



University of Tehran



College of Engineering

**عناوین و سرفصل انگلیسی دروس رشته مهندسی عمران، دانشکده  
مهندسی عمران، پردیس دانشکده‌های فنی، دانشگاه تهران**

**Civil Engineering Undergraduate Curriculum,  
School of Civil Engineering, College of  
Engineering, University of Tehran**

# Civil Engineering

## Course Tables

### 1- Courses

Course of study (Degree)	Type of Courses						Total (without Training)
	General	Basic	Mandatory	Elective	Project	Training	
Bachelor of Science	22	23	80	15	-	2	140

The Training course is not taken into account in grade point average (GPA) and total number of passed units.

### 2- General Courses

Row	Course Title	Units			Number of Hours			Prerequisite Courses
		Theoretical	Practical	Total	Theoretical	Practical	Total	
1	General Persian (Farsi) Language	3	-	3	48	-	48	-
2	General English Language	3	-	3	48	-	48	-
3	Physical Education	0.5	0.5	1	8	16	24	-
4	Sport I	-	1	1	-	32	32	-
5	Family and Population Knowledge	2	-	2	32	-	32	-
6	General Courses from the Department of Islamic Thoughts *	12	-	12	192	-	192	-
<b>Total</b>		<b>20.5</b>	<b>1.5</b>	<b>22</b>	<b>328</b>	<b>48</b>	<b>376</b>	<b>-</b>

Taking the Life Skills Training Workshop and Prevention of Psychosocial Injuries 1 in the first semester and also the Life Skills Training Workshop and Prevention of Psychosocial Injuries 2 in the second semester are mandatory.

**\* General Courses from the Faculty of Theology and Islamic Studies**

Row	Group	Course Title	Units			Number of Hours			Prerequisite Courses
			Theoretical	Practical	Total	Theoretical	Practical	Total	
1	Theoretical Foundations of Islam (4 Credits)	Islamic Thought 1 (Origin and Resurrection)	2	-	2	32	-	32	-
2		Islamic Thought 2 (Prophethood and Imamate)	2	-	2	32	-	32	-
3		Man in Islam	2	-	2	32	-	32	-
4		Social and Political Rights in Islam	2	-	2	32	-	32	-
5	Islamic Ethics (2 Credits)	Ethics Philosophy (With Emphasis on Educational Topics)	2	-	2	32	-	32	-
6		Islamic Ethics (Fundamentals and Concepts)	2	-	2	32	-	32	-
7		Way of Life (Applied Ethics)	2	-	2	32	-	32	-
8		Practical Mysticism in Islam	2	-	2	32	-	32	-
9	Islamic Revolution (2 Credits)	Iran's Islamic Revolution	2	-	2	32	-	32	-
10		Acquaintance with the Constitution of the Islamic Republic of Iran	2	-	2	32	-	32	-
11		Political Thoughts of Imam Khomeini	2	-	2	32	-	32	-
12	Islamic History and Civilization (2 Credits)	History of Islamic Culture and Civilization	2	-	2	32	-	32	-
13		Analytical History of Early Islam	2	-	2	32	-	32	-
14		History of Imamate	2	-	2	32	-	32	-
15	Acquaintance with Islamic Resources (2 Credits)	Thematic Interpretation of the Quran	2	-	2	32	-	32	-
16		Thematic Interpretation of the Nahj-al Balagha	2	-	2	32	-	32	-

### 3- Basic Courses

Row	Course Title	Units			Number of Hours			Prerequisite Courses
		Theoretical	Practical	Total	Theoretical	Practical	Total	
1	General Mathematics I	3	-	3	48	-	48	-
2	General Mathematics II	3	-	3	48	-	48	General Mathematics I
3	Differential Equations	3	-	3	48	-	48	General Mathematics II (Corequisite)
4	Numerical calculations and Programming	3	-	3	48	-	48	Differential Equations
5	Statistics and Probability	3	-	3	48	-	48	General Mathematics II
6	Physics I	3	-	3	48	-	48	-
7	Physics II	3	-	3	48	-	48	General Mathematics I , Physics I
8	Technical Drawing of Buildings	1	1	2	16	32	48	-
<b>Total</b>		<b>22</b>	<b>1</b>	<b>23</b>	<b>252</b>	<b>32</b>	<b>384</b>	<b>-</b>

### 3- Mandatory Courses

Row	Course Title	Units			Number of Hours			Prerequisite Courses
		Theoretical	Practical	Total	Theoretical	Practical	Total	
1	Engineering Geology and Lab	1	1	2	16	32	48	None
2	Statics	3	-	3	48	-	48	Mathematics I
3	Dynamics	2	-	2	32	-	32	Statics
4	Solid Mechanics I	2	-	2	32	-	32	Statics
5	Architectural Design	2	-	2	32	-	32	None
6	Solid Mechanics II	2	-	2	32	-	32	Solid mechanics I
7	Construction Materials	2	-	2	32	-	32	Passing 30 Credits
8	Structural Analysis	3	-	3	48	-	48	Solid Mechanics I
9	Concrete Technology	2	-	2	32	-	32	Construction Materials, Solid Mechanics I
10	Fluid Mechanics	3	-	3	48	-	48	Dynamics, Mathematics II
11	Soil Mechanics	3	-	3	48	-	48	Engineering Geology, Solid Mechanics I
								Fluid Mechanics (Corequisite)
12	Surveying Theory & Practice	1	1	2	16	32	48	Mathematics I
13	Principles of Numerical Analysis of Structures	3	-	3	48	-	48	Structural analysis, Numerical Calculations and Programming
14	Steel Structures I	2	-	2	32	-	32	Structural Analysis
15	Reinforced Concrete Structures I	2	-	2	32	-	32	Concrete Technology, Structural Analysis
16	Open Channels Hydraulics	2	-	2	32	-	32	Fluid Mechanics
17	Fluid Mechanic and Hydraulic Laboratory	-	1	1	-	32	32	Open Channel Hydraulics
18	Soil Mechanics Laboratory	-	1	1	-	32	32	Soil Mechanics
19	Engineering Hydrology	2	-	2	32	-	32	Statistics and Probability, Fluid Mechanics
20	Highway Geometric Design	2	-	2	32	-	32	Surveying Theory & Practice, Soil Mechanics
21	Steel Structures II	2	-	2	32	-	32	Solid Mechanics II, Steel Structures I
22	Reinforced Concrete Structures II	2	-	2	32	-	32	Reinforced Concrete Structures I, Solid Mechanics II

Row	Course Title	Units			Number of Hours			Prerequisite Courses
		Theoretical	Practical	Total	Theoretical	Practical	Total	
23	Water and Wastewater Engineering	2	-	2	32	-	32	Engineering Hydrology, Open Channel Hydraulics
24	Loading on Structures	2	-	2	32	-	32	Stochastic and Probability, Modeling of Structures, Steel Design I, Reinforced Concrete Design I Structural Analysis (Corequisite)
25	Water and Wastewater Engineering Project	-	1	1	-	32	32	Water and Wastewater Engineering
26	Hydraulic Structures	2	-	2	32	-	32	Soil Mechanics, Open Channel Hydraulics
27	Construction Materials Lab	-	1	1	-	32	32	Concrete Technology
28	Construction Equipment	2	-	2	32	-	32	Geometric Design of Highway
29	Project Evaluation & Cost Estimate	1	-	1	16	1	16	Steel Structures I, Reinforced Concrete Structures I, Architectural and Urban Design Highway Geometric Design (Corequisite)
30	Steel Structures Project	2	-	2	32	-	32	Loading, Steel Structures II
31	Reinforced Concrete Structures Project	-	1	1	-	32	32	Reinforced Concrete Structures II, Basics of Modeling of Structures, Loading on Structures
32	Foundation Engineering	3	-	3	48	-	48	Soil Mechanics, Reinforced concrete structures I, Soil Mechanics Laboratory
33	Pavement Engineering	2	-	2	32	-	32	Construction Materials, Geometric Design of Highways
34	Pavement Laboratory	-	1	1	-	32	32	Pavement Engineering (Corequisite)
35	Traffic Engineering	2	-	2	32	-	32	Statistics and Probability, Road Geometric Design
36	Highway Engineering Project	-	1	1	-	32	32	Pavement engineering, Traffic Engineering (Corequisites)
Row	Course Title	Units			Number of Hours			Prerequisite

		Theoretical	Practical	Total	Theoretical	Practical	Total	Courses
37	Construction Methods for Civil Engineering Projects	3	-	3	48	-	48	Steel Structures I, Reinforced Concrete Structures II, Construction Equipment
38	Earthquake Engineering	2	-	2	32	-	32	Loading on Structures
39	Training	-	2	2	-	240	240	Passing 90 Credits
40	Engineering Economics	2	-	2	32	-	32	Passing 45 credits
41	Environmental Engineering	2	-	2	32	-	32	Passing 65 credits
42	Introduction to Construction Project Management and Scheduling	2	-	2	32	-	32	Passing 65 credits
<b>Total (without Training)</b>		<b>70</b>	<b>10</b>	<b>80</b>	<b>1136</b>	<b>288</b>	<b>1440</b>	

## 2- Elective Courses (15 courses should be optionally selected)

Row	Course Title	Units			Number of Hours			Prerequisite Courses
		Theoretical	Practical	Total	Theoretical	Practical	Total	
1	Environment Laboratory	-	1	1	-	32	32	Environmental Engineering (Corequisite)
2	Introduction to Finite Element Method	2	-	2	32	-	32	Basics of structural equation modeling
3	Building Equipment	2	-	2	32	-	32	Engineering Drawing, Fluid Mechanics
4	Site Investigation	2	-	2	32	-	32	Foundation Engineering (Corequisite)
5	Rehabilitation of Structures	2	-	2	32	-	32	Steel Structures II, Reinforced Concrete Structures II
6	Sustainable Development in Civil Engineering	2	-	2	32	-	32	Environmental Engineering
7	Tunnel Engineering	2	-	2	32	-	32	Soil Mechanics, Reinforced Concrete Structures II, Loading of Structures (corequisite)
8	English for Civil Engineers	2	-	2	32	-	32	Passing 70 credits, General English
9	Design and assessment of Masonry Structures	2	-	2	32	-	32	Fundamentals of Structural Modeling, Reinforced Concrete Structures I
10	Structural Systems	2	-	2	32	-	32	Steel Structures I, Reinforced Concrete Structures I
11	Chemistry for Civil Engineering	2	-	2	32	-	32	-
12	Engineering Application GIS and RS In Civil	2	-	2	32	-	32	-
13	Foundations of Urban Planning	2	-	2	32	-	32	-
14	Building Information Modeling (BIM)	2	-	2	32	-	32	Passing 65 credits



