learning experience via numerous examples and homework problems |

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| **Descriptive Course Topics** | Principles of water resources management, sustainability and management of water resources under the impacts of climate change.<br>Hydrologic processes, surface runoff, reservoir and stream flow routing, Probability, Risk, and Uncertainty Analysis for Hydrologic and Hydraulic Design.<br>Design and analysis of water distribution systems, illustrative examples<br>Reservoir operations – optimization using linear programming and dynamic programming, simulation models for reservoir systems operation<br>Hydroelectric projects - hydropower development in Saudi Arabia, major hydroelectric projects in Saudi Arabia, comparison with thermal and nuclear plants, environmental issues related to hydropower production, firm and secondary power, power duration curves, reliability of hydropower production, illustrative examples |
| **Experimental Work** | No lab |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | To familiarize students with sustainable management of water resources. | a,k |
| C.L.O.2 | To prepare students to protect, develop, and manage available water resources effectively | a,e,k |
| C.L.O.3 | To familiarize students with modern techniques for effective water resources management | a, e |
| C.L.O.4 | To impart knowledge that would enable students to design and analyze water distribution systems | a,k,c |
| C.L.O.5 | To focus on state-of-the-art computer-based methods for the design of water distribution systems | a,k,c |
| C.L.O.6 | To create awareness among students regarding energy-related environmental issues | a,k |
| C.L.O.7 | To impart knowledge related to application of optimization models in the management, design, and operation of water resource systems | a,e,g |
| C.L.O.8 | To prepare students for professional practice in the field with unlimited challenges | A,g,k |
| C.L.O.9 | To provide comprehensive coverage of fundamental concepts and techniques that lays the foundation for life-long learning | a,e,g |
| C.L.O.10 | To enhance the student's learning experience via numerous examples and homework problems | a,e,g |

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| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

# Course Syllabus

| Course Code | CE 466 | | | |
|---|---|---|---|---|
| Course Title | Water and waste water treatment | | | |
| Year / Level | 4/9 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CE 352 | | | |

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| **Course Description** | The design of physical unit operations and chemical and biological unit process for water and wastewater treatment are emphasized. The primary goals are to provide detailed coverage of the procedures that are used to design water and wastewater plants for municipalities and introduce students to the engineering and scientific principles on which these are based. |
| **Textbook** | H, S. Peavy, D, R. Rowe, G, Tchobanoglous, Environmental Engineering, McGraw-Hill, NY, 1985 |
| **References** | 1. Reynolds, T. D., and P. A. Richards. Unit Operations and Processes in Environmental Engineering. 2nd ed. Boston, MA: PWS Publishing Company, 1996. ISBN: 0534948847.<br>2. Mara, D. Domestic Wastewater Treatment in Developing Countries. London, UK: Earthscan, 2003. ISBN: 1844070190.<br>3. Viessman, W., Jr., and M. J. Hammer. Water Supply and Pollution Control. 7th ed. Pearson Education, Inc., Upper Saddle River, NJ: Pearson Prentice Hall, 2005. ISBN: 0131409700.<br>4. Tchobanoglous, G., F. L. Burton, and H. D. Stensel. Wastewater Engineering: Treatment and Reuse. 4th ed. Metcalf and Eddy Inc., New York, NY: McGraw-Hill, 2003. ISBN: 0070418780.<br>5. MWH Staff. Water Treatment: Principles and Design. 2nd ed. New York, NY: Wiley, 2005. ISBN: 0471110183 |
| **Course learning Objectives (C.L.O.)** | 1. To provide knowledge of water and waster characteristics and treatment technologies<br>2. To impart knowledge related to physical, chemical and biological methods of water and wastewater treatment<br>3. To introduce microbial ecology and theory of growth kinetics for application to biological treatment methods<br>4. To introduce the basic principles of sludge treatment including thickening, digestion, dewatering, sludge drying, and composting<br>5. To equip the students with a knowledge of natural wastewater treatment systems<br>6. To focus on state-of-the-art desalination techniques and their applications in arid areas with scarcity of freshwater resources<br>7. To enhance the student's learning experience via numerous examples and homework problems |

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| | 8. To provide students with the capability to identify, formulate and solve water and wastewater engineering problems<br>9. To prepare students for professional practice in a field with unlimited challenges and opportunities for serving the society<br>10. To provide comprehensive coverage of water treatment technologies techniques that lays a foundation for lifelong learning |