Row	Course Title	Units			Number of Hours			Prerequisite Courses
		Theoretical	Practical	Total	Theoretical	Practical	Total	
15	Construction issues in foundation Engineering	2	-	2	32	-	32	Foundation Engineering
16	Transportation Engineering	2	-	2	32	-	32	Geometric Road Design, Statistics and Probability
17	Railway Engineering	2	-	2	32	-	32	Pavement Engineering (Corequisite)
18	Port Engineering	2	-	2	32	-	32	,Hydraulics Soil Mechanics
19	Bridge Engineering	2	-	2	32	-	32	Steel Structures I, Reinforced Concrete Structures II, Loading on Structures\ Construction Methods for Civil Engineering Projects (Corequisite)
20	River Engineering	2	-	2	32	-	32	Open Channel Hydraulics
21	Dam Engineering	2	-	2	32	-	32	Soil Mechanics, Open Channel Hydraulics
22	Coastal Engineering	2	-	2	32	-	32	Open Channel Hydraulics
23	Water Resources Engineering	2	-	2	32	-	32	Engineering Hydrology
24	Civil Engineering Systems Analysis	2	-	2	32	-	32	Statistics and Probability
25	Introduction to Engineering	2	-	2	32	-	32	-
26	Introduction to Project Management	2	-	2	32	-	32	Passing 80 credits
27	Engineering Ethics	2	-	2	32	-	32	-
28	Computational Geotechnics	2	-	2	32	-	32	Soil Mechanics, Numerical Analysis, Principles of Numerical Analysis of Structures
<b>Total</b>		<b>54</b>	<b>1</b>	<b>55</b>	<b>834</b>	<b>32</b>	<b>896</b>	

<b>Course name:</b> Engineering Geology and Lab	نام فارسی درس: زمین شناسی مهندسی و آزمایشگاه		
<b>Credits:</b> 3	<b>Credit type:</b> Theoretical 1, Practical 1		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b> None		
<b>Number of hours:</b> 48			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The objective of this course is to familiarize the students with fundamentals of engineering geology and its application in civil engineering projects such as dams, underground structures, and abutments of bridges as well as stability of slopes.			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
1. Role of engineering geology in civil engineering projects			
2. Minerals			
3. Igneous rocks			
4. Sedimentary rocks			
5. Metamorphic rocks			
6. Weathering			
7. Crustal deformation and plate tectonics'			
8. Earthquakes			
9. Groundwater			
10. Stability of slopes			
11. Geotechnical investigations			
<b>(Practical section):</b>			
This course also includes engineering geology lab to examine various types of minerals and rocks as well as some simple experiments such as unconfined compressive strength test and point load strength index test.			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
1- Engineering Geology for Civil Engineering, Varghese, P. C., 2011, PHI Learning Private Limited.			
2- Geology for Civil Engineers, McLean, A.C. and Gribble, C.D., 2005, E& FN, Spon.			

<b>Course name:</b> Statics	نام فارسی درس: استاتیک		
<b>Credits:</b> 3	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 48	Mathematics I		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The main purpose of this course is to provide students with a clear and thorough presentation of the theory and application of engineering mechanics, and to develop the capacity to predict the effects of force while the structure is in equilibrium. This course can equip students with the knowledge and tools for solving mechanics problems in realistic contexts.			
<b>Course contents:</b> <b>(Theoretical section):</b> <ol style="list-style-type: none"> <li>1- Review of Vector Analysis</li> <li>2- Equivalent System</li> <li>3- Equilibrium (of particles and solid bodies)</li> <li>4- Distributed Forces</li> <li>5- Centers of Mass and Centroids (of Lines, Areas, and Volumes), moment of inertia of area and mass moment of inertia</li> <li>6- Analysis of Trusses</li> <li>7- Analysis of Cables</li> <li>8- Analysis of Beams (Calculate the internal forces)</li> <li>9- Structural Analysis using method of virtual work</li> </ol> <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>%</b>
<b>References:</b> <ul style="list-style-type: none"> <li>- Beer, F., Johnston, E., Mazurek, D. (2021) Vector Mechanics for Engineers: Statics, McGraw-Hill Education.</li> <li>- Meriam, J. I., Kraige, L. G., (2006) Engineering Mechanics: Statics, Wiley.</li> <li>- Hibbeler, R., (2015) Engineering Mechanics: Statics, Pearson.</li> </ul>			

<b>Course name:</b> Dynamics	نام فارسی درس: دینامیک		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Statics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Course objectives:</b> The major objective of this course is teaching basics and fundamental concepts of mechanics of rigid bodies in motion.			
<b>Course contents</b> <b>(Theoretical section):</b> <ul style="list-style-type: none"> <li>- Particle Kinematics</li> <li>- Particle Kinetics (Newton's 2<sup>nd</sup> law, Energy and Momentum methods)</li> <li>- Particle systems</li> <li>- Kinematics of rigid bodies</li> <li>- Kinetics of rigid bodies (D'Alembert principle, Energy methods, Momentum and Euler principle)</li> <li>- Mechanical vibrations</li> </ul> <b>Course contents (Practical Section):</b> None			
<b>Evaluation method:</b> final test\written test\practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>%</b>
<b>References:</b> <ol style="list-style-type: none"> <li>1- Beer, F. P., Johnston, E. R., Vector Mechanics for Engineers: Dynamics, Mc Graw Hill, 2003.</li> <li>2- Meriam, J. L., Engineering Mechanics 1: Dynamics, Wiley, 2004.</li> <li>3- Shames, I. H., Dynamics, Elsevier, 1995.</li> </ol>			

<b>Course name:</b> Solid mechanics I	نام فارسی درس: مکانیک جامدات ۱		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Statics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The purpose of this course is to familiarize undergraduate civil engineering students with the method of calculating and the effect of axial and shear forces, bending and torsion moments on structures members and to determine the internal stresses caused by these factors in these members with different sections (solid and thin-walled sections). Furthermore, students will learn how to determine the stresses and strains in different parts of a structure.			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1- General assumptions, basic theories and review of internal forces determinations (axial forces, shear forces, bending moments, and torsions), and depicting the force diagrams for linear members.</li> <li>2- Stress, strain, stress-strain diagram (material behavior), Hooke's law, allowable stresses, and Poisson's ratio.</li> <li>3- Statically indeterminate axially loaded member, thermal stress, Elastic deformation of an axially loaded member, and principle of superposition</li> <li>4- Stress analysis (axial stress, shear stress, plane stress, and 3d stresses), principal stresses by Mohr's Circle for 2d stresses, maximum in-plane shear stresses, and extension of Hooke's law.</li> <li>5- Thin-walled pressure vessels</li> <li>6- Plane strain</li> <li>7- Torsion: torsional deformation of a circular shaft, thin-walled tubes having closed cross sections, angle of twist, and introduction to torsion in solid-rectangular sections.</li> <li>8- Bending stresses and beam design</li> <li>9- Shear stresses in beams (solid and closed/open thin-walled sections), and shear center.</li> </ol>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1- Popov, Egor P., "Engineering mechanics of solids" 2<sup>nd</sup> edition, Prentice Hall, 1998.</li> <li>2- Beer, F., Johnston, Jr., E. R., Dewolf, J., T. and Mazurek, D., "Mechanics of materials" 6<sup>th</sup> edition, 2011.</li> <li>3- Clive L. Dym and Irving H. Shames., "Solid Mechanics: A Variational Approach", Springer, 2013.</li> <li>4- Russell C. Hibbeler, "Mechanics of Materials", 9<sup>th</sup> Edition, 2013.</li> <li>5- Craig, Roy R., "Mechanics of materials", 3<sup>rd</sup> edition, 2011.</li> </ol>			

<b>Course name:</b> Architecture Design	نام فارسی درس: طراحی معماری		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b> None		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
<b>Type of advanced training:</b> Seminar			
<b>Course description and objectives:</b>			
<ul style="list-style-type: none"> <li>- Understand of close connection between architecture, civil and facilities fields in building efficiency</li> <li>- Familiarity with practical concept in architecture for civil engineering students</li> <li>- Creation common language between architecture and civil engineers students</li> </ul>			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ul style="list-style-type: none"> <li>- Familiarity with the principle and applied basics of architecture</li> <li>- Defining the relationship between form and function in architecture</li> <li>- Module and modulation principles of modular design</li> <li>- How architecture and civil engineers to cooperate</li> <li>- Familiarity with construction plans and projects</li> <li>- Study of the relationships and architectural spaces of the building</li> <li>- Carrying out an architectural design project by providing the necessary details and plans</li> </ul>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. Architectural Graphic Standards, Eleventh Edition – 2007</li> <li>2. Time - Saver Standards For Architecture Design Data The Reference For Architectural Fundamental</li> </ol>			

<b>Course name:</b> Solid mechanics II	نام فارسی درس: مکانیک جامدات ۲		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Solid mechanics I		
<b>Advanced training:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
<b>Type of advanced training:</b> Workshops and seminars			
<b>Course description and objectives:</b>			
The main objectives of this course for undergraduate civil engineering students are:			
<ul style="list-style-type: none"> <li>• Understand and determine deformations in beams resulting from various loadings</li> <li>• Learn how to use singularity functions</li> <li>• Learn how to determine the stress in 3d state and to determine the principal stresses in 2d and 3d states</li> <li>• Learn how to transfer stresses using Mohr's Circle</li> <li>• Understand and being able to calculate the internal stresses due to bending moments in composite beams, bending and shear stresses in beams with variable cross section and bent beams.</li> <li>• Learn how to investigate the effect of combined loads and the phenomenon of lateral instability (buckling) on columns and beam-columns.</li> </ul>			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1- Beam deflections: direct determination of the elastic curve from the load distribution and using singularity functions to determine the slope and deflection of a beam</li> <li>2- Transformations of stress and strain (3d stresses): 3d stresses, principal stresses, 2d strains, 3d strains, strain transformations directly and by Mohr's Circle</li> <li>3- Composite beams and bending and shear stresses in beams with variable cross section</li> <li>4- Bent beams</li> <li>5- Combined loading: bending with torsion, bending with axial and unsymmetrical bending</li> <li>6- Buckling: principal of buckling in columns and beam-columns, critical load, columns with eccentric loading, and curved columns</li> </ol>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b>			
<ol style="list-style-type: none"> <li>1- Popov, Egor P., "Engineering mechanics of solids" 2nd edition, Prentice Hall, 1998.</li> <li>2- Beer, F., Johnston, Jr., E., R., Dewolf, J., T. and Mazurek, D., "Mechanics of materials" 6th edition, 2011.</li> <li>3- Clive L. Dym and Irving H. Shames., "Solid Mechanics: A Variational Approach", Springer, 2013.</li> <li>4- Russell C. Hibbeler, "Mechanics of Materials" 9th Edition, 2013.</li> </ol>			

<b>Course name:</b> Construction Materials	نام فارسی درس: مصالح ساختمانی										
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical										
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>										
<b>Number of hours:</b> 32	30 Credits										
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>											
<b>Type of advanced training:</b>											
<b>Course description and objectives:</b> Introduction to common construction materials, their major properties, production methods and their applications in construction											
<b>Course contents:</b> <b>(Theoretical section):</b> After an introduction to different types of civil engineering projects and the significance of construction materials, general properties of construction materials will be discussed. Then, specific attention will be given to the main construction materials, including gypsum, lime, brick, ceramics, glass, steel, insulations and composite materials. For each material, its main properties, methods of production, and applications will be examined.  <b>(Practical section):</b> None											
<b>Evaluation method:</b> final test\ written test\ practical test											
<table border="1"> <thead> <tr> <th>Final test (writing\ operational)</th> <th>Midterm</th> <th>Continuous evaluation</th> <th>Project</th> </tr> </thead> <tbody> <tr> <td>50%</td> <td>30%</td> <td>0%</td> <td>20%</td> </tr> </tbody> </table>				Final test (writing\ operational)	Midterm	Continuous evaluation	Project	50%	30%	0%	20%
Final test (writing\ operational)	Midterm	Continuous evaluation	Project								
50%	30%	0%	20%								
<b>References:</b>											
1- Construction Materials, in Memory of Ahmad Hami, by group of Authors, University of Tehran Press, 2015											
2- Allen, L. "Fundamentals of Building Construction: Materials and Methods, 6th Edition", 6th Edition. Wiley, 2013.											



<b>Course name:</b> Structural Analysis	نام فارسی درس: تحلیل سازه‌ها		
<b>Credits:</b> 3	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 48	Solid Mechanics I		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b>			
Structural analysis, as a necessity for the design of any structure, is the first step in the process of analysis and design of structures. In this course, the basic principles of structural analysis are discussed, and students learn the various methods of analyzing statically determinate and indeterminate structures, including trusses, beams and frames. In general, different methods of structural analysis, especially classical methods, subjected to static loads are studied with the aim of understanding the behavior of structures (their deformation, internal forces of the elements and reactions).			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1. Stability and determinacy</li> <li>2. Analysis of statically determinate structures</li> <li>3. Deflection of structures <ol style="list-style-type: none"> <li>3.1. Moment-area method</li> <li>3.2. Elastic load method</li> <li>3.3. Conjugate beam method</li> </ol> </li> <li>4. Energy methods <ol style="list-style-type: none"> <li>4.1. Unit load method</li> <li>4.2. Real work method</li> <li>4.3. Castigliano's first theorem</li> <li>4.4. Castigliano's second theorem</li> <li>4.5. Reciprocal work/displacement theorems</li> </ol> </li> <li>5. Analysis of statically indeterminate structures <ol style="list-style-type: none"> <li>5.1. Unit load method</li> <li>5.2. Method of least work</li> <li>5.3. Three-moment method</li> </ol> </li> <li>6. Influence lines <ol style="list-style-type: none"> <li>6.1. Influence lines for statically determinate structures</li> <li>6.2. Influence lines for statically indeterminate structures</li> </ol> </li> </ol>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test/written test/practical test			
Final test (writing/operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

- 1- Rahimian, M., and Ghorbani-Tanha, A.K., Structural Analysis, Sanjesh Publications, Tehran, Iran, 2003. (In Persian)
- 2- Hibbeler, R. C., Structural Analysis, 8th ed., Prentice-Hall, Englewood Cliffs, New Jersey, 2012.
- 3- Hsieh, Y., Elementary Theory of Structures, 4th ed., Prentice-Hall, Englewood Cliffs, New Jersey, 1995.
- 4- Norris, C. H., Wilbur, J.B., and Utku, S. Elementary Structural analysis, 4th ed., McGrawHil, 1991.

<b>Course name:</b> Concrete Technology	نام فارسی درس: تکنولوژی بتن		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Construction Materials, Mechanics of Materials I		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Gaining knowledge of concrete, its constituents, proper mix design and curing of concrete, parameters affecting the properties of concrete, and advancements in concrete technology			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
The following topics will be discussed:			
1- Introduction to concrete, its significance, and applications			
2- Concrete constituents including cement, aggregates, water, mineral and chemical admixtures			
3- Properties of fresh concrete			
4- Mix design of concrete			
5- Properties of hardened concrete			
6- Durability of concrete			
7- Advancements in concrete technology			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
Neville, A. M. and Brooks, J. J. "Concrete Technology", 2nd edition, Prentice Hall, 2012			

<b>Course name:</b> Fluid Mechanics	نام فارسی درس: مکانیک سیالات		
<b>Credits:</b> 3	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 48	Dynamics, Basic Math II		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Teaching fundamental concepts of fluid mechanic and applications			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
1. Introduction, Definitions and fluid properties			
2. Hydro statics (fluid statics): Stress in static fluid, Hydrostatic pressure, Pressure gradient force, Pressure variation with elevation for a static incompressible and compressible fluid, Pressure measurement, hydrostatic Forces on plane and curved surfaces, stability of floating and submerged bodies, Relative equilibrium (pressure distribution in rigid body motion).			
3. Foundations, Concepts and basic principle of fluids (fluids dynamic and kinematic): Velocity and acceleration, Types of Flow, Flow, Control volume and System, Reynolds transport theorem, Continuity equation, Irrotational flow, The linear momentum equation, Energy equation, Euler and Bernoulli equations, Total energy line, Hydraulic gradient			
4. Dimensional analysis and dynamic similarity: Dimensionless groups, Buckingham theorem for dimensional analysis, Similarity rules and physical modelling.			
5. Incompressible pressure Flow in pipes: Energy loss in pipes and Darcy–Weisbach equation, Laminar flow in circular pipe and in parallel planes, Darcy–Weisbach friction factor, Developed flow and boundary layer, Turbulent flow in pipes, Empirical equations, minor losses in pipe systems, Basics of pipes network analysis			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b>			
1. Franzini, J. B. and Finnemore, E. J., Fluid Mechanics with Engineering Application, (2002), International Edition			
2. Vennard, J. K. and Street, R. L., Elementary Fluid Mechanics.			
3. Munson, B. R., Young, D. F. and Okiishi, T. H., Fundamentals of Fluid Mechanics, 3rd Edition, 1988.			
4. Fox, R.W. and McDonald A.T., Introduction to Fluid Mechanics, (1992)			
5. Shames, I.H., Mechanics of Fluid.			
6. Streeter, V.L. and Wylie, Fluid Mechanics.			
7. White, F.M., Fluid Mechanics, (1986) McGraw-Hill			

<b>Course Name:</b> Soil Mechanics	نام فارسی درس: مکانیک خاک		
<b>Credits:</b> 3	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite Courses:</b> Engineering Geology, Solid Mechanics I, Fluid Mechanics (Corequisite)		
<b>Number of hours:</b> 48			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b>			
<p>The major goal of this course is to teach the basic concepts of soil mechanics for civil engineering undergraduate students. Knowledge of these basic concepts is compulsory for civil engineers encounter with geotechnical engineering problems.</p> <p>Upon successful completion of the course, students will know:</p> <ol style="list-style-type: none"> <li>1- What is the basic characteristics of soils, the nature of soils, soil classification, phase relationships and how to compact soils,</li> <li>2- the fundamentals of water flow (seepage) in soils, how to construct flow nets, how to solve problems related to seepage in all soil conditions including anisotropic and non-homogeneous soil conditions,</li> <li>3- the principals of effective stress and its role in soils behavior,</li> <li>4- the basics of shear strength of soils in different soil conditions,</li> <li>5- how to calculate the induced and in-situ stresses in a soil mass, how to calculate displacements due to loading on a soil media,</li> <li>6- The basics of consolidation theory in soils including the calculation of consolidation settlement.</li> <li>7- Different methods employed for slope stability considerations.</li> </ol>			
<b>Course contents</b>			
<b>(Theoretical Section):</b>			
<u>Chapter 1.</u> Basic Characteristics of Soils			
<u>Chapter 2.</u> Seepage			
<u>Chapter 3.</u> Effective Stresses			
<u>Chapter 4.</u> Shear Strength			
<u>Chapter 5.</u> Stresses and Displacements			
<u>Chapter 6.</u> Consolidation Theory			
<u>Chapter 7.</u> Slope Stability			
<b>(Practical Section):</b> None			
<b>Evaluation method:</b> final test\written test\practical test			
Final test (writing\operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
1- Behnia K., Tabatabaie A.M., Soil Mechanics (Volume 1), University of Tehran Press.			
2- Craig, R.F, Soil Mechanics, Chapman & Hall, 7 <sup>th</sup> ed., 2004			
3- Braja M. Das, Principles of Geotechnical Engineering, <u>CL-Engineering</u> , 2009.			