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| **Descriptive Course Topics** | **Water Demand** - Estimation of water and wastewater quantity, population forecasting methods; water demand for various purposes; patterns in water and wastewater demand variation<br>**Water Supply/Distribution Systems, wastewater collection systems -** Philosophy of treatment; Unit operations and processes; Physical, chemical and biological methods<br>**Domestic Wastewater Treatment** - wastewater characteristics; primary, secondary and tertiary treatment;<br>**Physical Unit Processes -** Screening; Commutation; Grit Removal; Equilization; Sedimentation;<br>**Introduction to Microbiology** - Microbial ecology and Growth kinetics; Types of microorganisms; aerobic vs. anaerobic processes<br>**Biological Unit Processes -** Aerobic treatment; Suspended growth aerobic treatment processes; Activated sludge process and its modifications; Tricking filters and Rotating biological contactors; Anaerobic treatment; suspended growth, attached growth, fluidized bed and sludge blanket systems;<br>**SludgeTreatment** - Thickening; Digestion; Dewatering; Sludge drying; Composting<br>**Wastewater Treatment Plant Characteristics -** Sequencing of unit operations and processes; Plant layout; Hydraulic considerations.<br>**Natural Wastewater Treatment Systems** - Ponds and Lagoons; Wetlands and Root-zone systems.<br>**Surface and Ground Water Treatment for Potable Water Supply** - Water Characteristics; desalination methods, sequencing of unit operations and processes;<br>**Chemical Unit Processes** - Coagulation-Flocculation; Filtration; Disinfections; Aeration and Gas transfer; Precipitation; Softening; Adsorption and Ion exchange; Membrane processes. |
| **Experimental Work** | For each laboratory session, students are divided into groups of 3 – 5 members to carry out experiments. Where several tests are done concurrently, students should coordinate themselves to perform test and analysis in designated time. Each student will submit a separate report.<br>Experiments on water and wastewater consists of the following exercises:<br>Measurements of chloride, sulphate, pH, conductivity, turbidity, total dissolved solids, suspended solids, volatile solids, dissolved oxygen, alkalinity, hardness, |

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| | total and fecal coliforms, biochemical oxygen demand, chemical oxygen demand, and ammonia and total nitrogen. Chlorine demand test and jar test are also conducted. |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | To provide knowledge of water and waster characteristics and treatment technologies | a,k |
| C.L.O.2 | To impart knowledge related to physical, chemical and biological methods of water and wastewater treatment | a,e |
| C.L.O.3 | To introduce microbial ecology and theory of growth kinetics for application to biological treatment methods | a,e,k |
| C.L.O.4 | To introduce the basic principles of sludge treatment including thickening, digestion, dewatering, sludge drying, and composting | a,e |
| C.L.O.5 | To equip the students with a knowledge of natural wastewater treatment systems | a, k |
| C.L.O.6 | To focus on state-of-the-art desalination techniques and their applications in arid areas with scarcity of freshwater resources | a, k |
| C.L.O.7 | To enhance the student's learning experience via numerous examples and homework problems | a, k |
| C.L.O.8 | To provide students with the capability to identify, formulate and solve water and wastewater engineering problems | a,e,k |
| C.L.O.9 | To prepare students for professional practice in a field with unlimited challenges and opportunities for serving the society | a,e,g |
| C.L.O.10 | To provide comprehensive coverage of water treatment technologies techniques that lays a foundation for lifelong learning | a,k |

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| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

# Course Syllabus

| Course Code | CE467 | | | |
|---|---|---|---|---|
| Course Title | Design of Water and Wastewater Treatment Plants | | | |
| Year / Level | 4/9 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CE466 | | | |

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| **Course Description** | Fundamental principles and current practices in water processing, municipal wastewater treatment, and sludge processing. Characteristics of surface and ground waters, and municipal wastewater. Concepts and design of different unit operations and processes for the treatment of water/wastewater. Drinking water standards. Wastewater reuse and disposal criteria. Properties of sludge generated from treatment processes, treatment and utilization. Laboratory experiments related to water and wastewater quality and quality control. Field trips to water/wastewater treatment plants. |
| **Textbook** | Mines,R., Lackey,L.,"Introduction to Environmental Engineering", Prentice-Hall,2009 |
| **References** | 1- Metcalf & Eddy, "Wastewater Engineering: Treatment and Reuse", 4th Edition or later (2003 or later)<br>2- APHA, AWWA, and WEF. "Standard Methods for the Examination of Water and Wastewater", 20th edition, APHA, Washington, DC. (1998). |
| **Course learning Objectives (C.L.O.)** | 1- Understand the engineering and science principles for the design of water and wastewater treatment systems,<br>2. Design water/wastewater treatment facilities,<br>3. Understand the operation and maintenance aspects of water and wastewater treatment units,<br>4. Measure different physical, chemical, and microbiological parameters of water and wastewater.<br>5. Conduct laboratory experiments to determine chemical requirements and assess performance aspects for different water and wastewater processing means. |

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| **Descriptive Course Topics** | 1- Water Chemistry and Analysis (2 hours)<br>2. Water Quality Parameters and Measurements (7 hours)<br>3. Water Sources and Quality, and Drinking Water Standards Wastewater Disposal and Reuse Criteria (1 hours).<br>4. Water Treatment Processes: treatment objectives, coagulation and flocculation, sedimentation, filtration, softening, iron and manganese taste and odor control, demineralization (RO), chlorination, chloramination, ozonation, control of disinfection by-products, (8 hours)<br>5. Wastewater Treatment Processes: characteristics and composition of municipal wastewater, wastewater treatment objectives and effluent requirements/standards, preliminary treatment (screen, shredders, grit chambers, equalization), primary treatment (primary clarification), secondary treatment (biological filtration, activated |