<b>Course name:</b> Surveying Theory & Practice	نام فارسی درس: نقشه برداری و عملیات
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical 1, Practical 1
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>
<b>Number of hours:</b> 32	Basic Math I
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<b>Type of advanced training:</b>	
<b>Course description and objectives:</b> Understanding the different methods of map creation through terrestrial direct measurements and investigation of precisions, to know the types of maps standard and their application in civil engineering.	
<b>Course contents:</b>	
<b>(Theoretical section):</b>	
<ol style="list-style-type: none"> <li>1- Definitions and basic terms</li> <li>2- Introduction of surveying engineering course and its profession</li> <li>3- Introduction of different branches of surveying engineering</li> <li>4- Direct distance measuring</li> <li>5- Levelling</li> <li>6- Longitudinal and cross sections</li> <li>7- Angle measuring</li> <li>8- Indirect distance measuring</li> <li>9- Control points, definitions, Types, Different applications in surveying</li> <li>10- Determination of co-ordinates of control points, Different methods and computations</li> <li>11- Methods of surveying in details</li> <li>12- Principles of cartography</li> <li>13- Introduction of manuals and standard service details for map creation</li> <li>14- A review of the steps of preparing topographic maps</li> <li>15- Introduction of principles of satellite positioning</li> <li>16- Introduction of the new technologies in surveying engineering</li> <li>17- Designing in engineering surveying and its applications in urban designing and route designing</li> <li>18- Setting out and dimensional control in engineering surveying</li> <li>19- Practical soil (areas, land segregation, volumes, leveling)</li> <li>20- Construction and workshop surveying</li> </ol>	
<b>(Practical section):</b>	
<ol style="list-style-type: none"> <li>1- Creation of Longitudinal and cross sections and drawing of their maps</li> <li>2- Creation of map with suitable scale from limited region and presentation of types of maps</li> <li>3- Extraction of longitudinal and cross sections from maps and computation of areas and volumes</li> <li>4- Designing over map and setting out of design over ground in field</li> <li>5- Introduction software's map such as Civil 3D and ArcGIS</li> <li>6- Optional project in urban designing and road construction</li> </ol>	

**Evaluation method:** final test\ written test\ practical test

Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

- 1- W. Schofield & M. Breach (2007), "Engineering Surveying", Elsevier
- 2- F. A. Shepherd (1977), "Advanced Engineering Surveying", Thomson\_litholth
- 3- Barry F. Kavanagh (2010)," Surveying with Construction Applications", Prentice Hall

<b>Course name:</b> Principles of Numerical Analysis of Structures	نام فارسی درس: مبانی مدل سازی سازه ها			
<b>Credits:</b> 3	<b>Credit type:</b> Theoretical			
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b> Structure analysis, Numerical Calculations and Programming			
<b>Number of hours:</b> 48				
<b>Advanced training:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>				
<b>Type of advanced training:</b> Computer programming				
<b>Course description and objectives:</b> The objective of presenting this course is making civil engineering students familiar with principles of numerical structure analysis. These concepts will be used extensively in powerful software for modeling and calculating structures and other systems concerned in civil engineering. Teaching commercial programs is not covered in this course, but the use of them is allowed.				
<b>Course contents:</b> <b>(Theoretical section):</b> <ol style="list-style-type: none"> <li>1- Review of concepts of determinate and indeterminate structures and structures' degree of freedom</li> <li>2- Flexibility and stiffness method</li> <li>3- Slope-deflection equations</li> <li>4- Introduction to the flexibility method in matrix analysis</li> <li>5- Stiffness method in matrix analysis: <ul style="list-style-type: none"> <li>• Matrix analysis of truss</li> <li>• Matrix analysis of frame</li> </ul> </li> <li>6- methods of considering constraints</li> <li>7- Review of methods concerning storage and solution for the system of static equilibrium equations</li> <li>8- Miscellaneous</li> <li>9- Introduction to 2-dimensional elements</li> <li>10- Basics of methods for modeling rigid ceilings</li> <li>11- Basics of methods for modeling shear walls</li> <li>12- Basics of methods for modeling spread, strip, and mat foundations</li> <li>13- Introduction to methods of weighted residual, variational methods, and introductory finite elements</li> <li>14- Approximate methods for structural analysis</li> </ol> <b>(Practical section): No section. None</b>				
<b>Evaluation method:</b> final test\ written test\ practical test				
	Final test (writing\ operational)	Midterm	Continuous evaluation	Project
	<b>50%</b>	<b>30%</b>	<b>10%</b>	<b>10%</b>
<b>References:</b> <ol style="list-style-type: none"> <li>1- F. Szidarovszky, S.J. Yakowitz, "Principles and Procedures of Numerical Analysis", Springer, 1978.</li> <li>2- Z. Bittnar, J. Seinhof, "Numerical Methods in Structural Mechanics", ASCE, 2015.</li> <li>3- J.G. Easley, A.M. Waas, "Analysis of Structures: An Introduction Including Numerical Methods", Wiley, 2011.</li> <li>4- E. Hinton, D.R.J. Owen, "An Introduction to Finite Element Computations", Pineridge Press, 1980.</li> </ol>				



<b>Course name:</b> Steel Structures I	نام فارسی درس: سازه های فولادی ۱		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b> Analysis of Structures		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Introduction to the principles and methods of design of steel structures			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1. Principles and design philosophy: Design codes based on allowable stresses, LRFD and performance-based design of structural systems, safety load criterion</li> <li>2. Steel types, constructional steels, steel behavior (stress diagrams, strain, heat effect, fatigue, brittle failure, weathering and....), types of structural steel profiles</li> <li>3. Tensile members design, effective sections of tensile members, effects of holes on the design</li> <li>4. Compressive members design under axial load, stability of compressive members, local buckling, thickness to width ratio, effective length of columns.</li> <li>5. Flexural members design with and without lateral support, effects of profile specifications in design (compact and non-compact sections and seismic compactness), unbraced length, deformation of beams, strengthening of beams, continuous beams</li> <li>6. Design of purlins and crane beams</li> <li>7. Design of members subject to simultaneous pressure and bending (beam-columns), bi-axial bending, simultaneous tension and bending</li> <li>8. Design of combined columns with oblique or horizontal clamps, design of columns composed of several profiles</li> <li>9. Design of castellated beams</li> <li>10. Design of steel-concrete composite beams</li> <li>11. Design of cold-rolled sections</li> <li>12. Design of base plates of columns</li> </ol> <p><b>Note:</b> The contents of this course must be in accordance with the tenth national code of the buildings (official code of the country).</p>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50 %</b>	<b>30 %</b>	<b>20 %</b>	<b>0 %</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. M. Sadeghazar (1374), "Structural Steel, Theoretical-Applied", University of Tehran Press</li> <li>2. R. Mirghaderi &amp; M. Azhari (1392) "Design of Steel Structure, Volume I", Pillars of Knowledge Press</li> <li>3. M. Azhari &amp; R. Mirghaderi (1385) "Design of Steel Structures, Volume II ", Pillars of Knowledge Press</li> <li>4. M. Azhari &amp; R. Mirghaderi (1392) "Design of Steel Structures, Volume III (Connections)", Pillars of Knowledge Press</li> <li>5. S. Tahouni (2<sup>nd</sup> edition, 1393), "Design of Steel Structures (Volume I)", Science &amp; Literature Press</li> <li>6. S. Tahouni (2<sup>nd</sup> edition, 1391), "Design of Steel Structures (Volume II)", Science &amp; Literature Press</li> </ol>			

<b>Course Name:</b> Reinforced Concrete Structures I	نام فارسی درس: سازه‌های بتن‌آرمه ۱		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b> Concrete Technology, Structural Analysis		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The objective of this course is to get acquaintance with the basics of the design of reinforced concrete structures.			
<b>Course contents:</b>			
<b>(Theoretical Section):</b>			
1. Preliminaries and Mechanical Properties of Concrete and Rebar			
2. Design Methods of Reinforced Concrete (RC) Members, Safety Concepts and Limit States			
3. Behavior of RC beams in flexure under Different Loading Situations, Flexural Resistance of Beams, Design of Beams for Flexure and its Reinforcement			
4. Behavior of RC beams in Shear, Shear Resistance of Beams, Design of beams for shear, and its Reinforcement			
5. Bond between Concrete and Reinforcement: Theoretical and Experimental Basis, Anchorage of Reinforcement in Concrete, Splicing of Reinforcement, Anchorage and Splicing Requirements			
Note: This course shall Conform to the National Construction Regulations and National Concrete Code			
<b>(Practical Section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b>			
1. I.M. Kani, Design of Reinforced Concrete Structures, Tehran University Press Vols. 1 and 2, 2018			
2. E. G. Nawy, Reinforced Concrete, A Fundamental Approach, 5th ed., Prentice Hall, 2003, Ch.8 to16.			
3. J.G. MacGregor and J.K. Wight, Reinforced Concrete Mechanics and Design, Fourth Edition, Pearson-Prentice Hall, 2005.			
4. ACI Committee 318, Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14), American Concrete Institute, Farmington Hills, MI, 2014.			

<b>Course name:</b> Open Channel Hydraulics	نام فارسی درس: هیدرولیک کانال‌های باز		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Fluid Mechanics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> To enable students understand and apply the fundamental principles of open channel hydraulics			
<b>Course contents:</b> <b>(Theoretical section):</b> <b>1-Introduction:</b> open channel vs pipe flow, geometric parameters of open channels, different flow regimes based on Froude and Reynolds Numbers, classification of open channel flow, velocity and pressure distribution, review of governing equations <b>2-The energy principle in open channel flow:</b> specific energy, E-y curve, alternate depths, critical flow, application to rectangular channel section, the transition problem-changes in bed level and width, choking, analytical approach to the transition problem, nonrectangular channel sections, critical depth calculation. <b>3-The Momentum principle in open channel flow:</b> Momentum principle and momentum function (specific force), conjugate depths, hydraulic jump in rectangular horizontal channels, comparison of E-y and F-y curves, nonrectangular channels <b>4- Uniform flow/ flow resistance:</b> definition, resistance equation, empirical relations, the Manning equation and roughness coefficient, normal depth, classification of bed slopes, calculation of uniform flow, equivalent roughness, compound channels, the best hydraulic section <b>5-Gradually varied flow- theory:</b> governing equation, classification of water surface profiles, depth variation along the channel, combination of water surface profiles <b>6-Gradually varied flow- calculation:</b> calculation methods for prismatic and non-prismatic channels (Euler method, direct step method, standard step method . . . ), Software for calculation of water surface profiles  <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b> 1- Open Channel Hydraulics, Ven Te Chow, 1959 2- Open Channel Flow, F. M. Henderson, 1966 3- Open Chanel Hydraulics, R.H. French, 1986 4- Open Channel Flow, M.H. Chaudhry 5- Open Channel Hydraulics, Akan, 2006 6- Open Channel Hydraulics, Sturm, 2001			