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| | sludge, oxidation ponds) (7 hours).<br>6. Wastewater Reclamation & Reuse (2 hours)<br>7.Characteristics and Treatment of Water/Wastewater Sludge (3 hours) |
| **Experimental Work** | No lab |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | Understand the engineering and science principles for the design of water and wastewater treatment systems | a,k |
| C.L.O.2 | Design water/wastewater treatment facilities | a, e |
| C.L.O.3 | Understand the operation and maintenance aspects of water and wastewater treatment units | a, e |
| C.L.O.4 | Measure different physical, chemical, and microbiological parameters of water and wastewater | a, k |
| C.L.O.5 | Conduct laboratory experiments to determine chemical requirements and assess performance aspects for different water and wastewater processing means | b, k |

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| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

# Course Syllabus

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|---|---|---|---|---|
| **Course Code** | CE 468 | | | |
| **Course Title** | **Municipal Solid Waste Management** | | | |
| **Year / Level** | **4/10** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **3** | **-** | **-** |
| **Prerequisites** | CE 466 | | | |

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| **Course Description** | Sources, composition and properties of municipal solid wastes. Functional elements of solid waste management systems. Integrated solid waste management. Materials separation and processing technologies. Thermal, biological and chemical conversion technologies. Reuse and Recycling of recovered materials. Landfilling of solid waste. |
| **Textbook** | Tchobanoglous G., Theisen H., and Vigil S. "Integrated Solid Waste Management: Engineering Principles and Management Issues", International Edition, McGraw-Hill ، Inc., New York, 1993. |
| **References** | Williams P. T. "Waste Treatment and Disposal", John Wiley & Sons, Chichester, England, UK., 1999 |
| **Course learning Objectives (C.L.O.)** | 1- Identifying the types and Composition of Municipal Solid wastes<br>2- Clarifying the hazardous wastes in municipal solid waste<br>3- Understanding to Materials Processing and Recovery<br>4- Analysis the transfer and transport of solid waste<br>5- Evaluating the recycling of solid waste materials |

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| **Descriptive Course Topics** | 1-Sources, Types and Composition of Municipal Solid wastes (3 hours)<br>2. Characteristics of Municipal Solid Waste (3 hours)<br>3. Hazardous Wastes in Municipal Solid Waste (2 hours).<br>4. Generation and Collection Rates of Solid Waste (3 hours)<br>5. Waste Handling & Separation, Storage and Processing at the Source (3 hours).<br>6. Collection of Solid Waste (6 hours)<br>7. Materials Processing and Recovery (6 hours)<br>8. Waste Conversion/Transformation Technologies (6 hours)<br>9. Waste Transfer and Transport (4 hours)<br>10. Recycling of Solid Waste Materials (3 hours)<br>11. Disposal of Solid Waste and Residuals (6 hours) |
| **Experimental Work** | No Lab |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| C.L.O.1 | Identifying the types and Composition of Municipal Solid wastes | a, k |
| C.L.O.2 | Clarifying the hazardous wastes in municipal solid waste | e, k |
| C.L.O.3 | Understanding to Materials Processing and Recovery | a, e |
| C.L.O.4 | Analysis the transfer and transport of solid waste | a, e, k |
| C.L.O.5 | Evaluating the recycling of solid waste materials | e, k |

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| **Course Contribution to Professional Branches** | Engineering science | **80 %** |
| | Engineering design | **20 %** |

# Course Syllabus

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|---|---|---|---|---|
| **Course Code** | **CE 476** | | | |
| **Course Title** | **Advanced Methods of Construction** | | | |
| **Year / Level** | **4 / 9** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **3** | **-** | **-** |
| **Prerequisites** | **CE 371** | | | |

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| **Course Description** | The course will introduce unique construction methods involved with several types of complex construction projects. The construction process will be discussed as a system to provide a background for examining various types of projects including modern concretes and infrastructurs, temporary structures, high-rise construction, deep foundations construction, dams, bridges, tunneling and shotcretes, and other complex construction issues. |
| **Textbook** | - Handouts and other reference materials are available from the course website at:http://courses.washington.edu/cm510/ |
| **References** | - Recommended Text: P.K. Mehta and P.J.M. Monteiro "Concrete : Microstructure, Properties,and Materials," Third Edition, MacGraw Hill, 2006 (second edition is on two-hour reserve at both Engineering and Architecture Libraries). |

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| **Descriptive Course Topics** | 1-Introduction to Concrete as a Construction Material<br>2-Alaskan Way Viaduct Replacement project; Progress in Concrete Technology;<br>3- Site Improvement and Deep Foundations, Ground Freezing; Bridge Construction<br>4- Field Trip to Spokane Street Swing Bridge<br>5- Dams, Cofferdams, Construction Dewatering, Shotcrete<br>6- High-Rise Construction<br>7- Tunneling<br>8- Pavement Construction<br>9- IDX Tower, Presentations<br>10- Thanksgiving Holiday |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | This course does not include design activities or projects. |

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| **Course Contribution to Professional Branches** | Engineering science | **100 %** |
| | Engineering design | **00 %** |

# Course Syllabus

| Course Code | CE 477 | | | |
|---|---|---|---|---|
| Course Title | Construction Organization and Planning | | | |
| Year / Level | 4 / 9 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CE 476 | | | |

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| **Course Description** | This course examines the management focus of the design and/or construction company and how corporate management is different from, yet relates to, and impacts project management. The company creates the framework within which projects may consistently achieve excellent performance or they may struggle to complete behind schedule, over budget, and not meet the customer's requirements. What makes the difference? |
| **Textbook** | - Construction Project Management, 2/e, by Frederick E. Gould and Nancy E. Joyce, Published by Prentice Hal.<br>- Case Studies in Building Design and Construction by Robert Dorsey, published by Prentice Hall |
| **References** | - Management: Quality and Competitiveness by Ivancevich, Lorenzi, Skinner, and<br>- Crosby, published by Irwin Skyscraper by Karl Sabbagh, published by Viking (plus videos) |
| **Course learning Objectives (C.L.O.)** | 1. The management of a construction firm, design firm, construction project, and specific project operational tasks, including the interrelationships between each of these three levels of organization.<br>2. Planning and strategy, including determining the objectives of a design firm, a construction firm, and a development firm.<br>3. Marketing of construction organization services, and competitive negotiation in the industry.<br>4. Project planning. Construction Organizations – General Contractors, DesignBuilders, Owner-Builders, Construction Managers.<br>5. Detailed organization planning for operations and support, including required resources.<br>6. The organizational structure of a construction firm, design firm, and development firm at both the office level and project field level.<br>7. The organization of a construction operation including the design of the specific tasks to be performed.<br>8. Selecting project delivery systems. |

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| | 9. The objectives of control, and the design and development of a management information system for a firm and a project.<br>10. Conflict resolution and dispute resolution in the construction industry. |

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| **Descriptive Course Topics** | 1. Class orientation and introduction. Summary of case studies. Management of Design & Construction Organizations<br>2. The Construction Industry - Types of Industry, Industry Sectors.<br>3. Organizing and Leading the Construction Project. - Organizing and Managing. Legal Forms of Organizations. Leadership<br>4. Project Delivery Methods. - Managing, Assessing and Minimizing Project Risks. Delivery Methods. Contract Types. Contract Changes<br>5. Project Chronology. - Project Initiation. Feasibility Analysis. Financing.<br>6. Construction Services During Design - Finding the Right Construction<br>7. Bidding and Procurement - Qualification of Bidders. Work Packages.Construction Documents. Bidding, Contractual, & Technical Information.<br>8. Construction and Closeout - Subcontracts. Staffing. Job Start. Construction Operations. Procurement. Job Site. Project Completion.<br>9. Estimating Project Costs. Project Planning and Scheduling. Controlling Project Cost, Time and Quality.<br>10. Job Site Administration - Communication. Submittals. Payme Applications. Changes to the Work. |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | This course does not include design activities or projects. |

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| **Course Contribution to Professional Branches** | Engineering science | **100 %** |
| | Engineering design | **00 %** |

## Course Syllabus

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|---|---|---|---|---|
| **Course Code** | **CE 486** | | | |
| **Course Title** | **survey Measurements adjustment** | | | |
| **Year / Level** | **4 / 9** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **3** | **-** | **-** |
| **Prerequisites** | **CE 382** | | | |

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| **Course Description** | This course is intended to introduce the fundamentals of errors and methods for analyzing them. The first three chapters are devoted to the subject of error propagation in the various types of traditional surveying measurements. Then chapters follow that describe observation weighting and introduce the least-squares method for adjusting observations. Least-squares adjustments often require the formation and solution of nonlinear equations. Procedures for linearizing nonlinear equations by Taylor's theorem are therefore important in adjustment computations, and this topic is also presented. Application of least squares in adjusting basic types of surveys are then presented in separate chapters. Adjustment of level nets, trilateration, triangulation and traverses are included. |
| **Textbook** | • Adjustment Computations Spatial Data Analysis , (4th Edition) by Charles D. Ghilani and Paul R. Wolf (Hardcover - Jan 10, 2006). |
| **References** | • Mikhail, E. M. [1998]: Observations and Least Squares. IEP-A dun-Donnelley Publisher. |
| **Course learning Objectives (C.L.O.)** | 1- Distinguish between direct and indirect measurements.<br>2- Define precision and accuracy as they pertain to survey data.<br>3- Describe the basic error propagation equation and the concept of Least Squares in both equal-weight and weighed cases.<br>4- Evaluate error propagation model for surveying networks.<br>5- Recognize the stochastic model as it is used in the context of Least Squares.<br>6- Evaluate the observation equations of different surveying measurements.<br>7- Solve the different survey problems (leveling – triangulation - traverse network) using the method of Least Squares adjustment.<br>8- Compute error ellipse parameters from adjustment covariance matrix.<br>9- Calculate the adjusted parameters and their covariance matrix of the network point coordinates. |