<b>Course Name:</b> Soil Mechanics Laboratory	نام فارسی درس: آزمایشگاه مکانیک خاک		
<b>Credits:</b> 1	<b>Credit type:</b> Practical		
<b>Course type:</b> Mandatory	<b>Prerequisite Courses:</b>		
<b>Number of hours:</b> 32	Soil Mechanics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b>			
The major goal of this course is the practical understanding of basic soil mechanics concepts as well as common laboratory techniques to quantify the mechanical properties of soils. Students who successfully complete this course will be able to:			
<ol style="list-style-type: none"> <li>1. describe common soil mechanic test methods and standards along with their terminology and applicability</li> <li>2. perform common laboratory tests according to the standard procedures to quantify mechanical and physical properties of soils</li> <li>3. analyze, understand, interpret and properly apply laboratory test results for geotechnical design</li> </ol>			
<b>Course contents (Theoretical Section):</b> None			
<b>Course contents (Practical Section):</b>			
Chapter 1. Soil sampling methods, common soil mechanics laboratory tests, preparing soil samples for testing, laboratory report writing			
Chapter 2. Determination of moisture content of soils, determination of specific gravity of soil solids			
Chapter 3. Analysis of grain size distribution: sieve analysis (dry and wet methods), hydrometer analysis			
Chapter 4. Determination of Atterberg limits of soils (liquid limit, plastic limit and shrinkage limit tests)			
Chapter 5. Sand equivalent test (optional)			
Chapter 6. Permeability tests (constant head and falling head methods)			
Chapter 7. Laboratory soil compaction (standard and modified Proctor tests)			
Chapter 8. Field measurement of dry density of compaction by sand cone method			
Chapter 9. California Bearing Ratio (CBR) test			
Chapter 10. Consolidation test			
Chapter 11. Direct shear test			
Chapter 12. Unconfined compression test			
Chapter 13. Static triaxial test			
<b>Evaluation method:</b> final test\written test\practical test			
Final test (writing\operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
1- American Society of Testing Materials (ASTM), Standard Test Methods, Soil and Rock Section,			
2- Kalinski, M.E., <i>Soil Mechanics Lab Manual</i> , 2nd edition, John Wiley INC, 2011.			
3- Bardet, J., <i>Experimental Soil Mechanics</i> , Prentice-Hall, Inc., NJ, 1997.			
4- Das B.M., <i>Soil Mechanics Laboratory Manual</i> , Sixth edition, Oxford University Press, 2002.			
5- Bowles J.E., <i>Engineering Properties of Soils and Their Measurement</i> , McGraw-Hill, 1992.			

<b>Course name:</b> Engineering hydrology	نام فارسی درس: هیدرولوژی مهندسی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Statistics and probability, Mechanics of fluids.		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Getting familiar with components of water cycle and their analysis methods			
<b>Course contents:</b> <b>(Theoretical section):</b> 1- Definition of engineering hydrology, water cycle and its components 2- Definition of watershed and its characteristics 3- The basis of meteorological studies including introducing climate, climate change and weather changes, introducing weather variables and their variations in different layers of atmosphere and calculating the precipitable water 4- Rainfall measuring methods and validation of collected data, regionalization of rainfall methods 5- Evapotranspiration (monitoring methods and experimental methods for calculating evaporation and potential evapotranspiration) 6- Infiltration (modeling and monitoring methods) 7- Hydrology of urban areas and small watersheds 6- Groundwater hydrology (geological characteristics, different types of groundwater resources, hydraulic of wells, the basis of correct withdrawal of aquifers and introducing the sustainable and traditional methods of groundwater resources withdrawal in Iran. 7- Methods of measuring surface flows and hydrograph analysis 8- Hydrological routing in reservoirs and channels 9- Statistical hydrology (risk analysis and reliability, return period, fitting probability distributions)  <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b> 1- Singh, V. J. (1991), "Elementary Hydrology", 2nd Edition, Printice Hall. 2- Gupta, R. S. (2001) "Hydrology and Hydraulic Systems", 2nd Edition, Printice Hall. 3- Bedient, P. B. and C. H. Wayne (2007), "Hydrology and Floodplain Analysis", 4th Edition, Addison – Wesley Publishing Company. 4- Viessman, W., J. W. Knapp, G. L. Lewis, and E. Harbaugh (2002), "Introduction to Hydrology", 5th Edition, Harper and Row, Publishers.			

<b>Course name:</b> Geometric Design of Highways	نام فارسی درس: طرح هندسی راه		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Surveying Theory, Practice Soil Mechanics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The purpose of this course is to familiarize students with the basics and principles of road construction and their application in the design and implementation of road infrastructure.			
<b>Course contents:</b> <b>(Theoretical section):</b> Introduction to road engineering and planning Design parameter & standards Horizontal and vertical alignments Earthworks Surface water discharge Road infrastructures and safety  <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	%
<b>References:</b> 1. Code 15, Plan and Budget Organization of Iran (in Persian) 2. Code 101, Plan and Budget Organization of Iran (in Persian) 3. A Policy on Geometric Design of Highways and Streets, 2011, AASHTO. 4. Geometric Design of Roads handbook, 2015, Wolhuter, K.M., CRC Press			

<b>Course name:</b> Steel Structures II	نام فارسی درس: سازه های فولادی ۲		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisites:</b>		
<b>Number of hours:</b> 32	Solid Mechanics II, Steel Structures I		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Introduction to the principles and methods of design of steel structures			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1. Design of plate girders including design of flange, web and transverse stiffeners, methods of strengthening the flange of the beams, determining allowable shear stress in the web, tension field action</li> <li>2. Special issues in the design of beams and columns, bearing and yielding of the beam webs and columns, the effects of concentrated loads on the web and flange</li> <li>3. Centrically and eccentrically braced frames and their seismic design principles</li> <li>4. Seismic design of moment frames</li> <li>5. Equipment and technology of connections in steel structures, types of bolts and welds, welding methods and equipment, methods of establishing friction-based bolted connections</li> <li>6. Design of beam and column connections (simple, fixed and semi-fixed), bracing connections, column splice, column connection to the base plate, truss connections</li> <li>7. Variable sections design</li> </ol> <p><b>Note:</b> The contents of this course must be in accordance with the tenth national code of the buildings (official code of the country).</p>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50 %	30 %	20 %	0 %
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. M. Sadeghazar (1374), "Structural Steel, Theoretical-Applied", University of Tehran Press</li> <li>2. R. Mirghaderi &amp; M. Azhari (1392) "Design of Steel Structure, Volume I", Pillars of Knowledge Press</li> <li>3. M. Azhari &amp; R. Mirghaderi (1385) "Design of Steel Structures, Volume II ", Pillars of Knowledge Press</li> <li>4. M. Azhari &amp; R. Mirghaderi (1392) "Design of Steel Structures, Volume III (Connections)", Pillars of Knowledge Press</li> <li>5. S. Tahouni (2<sup>nd</sup> edition, 1393), "Design of Steel Structures (Volume I)", Science &amp; Literature Press</li> <li>6. S. Tahouni (2<sup>nd</sup> edition, 1391), "Design of Steel Structures (Volume II)", Science &amp; Literature Press</li> </ol>			

<b>Course Name:</b> Reinforced Concrete Structures II	نام فارسی درس: سازه‌های بتن‌آرمه ۲		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Reinforced Concrete Structures I, Solid Mechanics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The objective of this course is to get acquaintance with the basics of the design of reinforced concrete structures.			
<b>Course contents:</b>			
<b>(Theoretical Section):</b>			
1. Design for Torsion			
2. Serviceability Limit States			
3. Design of Short Columns			
4. Design of Slender Columns			
5. Design of One-Way Slabs			
6. Design of Two-Way Slabs: Direct Method, Shear in Two-Way Slabs, Moment and Shear Transfer from Slab to Column, Design of Slab Thickness for Deflection Control, Equivalent Frame Method			
7. Design of Foundations			
<b>Note:</b> This course shall Conform to the National Construction Regulations and National Concrete Code			
<b>(Practical Section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
1. I.M. Kani, Design of Reinforced Concrete Structures, Tehran University Press Vols. 1 and 2, 2018			
2. E. G. Nawy, Reinforced Concrete, A Fundamental Approach, 5th ed., Prentice Hall, 2003, Ch.8 to16.			
3. J.G. MacGregor and J.K. Wight, Reinforced Concrete Mechanics and Design, Fourth Edition, Pearson-Prentice Hall, 2005.			
4. ACI Committee 318, Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14), American Concrete Institute, Farmington Hills, MI, 2014.			



<b>Course name:</b> Water and Wastewater Engineering	نام فارسی درس: مهندسی آب و فاضلاب		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Engineering Hydrology, Open channel Hydraulics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Introduction to design principles of water systems, urban wastewater and runoff collection networks.			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1. Estimation of water demand: factors affecting water consumption, residential, industrial and general demand, water demand fluctuations</li> <li>2. Fundamentals of capacity design for water supply system components: water resources, transmission lines, treatment plant, water storage tanks, water distribution networks.</li> <li>3. Design period for water and wastewater system components, prediction of population over the design period.</li> <li>4. Characteristics of drinking water quality: pH, hardness, alkalinity, how to measure and quantify them, water quality standards, microbiological indices and methods of water disinfection.</li> <li>5. Types of water storage tanks and calculation of their volume</li> <li>6. Hydraulic flow in pressurized channels and providing different computational methods.</li> <li>7. Technical basics and limitations in the design of transmission lines and distribution networks.</li> <li>8. Types of water distribution networks and their hydraulic calculations.</li> <li>9. Components of water distribution network: pipes, joint, valves.</li> <li>10. Water distribution network structure: location of pipes in corridors, how to use pipes, pressure test and ...</li> <li>11. Introducing wastewater quality parameters: BOD, COD, DO, suspended solids, color, odor, and temperature.</li> <li>12. Factors polluting surface and groundwater resources and introducing the self-purification phenomenon of natural systems, including rivers.</li> <li>13. Determine the amount of wastewater according to the effective factors, fluctuations in the amount of wastewater and determine the design flow rate.</li> <li>14. Different ways of collecting wastewater and runoff.</li> <li>15. Hydraulic basics of collecting networks and related calculations.</li> <li>16. Collecting network facilities: Pipes, manholes, rainwater inlets, rainwater overflows, washing ponds, etc.</li> </ol>			
<b>(practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
45%	45%	10%	0%
<b>References:</b>			

- 1- Monzavi, M.T., (2014), Water supply, University of Tehran Press.
- 2- Monzavi, M.T., (2012), Wastewater collection, University of Tehran Press.
- 3- Monzavi, M.T., (2011), Wastewater treatment, University of Tehran Press.
- 4- Taebi, A., and Chamani, M.R., (2016), Water distribution networks, Isfahan University of Technology Press.
- 5- Tabesh, M., (2016), Advanced modeling of water distribution networks, University of Tehran Press.
- 6- Islamic Republic of Iran, Vice Presidency For Strategic Planning and Supervision, Office of Deputy for Strategic Supervision (2013), Design criteria for urban and rural transmission and distribution of water systems, Publication No. 117-3 First Revision, Office of Deputy for Strategic Supervision Tehran, Iran.
- 7- Islamic Republic of Iran, Plan and Budget Organization (2016), Guidelines for Design of Wastewater Collection Systems, (Supersedes Publications No. 118-3 & 163), Publication No. 118, Tehran, Iran.
- 8- Islamic Republic of Iran, Vice Presidency For Strategic Planning and Supervision, (2012), Design criteria for urban and rural transmission and distribution systems, Publication No. 556, Office of Deputy for Strategic Supervision Tehran, Iran.
- 9- Twort, A.C., Law, F., Crowley, F., and Ratnayaka, D., (2000), Water supply, Edward Arnold (Publisher) Ltd.
- 10- Savic, D., and Banyard, J., (2011), Water distribution systems, ICE Publishing.