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| **Descriptive Course Topics** | **1- Propagation of Random Errors in Indirectly Measured Quantities**<br>Basic Error Propagation Equation - Generic Example - Frequently Encountered Specific Functions - Standard Deviation of a Sum - Standard Deviation in a Series - Standard Deviation of the Mean - Error Sources in Horizontal Angles - Effects of Leveling Errors in Angle Observations Errors |

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| | in Electronic Distance Observations.<br><br>**2- Error Propagation in Traverse Surveys**<br>Derivation of Estimated Error in Latitude and Departure - Derivation of Estimated Standard Errors in Course Azimuths - Computing and Analyzing Polygon Traverse Misclosure – Computing and Analyzing Link Traverse Misclosure Errors.<br><br>**3- Error Propagation in Elevation Determination**<br>Systematic Errors in Differential Leveling - Earth Curvature and Refraction - Combined Effects of Systematic Errors on Elevation Differences - Random Errors in Differential Leveling - Instrument Leveling Errors Rod Plumbing Error - Estimated Errors in Differential Leveling - Error Propagation in Trigonometric Leveling.<br><br>**4- Weights of Observations**<br>Weighted Mean - Relation between Weights and Standard Errors - Statistics of Weighted Observations - Standard Deviation - Standard Error of Weight *w* and Standard - Error of the Weighted Mean - Weights in Angle Observations - Weights in Differential Leveling - Practical Examples<br><br>**5- Principles of Least Squares**<br>Fundamental Principle of Weighted Least Squares - Stochastic Model - Functional Model - Observation Equations- Elementary Example of Observation Equation Adjustment - Systematic Formulation of the Normal Equations - Equal-Weight Case - Weighted Case - Advantages of the Systematic Approach - Using Matrices to Form the Normal Equations - Equal-Weight Case - Weighted Case - Least Squares Solution of Nonlinear Systems - Least Squares Fit of Points to a Line or Curve - Least Squares Adjustment Using Conditional Equations - Examples Using Observation Equations.<br><br>**6- Adjustment of Level Nets**<br>Observation Equations – Unweighted Example – Weighted Example - Reference Standard Deviation – Formulation of the Normal Equations – Covariance matrix of the adjusted parameters – Standard Deviations of Computed Quantities.<br><br>**7- Adjustment of Horizontal Surveys**<br>Distance Observation Equations – Trilateration Adjustment Example – traverse network adjustment – Computer Solution of a Trilaterated Quadrilateral – Formulation of the Normal Equations – Iteration Termination - Method of Maximum Iterations – Covariance Matrix of the Adjusted Parameters. |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | 1- Distinguish between direct and indirect measurements. | [ a, e ] |
| Course learning objective-2 | 2- Define precision and accuracy as they pertain to survey data. | [ a, e ] |
| Course learning objective-3 | 3- Describe the basic error propagation equation and the concept of Least Squares in both equal-weight and weighed cases. | [ a, e ] |
| Course learning objective-4 | 4- Evaluate error propagation model for surveying networks. | [ a, e, k ] |
| Course learning objective-5 | 5- Recognize the stochastic model as it is used in the context of Least Squares. | [ a, e ] |
| Course learning objective-6 | 6- Evaluate the observation equations of different surveying measurements. | [ a, e, k ] |
| Course learning objective-7 | 7- Solve the different survey problems (leveling – traverse network) using the method of Least Squares adjustment. | [ a, e, k ] |
| Course learning objective-8 | 8- Compute error ellipse parameters from adjustment covariance matrix. | [ a, e, k ] |
| Course learning objective-9 | 9- Calculate the adjusted parameters and their covariance matrix of the network point coordinates. | [ a, e, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **70 %** |
| | Engineering design | **30 %** |

# Course Syllabus

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|---|---|---|---|---|
| **Course Code** | **CE 487** | | | |
| **Course Title** | **Geodesy and Geomatics** | | | |
| **Year / Level** | **4 / 9** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **3** | **-** | **-** |
| **Prerequisites** | **CIE 486** | | | |