<b>Course Name:</b> Loading on Structures	نام فارسی درس: بارگذاری
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical
<b>Course Type:</b> Mandatory	<b>Prerequisite Courses:</b> Stochastic and Probability, Modeling of Structures, Steel Design I, Reinforced Concrete Design I, Structural Analysis (Corequisite)
<b>Number of hours:</b> 32	
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<b>Type of Advanced Training:</b>	
<b>Course description and objectives:</b>	
<p>The course helps students to understand different loads applied to structures based on existing codes and the way to withstand them in steel and concrete buildings in order to enable students to do their steel and concrete design projects.</p> <p>Upon successful completion of the course, students will be able</p> <ol style="list-style-type: none"> <li>1. To get familiar with different gravity and lateral loads.</li> <li>2. to learn vertical and lateral load carrying systems in steel and concrete building structures,</li> <li>3. to understand computer modeling and analysis of structures in theory and in practice by doing a couple of projects.</li> </ol>	
<b>Course contents (Theoretical Section):</b>	
<ol style="list-style-type: none"> <li>1. To briefly review phases of building projects, uncertainty in load and strength, safety concepts in structures, code procedures in loading, introduction to various loads applied to structures</li> <li>2. Vertical loads: dead (permanent) loads and live (service) loads, worst case scenario for live loads</li> <li>3. Live load reduction, loads during construction, impact loads, vehicle impacts.</li> <li>4. Snow load, unsymmetrical loading, overburden of snow loads</li> <li>5. Other environmental loads, loads due to temperature, material deformations, water pressure and soil (passive and active) pressure, bearing settlement</li> <li>6. Gravity resisting building systems, distribution of vertical loads among them and analysis of such systems against gravity loads by approximate and exact methods, giving first project</li> <li>7. Lateral loads, wind load, theory and computing basics</li> <li>8. Earthquake loads, seismology and destructive seismic damages</li> <li>9. Lateral resisting systems, appropriate building forms, distribution of lateral loads among load bearing systems and analysis of such systems against lateral loads by approximate and exact methods, giving second project</li> <li>10. Static method to determine seismic loads, computer modeling</li> <li>11. Loading in special structures (containers, platforms, guyed towers, silos, ...)</li> <li>12. Load combinations based on different types of codes</li> <li>13. Brief review of dynamic methods (spectral and time-history)</li> </ol> <p>Loading in highway and railroad bridges</p>	
<b>Course contents (Practical Section):</b>	
- Two Projects in team groups of 3 students, to get familiar with the vertical and horizontal loads applied to buildings	

**Evaluation method:** final test\written test\practical test

Final test (writing\operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

- 1- Zahrai, S.M., "Design Loads of structures", Fadak Isatis Press, 2014.
- 2- Standard 2800 permanent committee, Seismic building design code, BHRC press, Version 4, 2015
- 3- Ministry of Road, Housing and Urban Development, National Building Guidelines: Sec. 6, Version 3, 2015.
- 4- National Building Code of Canada, National Research Council, 2015.
- 5- ASCE7-10, "Minimum Design Loads for Buildings and Other Structures", American Society of Civil Engineers, 2010, 3rd Edition.
- 6- AISC/ANSI 341-10, "Seismic provisions for structural steel buildings", American Institute of Steel Construction, Inc., 2010

<b>Course name:</b> Water and Wastewater Engineering project	نام فارسی درس: پروژه مهندسی آب و فاضلاب		
<b>Credits:</b> 1	<b>Credit type:</b> Practical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Water and Wastewater Engineering		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b> project			
<b>Course description and objectives:</b> Design of water distribution network, collection and disposal of wastewater and runoff			
<b>Course contents:</b> <b>(Theoretical section):</b> None <b>(practical section):</b> Project: In this section, students will present the full design of the water distribution, collection and disposal network of a city or township, the plan of which will be specified by the respective professor. During the course of the project, students should become more familiar with the concepts they have seen in the respective courses. It should even be possible to try to make the locations of the project realistic.			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing of report)	Software skills	Continuous evaluation	Project
<b>30%</b>	<b>50%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
1- Islamic Republic of Iran, Vice Presidency For Strategic Planning and Supervision, Office of Deputy for Strategic Supervision (2013), Design criteria for urban and rural transmission and distribution of water systems, Publication No. 117-3 First Revision, Office of Deputy for Strategic Supervision Tehran, Iran. 2- Islamic Republic of Iran, Plan and Budget Organization (2016), Guidelines for Design of Wastewater Collection Systems, (Supersedes Publications No. 118-3 & 163), Publication No. 118, Tehran, Iran.			

<b>Course name:</b> Hydraulic Structures	نام فارسی درس: بنا های آبی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Soil Mechanics, Open Channel Hydraulics		
<b>Advanced training:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
<b>Type of advanced training:</b> Educational Field Trip			
<b>Course description and objectives:</b>			
<ul style="list-style-type: none"> <li>- To get a knowledge of various types of reservoir dam and their design principles.</li> <li>- To understand the different elements of dam, including spillways, outlet works and gates, and to get a knowledge on their design principles.</li> <li>- To train the students in planning and designing of various types of diversion works and their related components.</li> <li>- To get a knowledge of various types conveyance and control structures and their design procedure.</li> </ul>			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ul style="list-style-type: none"> <li>- <b>Storage Dams.</b> (Purpose of storage dams, Type of dams, Choice of dam site, Gravity dam, Arc dam, Buttress dam)</li> <li>- <b>Spillways.</b> (Purpose of spillways, Types of spillways, Components of spillways)</li> <li>- <b>Outlet works.</b> (Purpose of outlets, Types of outlets, Hydraulics of outlets, elements of outlet)</li> <li>- <b>Diversion works.</b> (Design of diversion dam and its related structures including Headgate, Sluiceway, fish-ladder. Analyzing and designing of different piping control systems.)</li> <li>- <b>Drops.</b> (Different types of drops, Design principles of drops)</li> <li>- <b>Stone Structures.</b> (Bank protection, Coastal protection works, Stone drop structures, Stone dissipation basin)</li> <li>- <b>Water conveyance systems.</b> (Flumes, invert siphons, .. )</li> </ul>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>40%</b>	<b>25%</b>	<b>15%</b>	<b>20%</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1- Hydraulic Structures, C. D. Smith, (Hydraulic engineer); University of askatchewan. (1978)</li> <li>2- Hydraulic Structures 4th Edition, P. Novak, A.I.B. Moffat and C. Nalluri, R. Narayanan (2004)</li> <li>3- Hydraulic Design Handbook, Larry W. Mays. (1999)</li> <li>4- Hydraulic Structures, Chen, Sheng-Hong (2015)</li> </ol>			

<b>Course name:</b> Construction Materials Lab	نام فارسی درس: آزمایشگاه مصالح ساختمانی		
<b>Credits:</b> 1	<b>Credit type:</b> Practical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Concrete Technology		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Introduction to the main test methods for quality control of construction materials, performing the tests, and preparing test reports			
<b>Course contents:</b> <b>(Theoretical section):</b> None			
<b>(Practical section):</b> The test methods include: <ul style="list-style-type: none"> <li>1- Consistency of cement paste</li> <li>2- Aggregate grading</li> <li>3- Mix design, slump, and compressive strength of concrete</li> <li>4- Abrasion resistance of aggregates</li> <li>5- Tension of steel rebar</li> <li>6- Torsion of steel rebar</li> <li>7- Surface harness of steel</li> </ul>			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>0%</b>	<b>50%</b>	<b>0%</b>
<b>References:</b> ASTM A370, ASTM A400-69, ASTM E8, ASTM E111, ASTM C39, ASTM C131/535, ASTM C136, ASTM C143, ASTM C151, ASTM C187, ASTM C192			

<b>Course name:</b> Construction Equipment	نام فارسی درس: ماشین آلات عمرانی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Geometric Design of Highway		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b>			
<p>Students in this course get familiar with the execution method and equipment employed for constructing roads and buildings. They also get introduced to the technical specifications, efficiency, and proper operation and effective maintenance of construction equipment.</p> <p>Besides, students learn to calculate the ownership and operating costs, the operating cycle, and the production of construction equipment. They also learn how to plan for replacing construction equipment with a new option and identifying the optimal combination of machinery fleets to minimize labor costs or to maximize output production.</p>			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1. Economic considerations in the use of construction equipment</li> <li>2. Depreciation, cost, ownership, and use of construction equipment, calculation of economic life of construction equipment, funding source of construction equipment supply (e.g., rent or ownership)</li> <li>3. Factors affecting the operation of equipment</li> <li>4. Influence of soil type, rolling resistance on friction, slope, temperature, sea level.</li> <li>5. Introduction to road construction equipment in terms of machine type, capacity, and operation methods, including:</li> <li>6. Tractors, rollers, bulldozers, graders, rippers, excavators, skippers, draglines, clamshell, cranes, diggers, trucks, TBMs, conveyors, elevators, compressors, air hammers, drill wagons, pumps, concrete mixers, screening and sand cleaning, finishers, concrete mixers, pile drivers, etc.</li> <li>7. Service and maintenance of equipment.</li> <li>8. Site mobilization and equipment management:</li> <li>9. Planning the fleet of equipment to carry out the operations and execution.</li> <li>10. Investigating the methods of performing soil operations.</li> <li>11. Excavation, Trenching, Backfill, embankment, compaction, etc.</li> <li>12. Road pavement equipment and techniques.</li> </ol>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. Construction Planning, Equipment, and Methods, 7th, Ed. Peurifoy, 2006, McGraw Hill.</li> <li>2. Construction Methods and Management, 7th, Ed., Nunnally, 2006, Prentice Hall.</li> </ol>			



3. Modern Construction Equipment and Methods, Frank Harris, Longman, 1989.
4. Construction Equipment and its Management, S.C. Sharam.
5. Moving the Earth, North Castle Books 1976.
6. Construction Equipment, J.E. Russell, prentice-Hall, 1985.