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| **Course Description** | This course is started by introducing the history of geodesy that is related to the determination of the figure of the earth. Coordinate Systems in Geodesy is a basic for positioning systems in geodesy; it is consists of earth coordinate system, geodetic coordinate system, celestial and natural coordinate systems, geodetic datum and its transformation, and computation of geodetic coordinate from geocentric coordinate. Field procedures used in horizontal and vertical control surveys have traditionally been the ground methods of *triangulation*, *precise traversing*, *trilateration*, leveling and combinations of these basic approaches. In addition, The student uses the Global Positioning System (GPS) as a tool for obtaining spatial data and coordinate information. He will be provided with a review of code differential GPS and its applications, especially as it relates to GIS and mapping data collection. The student will then explore the use of carrier phase GPS observables to collect data for geodetic control, topographic surveys, etc. He will use proprietary software to process and analyze code and carrier phase GPS data sets. The student will be able to export this data in various formats for use by other software packages. |
| **Textbook** | • Elementary Surveying: An Introduction to Geomatics", (12th Edition) by Charles D. Ghilani and Paul R. Wolf (2008). |
| **References** | • Geometric Geodesy part 1, by Rapp, R.H. , Columbus, Ohio, 1991.<br>• GPS Theory, Algorithms and Applications, (2nd Edition) by *Guochang Xu*, Springer Verlag Berlin Heidelberg (2007). |
| **Course learning Objectives (C.L.O.)** | By the completion of the course, the students should be able to:<br>1- Explain geodetic principals, and coordinate Systems.<br>2- Convert earth coordinate system to geodetic coordinate system.<br>3- Distinguish between intersection and resection process.<br>4- Adjust the triangulation and trilateration geodetic networks.<br>5- Describe GPS system, software, and applications.<br>6- integration between GPS and traditional surveying. |

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| **Descriptive Course Topics** | **1- Geodetic Position Computations**<br>Figure of the Earth – Scope of Geodesy – The Ellipsoid and Geoid – Geoid Undulation and Deflection of the Vertical – Coordinate systems in geodesy – Geodetic datum – Flat Earth Coordinate System – Celestial Coordinate System – Natural Coordinate System – Geodetic Datum – Datum Shift and |

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| | Transformation – Computation of Geodetic Coordinate from Cartesian Coordinate – Geodetic Positioning - Satellite Positioning System.<br><br>**2- Intersection and Resection**<br>Intersection by solution of triangle – Intersection using the observed angles – Intersection from two baselines – Resection – Angular resections – Distance resections – Free stationing.<br><br>**3- Triangulation and Trilateration**<br>Principle of triangulation – Objective of triangulation surveys – Classification of triangulation system – Triangulation figures and layouts – Combination of all above systems – Layout of primary triangulation for large countries – Criteria for selection of the layout of triangles – Well-conditioned triangles – strength of figure.<br><br>**4- Setting out (dimensional control)**<br>Responsibility on site – Responsibility of the setting-out engineer – Protection and<br>referencing – Basic setting-out procedures using coordinates – Use of grids – Setting out buildings – Controlling verticality – Controlling grading excavation – Rotating lasers – Route location.<br><br>**5- GPS Static Surveys**<br>Field Procedures in Satellite Surveys – Planning Satellite Surveys – Performing Static Surveys – Data Processing and Analysis – Sources of Errors in Satellite Surveys – Mistakes in Satellite Surveys<br><br>**6- GPS Kinematic Surveys**<br>Planning of Kinematic Surveys – Initialization – Equipment Used in Kinematic Surveys – Methods Used in Kinematic Surveys – Performing Post-Processed Kinematic Surveys – Communication in Real-Time Kinematic Surveys – Real-Time Networks – Performing Real-Time Kinematic Surveys – Machine Control – Errors in Kinematic Surveys – Mistakes in Kinematic Surveys. |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Explain geodetic principals, and coordinate Systems. | [ a, e, k ] |
| Course | Convert earth coordinate system to geodetic coordinate | [ a, e ] |

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| learning objective-2 | system | |
| Course learning objective-3 | Distinguish between intersection and resection process. | [ a, e, k ] |
| Course learning objective-4 | Adjust the triangulation and trilateration geodetic networks. | [ a, e, k ] |
| Course learning objective-5 | Describe GPS system, software, and applications. | [ a, e, k ] |
| Course learning objective-6 | Integration between GPS and traditional surveying. | [ a, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **70 %** |
| | Engineering design | **30 %** |

# Course Syllabus

| Course Code | CIE 488 | | | |
|---|---|---|---|---|
| Course Title | Remote Sensing | | | |
| Year / Level | 4 / 10 | | | |
| Hours | Credit | Lec. | Lab. | Tut. |
| | 3 | 3 | - | - |
| Prerequisites | CIE 486 | | | |

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| **Course Description** | This lecture course provides an overview of Geographic Information Systems technology. Topics include fundamental concepts, terminology, and technologies associated with GIS, applications of GIS, the role of GIS in spatial data management, data modeling, concepts of file and database systems, spatial data models, architecture of GIS software, methods of data collection and input, manipulation and analysis features of GIS, general management issues.<br>In addition, remote sensing is defined as the science of acquiring, processing, and interpreting images, and related data, obtained from aircraft and satellites that record the interaction between matter and electromagnetic radiation. |
| **Textbook** | • Geographical Information Systems: An Introduction, Julie Delaney, 2000, Publisher: Oxford Univ Pr, ISBN: 0195507894<br>• Remote Sensing and Image Interpretation (5th edition), Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, 2003, Publisher: John Wiley & Sons Inc, ISBN: 0471152277 |
| **References** | • Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems, Gottfried Konecny, 2002, Publisher: Taylor & Francis, ISBN: 0415237955<br>• Introduction to Remote Sensing (3rd edition), James B. Campbell, 2002, Publisher: Guilford Pr, ISBN: 1572306408 |
| **Course learning Objectives (C.L.O.)** | 1. Identify the basic types of maps and geographic data used with GIS.<br>2. Explain how geographic data and geographic information systems are used.<br>3. Contrast and compare raster and vector data structures and operations.<br>4. Describe the procedure for collecting and locations for accessing data for GIS.<br>5. Perform database query and simple spatial analysis with GIS software.<br>6. Examine and understand the relationship between scatter plots and the spectral response of land cover targets.<br>7. Discuss how to use ground truth, scatter plots, and spatial patterns in imagery to create a land cover map.<br>8. Demonstrate understanding of multi-spectral scanning, and operating Earth Resource Satellites<br>9. Calculate the height of land objects (buildings, towers, trees, hills, etc.) using an aerial/space photograph.<br>10. Generate digital orthophotos using scanned aerial/space photographs. |

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| **Descriptive Course Topics** | **1- INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS**<br>Land Information Systems - GIS Data Sources and Classifications - Spatial Data - Nonspatial Data - Data Format Conversions - Creating GIS Databases - Metadata - GIS Analytical Functions - GIS Applications - Data Sources<br><br>**2- GIS and Spatial Data Management**<br>Spatial/geometric data use in CAD - Computer mapping, and Computer graphics - Spatial data use in GIS with CAD, mapping, computer graphics - Distinguish between GIS and LIS (LRIS)<br><br>**3. Data Modeling**<br>Data modeling - conceptual, logical, physical - Spatial and attribute data - Scales of measurement – Dimensions - Multiple representation - Discrete versus continuous - Spatial relationships<br><br>**4. Geo-Referencing and Spatial Data Models**<br>Spatial referencing - Types of spatial referencing - Types of geo-referencing frameworks Field and object methods - Vector data models – Topology - Files - records and fields - The file processing environment; database management systems - Relational data model<br><br>**5. Raster Data Model**<br>Data organization - Data modeling - Assigning values to cells - Geo-referencing - Advantages and disadvantages - Data compression techniques – Public and private data - Primary and secondary data - Remote Sensing - Data capture and input technology - Technical Issues in data conversion - Data validation and quality<br><br>**6- Introduction to Remote Sensing**<br>What is remote sensing - Basic concepts of electromagnetic waves and reflection - Electromagnetic energy - Energy interaction in the atmosphere – Electro- magnetic energy interactions with the main surface materials<br><br>**7- Sensors and Sensor Platforms**<br>Passive sensors - Active sensors - Air borne and Space borne remote sensing platforms<br><br>**8- Multi Spectral Sensing and Earth Resource Satellites**<br>Multi spectral, Thermal, and Hyper spectral Sensing - Different kinds of scanners - The processes, across-track and along track scanning - How multi spectral scanner images are acquired physically - Multi spectral scanner basic operating principles - Thermal scanning and its basic principles of radiation - Hyper-spectral scanning - Earth Resource Satellites Operating in the Optical Spectrum - Different kinds of earth resources satellites and their usefulness. |
| **Experimental Work** | This course does not include experimental work. |
| **Design Activities/Projects** | This course does not include design activities or projects. |

| Course learning Objectives (C.L.O.) | Student Learning Outcomes (S.L.O.) | Program Outcomes (P.O.) |
|---|---|---|
| Course learning objective-1 | Identify the basic types of maps and geographic data used with GIS. | [ a, e ] |
| Course learning objective-2 | Explain how geographic data and geographic information systems are used. | [ a, e ] |
| Course learning objective-3 | Contrast and compare raster and vector data structures and operations. | [ a, e, k ] |
| Course learning objective-4 | Describe the procedure for collecting and locations for accessing data for GIS. | [ a, e ] |
| Course learning objective-5 | Perform database query and simple spatial analysis with GIS software. | [ a, e, k ] |
| Course learning objective-6 | Examine and understand the relationship between scatter plots and the spectral response of land cover targets. | [ a, e, k ] |
| Course learning objective-7 | Discuss how to use ground truth, scatter plots, and spatial patterns in imagery to create a land cover map. | [ a, e ] |
| Course learning objective-8 | Demonstrate understanding of multi-spectral scanning, and operating Earth Resource Satellites | [ a, e ] |
| Course learning objective-9 | Calculate the height of land objects (buildings, towers, trees, hills, etc.) using an aerial/space photograph. | [ a, e, k ] |
| Course learning objective-10 | Generate digital orthophotos using scanned aerial/space photographs | [ a, k ] |

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| **Course Contribution to Professional Branches** | Engineering science | **70 %** |
| | Engineering design | **30 %** |

# Senior Design project

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| **Course Code** | CE 498 | | | |
| **Course Title** | **Senior Design project (1)** | | | |
| **Year / Level** | **5 / 9** | | | |
| **Hours** | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **1** | **1** | **3** | **-** |
| **Prerequisites** | ENG 357, CE 261, CE 282, CE 316, CE 317, CE 332, CE 342 | | | |