<b>Course name:</b> Project Evaluation & Cost Estimate	نام فارسی درس: متره و برآورد پروژه		
<b>Credits:</b> 1	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisites:</b> Steel Structures I, Reinforced Concrete Structures I, Architectural and Urban Design, Highway Geometric Design (Corequisite)		
<b>Number of hours:</b> 16			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Familiarizing students with estimation of building construction work and price analysis of various items in building construction.			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1. Familiarity with different types of contract, holding tenders and contract terms</li> <li>2. Familiarity with how directory books are prepared</li> <li>3. Familiarity with the relationship between the employer, supervisor, and contractor and their duties</li> <li>4. Methods of estimating different types of construction works</li> <li>5. Price analysis of different construction tasks</li> <li>6. Method of transferring the values obtained from estimating different parts and preparing the estimate summary</li> <li>7. Assessment of contractor's invoice adjustment and conversion</li> </ol>			
<b>(Practical section):</b>			
<ol style="list-style-type: none"> <li>1. After teaching the aforementioned subjects and familiarizing the students with the general principles of estimation and cost analysis of different types of construction work, it is required that the students estimate the cost of all or some parts of a complete executive map and present their calculations in the format of a definite invoice.</li> <li>2. Learning cost estimation software</li> </ol>			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
30%	0 %	20 %	50 %
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. The Base Unit Price List, The Management and Planning Organization, 1394</li> <li>2. A. Milanizadeh, "Cost Engineering: Application of Cost Estimation", Milanafzar Computer Company, 1387</li> <li>3. M. A. Arjmand &amp; M. Nikbakht, "Estimation and Contracting Principles", Azadeh Press, 1390</li> <li>4. D. Pratt, "Estimating for Residential Construction", Cengage Learning, 2011</li> <li>5. F. R. Dagostino &amp; L. Feigenbaum, "Estimating in Building Construction", Pearson Education, 1999</li> <li>6. S. J. Peterson, "Construction Estimating using Excel", Prentice-Hall Inc., 2006</li> <li>7. D. Pratt, "Fundamentals of Construction Estimating" Cengage Learning, 2010</li> <li>8. R. S. Means, "Means Illustrated Construction Dictionary", 2010</li> </ol>			

<b>Course name:</b> Steel Structures Project	نام فارسی درس: پروژه سازه های فولادی		
<b>Credits:</b> 1	<b>Credit type:</b> Practical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Loading on Structures , Steel Structures II		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Learning advanced design methods of steel structures and performing full design of a typical steel building			
<b>Course contents:</b>			
<b>(Theoretical section):</b> None			
<b>(Practical section):</b>			
1. Choosing the architectural plan			
2. Selection of resistant systems for vertical and lateral loads considering behavioral issues and economic issues			
3. Calculation of dead, live, and lateral loads			
4. Preliminary analysis and design			
5. Analysis and design using existing software and comparison with the approximate manual methods			
6. Structural plan, joints, foundation etc.			
7. Preparation of shop drawings with appropriate scale			
8. Design of a multi-story building or an industrial hall or a space-frame structure should be selected as the project.			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
30 %	0 %	20 %	50%
<b>References:</b>			
1. M. Sadeghazar (1374), "Structural Steel, Theoretical-Applied", University of Tehran Press			
2. R. Mirghaderi & M. Azhari (1392) "Design of Steel Structure, Volume I", Pillars of Knowledge Press			
3. M. Azhari & R. Mirghaderi (1385) "Design of Steel Structures, Volume II ", Pillars of Knowledge Press			
4. M. Azhari & R. Mirghaderi (1392) "Design of Steel Structures, Volume III (Connections)", Pillars of Knowledge Press			
5. S. Tahouni (2 <sup>nd</sup> edition, 1393), "Design of Steel Structures (Volume I)", Science & Literature Press			
6. S. Tahouni (2 <sup>nd</sup> edition, 1391), "Design of Steel Structures (Volume II)", Science & Literature Press			

<b>Course Name:</b> Reinforced Concrete Structures Project	نام فارسی درس: پروژه سازه های بتن آرمه		
<b>Credits:</b> 1	<b>Credit type:</b> Practical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b> Reinforced Concrete Structures II, Basics of Modeling of Structures, Loading on Structures		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The objective of this course is to get acquaintance with the complementary issues in the design of reinforced concrete (RC) structures and performance of the complete design of a typical reinforced concrete structure.			
<b>Course contents:</b>			
<b>(Theoretical Section):</b>			
To complete the issues related to the course of the design of reinforced concrete structures 2, the following topics are first covered:			
<ol style="list-style-type: none"> <li>1. General Principles of the Design of Reinforced Concrete Structures</li> <li>2. Plastic Design and Analysis of Slabs</li> <li>3. Design of RC Stair Cases</li> <li>4. Ductile Design of RC Structures under Seismic Loading</li> <li>5. Design of Connections in RC Structures</li> <li>6. General Principles of Preparation of Drawings of RC Structures</li> </ol>			
<b>Note:</b> This course shall Conform to the National Construction Regulations and National Concrete Code			
<b>(Practical Section): Complete Analysis and Design of a Typical RC Structure</b>			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>0%</b>	<b>0%</b>	<b>20%</b>	<b>80%</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. I.M. Kani, Design of Reinforced Concrete Structures, Tehran University Press Vols. 1 and 2, 2018</li> <li>2. E. G. Nawy, Reinforced Concrete, A Fundamental Approach, 5th ed., Prentice Hall, 2003, Ch.8 to16.</li> <li>3. J.G. MacGregor and J.K. Wight, Reinforced Concrete Mechanics and Design, Fourth Edition, Pearson-Prentice Hall, 2005.</li> <li>4. ACI Committee 318, Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14), American Concrete Institute, Farmington Hills, MI, 2014.</li> </ol>			

<b>Course name:</b> Foundation Engineering	نام فارسی درس: مهندسی پی
<b>Credits:</b> 3	<b>Credit type:</b> Theoretical
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b> Soil Mechanics, Reinforced concrete structures I , Soil Mechanics Laboratory
<b>Number of hours:</b> 48	
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<b>Type of advanced training:</b>	
<b>Course description and objectives:</b>	
<p><b>Course contents:</b>  <b>(Theoretical section):</b>  <b>1.Subsurface Investigation and characterization</b>  -Geophysical and Geotechnical investigation  -Drilling and boring  -Sampling  -In-situ testing  -Laboratory testing  -Determination of soil properties for foundation design  <b>2.Shallow Foundation</b>  -Types of shallow foundations  -Bearing capacity: under axial load, eccentric loading and, inclined loading, ground inclination and layered soils  -Settlement of shallow foundation  -Foundations on problematic soils (Expansive soils, compressible soils, ...)  -Ground water effects on shallow foundations  <b>3.Geotechnical Design of shallow foundations</b>  spread footings, strap footing with grade beam, continuous footing, mat foundations, rigid and flexible foundations  <b>4.Earth retaining structures</b>  Types of retaining wall, Lateral earth pressures, hydrodynamic pressures, stability of retaining walls, Design of retaining walls,  <b>5.Soil excavation and methods of stabilization of excavations</b>  <b>6.Deep foundations</b>  Types of deep foundations  Bearing capacity based on static and dynamic Methods  Design of deep foundations  <b>7. Pile group</b>  , Axial capacity and load transfer mechanism, design of pile and pile cap  <b>8. It is necessary that the foundations of a structure are designed by students based on a geotechnical investigation report.</b></p> <p><b>(Practical section):</b> None</p>	

**Evaluation method:** final test\ written test\ practical test

Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

- 1.Kambiz Behnia & Amir Mohammad Tabatabaei (2011), Soil mechanics: second volume, Foundation Engineering, University of Tehran Press
- 2.Donald P. Coduto, William A. Kitch & Man-chu Ronald Yeung (2016), Foundation Design (third edition), Pearson
- 3.Joseph E. Bowels (2001), Foundation Analysis and Design, McGraw-Hill
- 4.Braja M. Das (2003), Principles of Foundation Engineering, CL Engineering Publisher

<b>Course name:</b> Pavement Engineering	نام فارسی درس: روسازی راه		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Construction Materials, Geometric Design of Highways		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Understanding fundamentals of design and construction of pavements, pavement maintenance and rehabilitation.			
<b>Course contents:</b> <b>(Theoretical section):</b> 1- Pavement function on roads, different types of pavements, factors affecting pavement design 2- Engineering properties of road materials and pavement layers' materials, subbase, base, asphalt binder (bitumen) types and laboratory tests, lime treated (stabilized) materials 3- Influencing environmental factors (freezing and moisture) on pavement design 4- Pavement loading condition, distribution of stress and strain in pavement structure 5- Typical methods for design of concrete pavements 6- Typical methods for design of asphalt pavements (roads, runways, taxiways and aprons) 7- Typical methods for design of concrete pavements for airports (runways, taxiways, and apron) 8- Typical methods for design of asphalt pavements and unpaved roads 9- Pavement distress types and evaluation 10- Maintenance and rehabilitation for asphalt pavement and unpaved roads 11- Typical methods for design of overlays 12- Effect of economic factors on pavement design 13- Paving operation  <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b> 1. P.G. Lavin (2003), "Asphalt Pavements – A Practical Guide to Design, Production, and Maintenance for Engineers and Architects". 2. R.B. Mallick and T.E. Korchi (2013), "Pavement Engineering – Principles and Practice", 2nd Edition. 3. Yuang H. Huang (2003), "Pavement Analysis and Design", 2nd Edition.			

<b>Course name:</b> Pavement Laboratory	نام فارسی درس: آزمایشگاه روسازی راه		
<b>Credits:</b> 1	<b>Credit type:</b> Practical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Pavement Engineering		
<b>Advanced training:</b> Yeas <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b>			
1- Understanding the physical and engineering properties of asphalt binders (bitumen) and asphalt binder laboratory test methods.			
2- Understanding weight-volume (volumetric) relationships for asphalt mixes, RICE test, and design of asphalt mix using Marshall mix design method.			
<b>Course contents:</b>			
<b>(Theoretical section):</b> None			
<b>(Practical section):</b>			
Asphalt binder test methods for measuring engineering and physical properties			
Asphalt mix design using Marshall mix design method			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
1. ASTM Standards.			
2. NCHRP Publications.			