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| **Course Description** | In addition to teaching the basic concepts of civil engineering, this course is designed to help the senior student to prepare his proposal for the final project. Topics include: analytical calculations, analysis, design, and preparing drawings and details of the project. |
| **Textbook** | Each supervisors of a project prepare lecture notes for their project. |
| **References** | Each supervisors of a project determine references for their project. |
| **Course learning Objectives (C.L.O.)** | 1-Revision of the civil engineering knowledge taught in the early semesters.<br>2 – Application of these knowledge in a real applicable project. |

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| **Descriptive Course Topics** | 1- Definition of the project.<br>2- Analysis of the main elements of the project.<br>3- Design of the main elements of the project.<br>4- Drawing details of the main elements of the project.<br>5- Surveying of quantities. |
| **Experimental Work** | Civil Engineering project may include experimental works or not. |
| **Design Activities/Projects** | Application on simple design project related to the contents of the subject. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | The ability of Remembering and recalls the principles of design, including the different design elements. | [ a ] |
| Course learning objective-2 | The ability of Developing civil engineering design skills. | [ c] |
| Course learning objective-3 | The ability of recognizing the relationship between analysis and design of different elements of the | [ a] |

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|---|---|---|
| | project components. | |
| Course learning objective-4 | The ability of dealing with the civil character and its uses in projects. | [ d ] |
| Course learning objective-5 | The ability of Understanding the basics of analysis using computer software. | [ b ] |
| Course learning objective-6 | The ability of utilizing and recalling theories of design a civil engineering project. | [ c ] |

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| **Course Contribution to Professional Branches** | Engineering Science | **30 %** |
| | Engineering Design | **70 %** |

| Course Code | CE 499 | | | |
|---|---|---|---|---|
| Course Title | **Senior Design project (2)** | | | |
| Year / Level | **5 / 10** | | | |
| Hours | **Credit** | **Lec.** | **Lab.** | **Tut.** |
| | **3** | **-** | **1** | **6** |
| Prerequisites | CE 498 | | | |

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| **Course Description** | Designing of graduation project for which the student had prepared a program and chose a location during the first semester – The project should be both complex and comprehensive to show student ability to utilize the experience gained during the study period in the department – the student should be able to meet project objectives. |
| **Textbook** | Each supervisors of a project prepare lecture notes for their project. |
| **References** | Each supervisors of a project determine references for their project. |
| **Course learning Objectives (C.L.O.)** | 1- Student should be able to design and implement an integrated project.<br>2 - The student will be qualified to the practice its role in the community as a civil engineer.<br>3 - Student should be able to compete with his colleagues in the preparation of good civil work. |

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| **Descriptive Course Topics** | 1. Definition of the design process with its various stages.<br>2. Analysis of each element of the project.<br>3. Design of each element of the project.<br>4. Drawing of each element of the project.<br>5. Surveying of the quantities. |
| **Experimental Work** | Civil Engineering project may include experimental works or not. |
| **Design Activities/Projects** | Application on simple design project related to the contents of the subject. |

| **Course learning Objectives (C.L.O.)** | **Student Learning Outcomes (S.L.O.)** | **Program Outcomes (P.O.)** |
|---|---|---|
| Course learning objective-1 | The ability of Remembering and recalls the principles of design, including the different design elements. | [ a ] |
| Course learning objective-2 | The ability of Developing civil engineering design skills. | [ c] |
| Course | The ability of recognizing the relationship between | |

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| learning objective-3 | analysis and design of different elements of the project components. | [ a] |
| Course learning objective-4 | The ability of dealing with the civil character and its uses in projects. | [ d ] |
| Course learning objective-5 | The ability of Understanding the basics of analysis using computer software. | [ b ] |
| Course learning objective-6 | The ability of utilizing and recalling theories of design a civil engineering project. | [ c ] |

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| **Course Contribution to Professional Branches** | Engineering Science | **20 %** |
| | Engineering Design | **80 %** |

**NOTICE**

**Basic science courses and others courses from different colleges and department**

**Syllabi and Description will be taken from the colleges.**

## References

**1-** The national Commission for Academic Accreditation and Assessment (NCAAA), www.ncaaa.org.sa/

**2-** Accreditation Board for Engineering and Technology (ABET), Inc., www.abet.org/

**3-** The Bachelor of Science in Civil Engineering,Civil Engineering Department,College of Engineering, Jazan University, KSA, www.jazanu.edu.sa/

**4-**The Bachelor of Science in Civil Engineering, King Fahd University of Petroleum & Minerals, KSA, www.kfupm.edu.sa/

**5-** The Bachelor of Science in Civil Engineering,College of Engineering, King Saud University, KSA, www.ksu.edu.sa/

**8-** The Bachelor of Science in Civil Engineering,College of Engineering, QassimUniversity, KSA, www.qu.edu.sa/