<b>Course name:</b> Traffic Engineering	نام فارسی درس: مهندسی ترافیک
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>
<b>Number of hours:</b> 32	Statistics and Probability , Road Geometric Design
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<b>Type of advanced training:</b>	
<p>Course description and objectives: to make students familiar with the initial concepts of traffic engineering and the role it plays in planning, design and the management of urban and rural transportation systems. This course helps students learn basic components of traffic engineering and their mathematical relationships, and also provides information about traffic control systems which are means of improving the traffic measures of effectiveness.</p>	
<p>Course contents: (Theoretical section):</p> <ol style="list-style-type: none"> <li>1. The profession of transportation engineering and the place of traffic engineering within</li> <li>2. The responsibilities of traffic engineers in traffic control and management</li> <li>3. Types of transportation modes: highway, rail, air, and water</li> <li>4. The main components of any transportation mode: human, vehicle, and travelway</li> <li>5. Human characteristics (visual acuity, glare vision, hearing perception, walking speed, perception reaction time, ...)</li> <li>6. Vehicle characteristics: static, kinematic, dynamic( weight, dimensions, braking distance, ...)</li> <li>7. Travelway characteristics (stopping sight distance, decision sight distance, passing sight distance)</li> <li>8. Traffic studies (traffic volume, speed, travel time, and parking)</li> <li>9. Primary parameters of traffic flow: flow, density, and speed (flow versus density, time mean speed versus space mean speed)</li> <li>10. Secondary parameters of traffic flow: headway and spacing</li> <li>11. Macroscopic versus microscopic relationships among traffic flow parameters</li> <li>12. Fundamental diagram of macroscopic traffic flow</li> <li>13. Mathematical relationships between macroscopic parameters (flow-density, speed-density, and speed-flow)</li> <li>14. Samples of macroscopic traffic flow models (Greenshields, Greenberg, and Underwood models)</li> <li>15. Calibration of macroscopic traffic models using linear regression analysis</li> <li>16. Shock waves in traffic streams</li> <li>17. Application of Shock wave theory in estimating the lengths of traffic queues (signalized intersections, bottlenecks)</li> <li>18. Gap and Gap acceptance</li> <li>19. Stochastic approach to gap and Gap acceptance problems (capacity analysis of TWSC intersections)</li> <li>20. Introduction of queuing theory (single channel, undersaturated, finite and infinite queues)</li> <li>21. Deterministic and stochastic analyses of traffic queues using queuing theory</li> <li>22. Types of intersection and intersection control</li> <li>23. Conflict points at intersections</li> <li>24. Types of traffic signals (fixed and actuated)</li> <li>25. Timing of fixed signals at isolated intersections (calculations of yellow interval, cycle length, minimum</li> </ol>	

green time, ...)

- 26. Timing of semi-actuated and actuated signals (initial and extendable portions, extension limit, and unit extension of green interval)
- 27. Timing of fixed signals at arterial routes (simultaneous, alternate, and progressive systems)
- 28. Introduction to the highway capacity manual (HCM)

**(Practical section):** None

**Evaluation method:** final test\ written test\ practical test

Final test (writing)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

- 1. Garber, N. J. and Hoel, L.A., Traffic and Highway Engineering, Fifth Edition, SI Edition Stamford, CT, USA : Cengage Learning, 2015.
- 2. Highway Capacity Manual, Sixth Edition: A Guide for Multimodal Mobility Analysis, Transportation research Board, 2016.

<b>Course name:</b> Highway Engineering Project	نام فارسی درس: پروژه راه		
<b>Credits:</b> 1	<b>Credit type:</b> Practical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Pavement engineering , Traffic Engineering		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The purpose of this course is to familiarize students with the application of the basics and principles of road construction to design a road.			
<b>Course contents:</b>			
<b>(Theoretical section):</b> No			
<b>(Practical section):</b>			
The topographic map of a region of Iran is given to each group and several mandatory points are identified. Each group should take the best route through the mandatory points considering what they have learnt in their previous courses particularly geometric design of highways. They should present the road horizontal alignment, vertical alignment, cross-sections and mass-haul (Bruckner) diagram. Further, they should estimate the road construction cost based on the standardized list price.			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>%</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. Code 15, Plan and Budget Organization of Iran (in Persian)</li> <li>2. Code 101, Plan and Budget Organization of Iran (in Persian)</li> <li>3. A Policy on Geometric Design of Highways and Streets, 2011, AASHTO.</li> <li>4. Geometric Design of Roads handbook, 2015, Wolhuter, K.M., CRC Press</li> </ol>			

<b>Course name:</b> Construction Methods for Civil Engineering Projects	نام فارسی درس: روش‌های ساخت پروژه‌های عمرانی
<b>Credits:</b> 3	<b>Credit type:</b> Theoretical
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b> Steel Structures I, Reinforced Concrete Structures II, Construction Equipment
<b>Number of hours:</b> 48	
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<b>Type of advanced training:</b>	
<b>Course description and objectives:</b> the student learn the construction methods of steel and concrete civil engineering projects as well as infrastructures and industrial projects	
<b>Course contents: (Theoretical section):</b> 1-familiar with contractor Description of Services and methods of contracts: Familiar with the project and its foundations Constitutive Relations of different project execution systems and their comparison Contractual relationship between the main factors of the project Legal basis of contracts and contract bylaws General and special condition of the contract  2-Executive requirements on the preparation, production and use of materials in construction sites: Cement and properties Aggregate gradation and mixture of concrete, Q.C and Q.A Rebars and Q.C and Q.A  3-General introduction on soil improvement methods and micro pile: General introducing soil improvement methods Detail introducing ground consolidation using micro pile Detail introducing the excavation stabilization including both traditional and nailing methods  4-The construction methods of top-down: Top-down methods and executive requirements  5-Construction methods of steel structures: Steel material properties ( including to bolts and weld)and Q.C and Q.A during the construction and mounting and installation Familiar with different types of construction documents including to shop drawings, mounting and installation drawings, as-built drawings, pre-installation requirements, WPS, PQR, ... Welding Electrodes and applications in steel structures as well as testing methods of welded structures including to destructive (DT) and nondestructive tests (NDT). Familiar with preparation, mounting, pre-installation, welding process, sand blast, painting, and transportation of steel members during construction Familiar with composite steel-concrete structures and Connection in steel structures and common methods. Base plate and the methods of installation in steel structures. Bolted structures: methods of construction and execution concern during the mounting and installation.	

The allowable Clearance in construction of steel structures

6-Construction methods of concrete structures:

Different type of foundations and applications in buildings and construction methods

Different type of formworks and their applications in buildings and non-buildings structures, formwork removal requirements

Rebar binding and their executive requirements.

Concreting and requirements of mixing, transportation, pouring, curing, equipment and methods.

Camber and allowable clearance in construction of members.

7-Additional topics:

Familiar with different types of bridges and construction methods

Familiar with different methods of construction of tunnels and lining

Familiar with industrial construction methods and new constructional technologies.

Visiting some construction project sites and report

**(Practical section):** None

**Evaluation method:** final test\ written test\ practical test

Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>0</b>	<b>20%</b>	<b>30%</b>

**References:**

1. Nunnally, S. W. (2011). Construction Methods and Management, 8<sup>th</sup> Ed., Pearson Education, Inc., New Jersey.
2. Chudley, R. and Greeno, R. (2016). Building Construction Handbook, 11<sup>th</sup> edition, Elsevier, MPG Books Ltd, Cornwall.
3. Peurifoy, R. L., Schexnayder, C. J., Shapira, A. and Schmitt R. (2011). Construction Planning, Equipment, and Methods, 8<sup>th</sup> Ed., McGraw-Hill, New York.

<b>Course name:</b> Earthquake Engineering	نام فارسی درس: مهندسی زلزله		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Loading on Structures		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Regarding BSc students in civil engineering, the aim of this course is to introduce the principle of earthquake engineering, earthquake phenomena, the seismicity of Iran, evaluation of design earthquake, different structural analysis methods for earthquake forces, different earthquake resistant structural systems and their design procedures, seismic design requirements based on structural seismic design code of practice (the standard No. 2800 of Iran)			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1. Introduction to seismology, earthquake engineering, causes of earthquakes, earthquake induced phenomena, the scale of the size of earthquakes (magnitude and intensity), the seismicity of Iran</li> <li>2. Failure mechanisms triggered by earthquake, liquefaction, landslides, Tsunami, earthquake fire, facing and mitigation of seismic hazard, possible disaster of earthquakes in large cities,</li> <li>3. Evaluation of design earthquake; affecting parameters on ground motions, including distance, regional soil properties and earthquake magnitude; studying earthquakes in terms of their probabilistic feature and earthquake risk,</li> <li>4. Equivalent static force procedure for earthquake structural analysis, and the basis and the concept of the method,</li> <li>5. Defining dynamic loads, degrees of freedom and modeling,</li> <li>6. Fundamental concepts of dynamic of structures, including single degree of freedom system, free vibration, response to harmonic excitations, Duhamel's integral,</li> <li>7. Multi-degree of freedom systems, free vibration, and natural vibration frequencies and modes,</li> <li>8. Dynamic (time history) earthquake analysis of structures (single-degree and multi-degree of freedoms),</li> <li>9. Earthquake response spectrum analysis for systems, response and design spectrums,</li> <li>10. Different earthquake resistant structural systems and their seismic behaviors.</li> </ol>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

- 1- Bargi, Kh., "Fundamentals of Earthquake Engineering", 10<sup>th</sup> edition, University of Tehran Press, 2012,
- 2- Road, Housing and Urban Development Research Center, "Iranian code of practice for seismic resistant design of buildings, standard No. 2800" (4<sup>th</sup> Edition) 2015,
- 3- Villaverde, R., "Fundamental concepts of earthquake engineering", CRC Press, 2009,
- 4- Chopra, A., K., "Dynamics of structures: Theory and application to earthquake engineering", 4th edition, Prentice-Hall International, 2011,
- 5- Dowrick, D., J., "Earthquake resistant design and risk reduction", 2nd edition, John Wiley & Sons, Inc., 2009,
- 6- Kramer, S., L., "Geotechnical earthquake engineering", 2013,
- 7- Chen, W., F., and Lui, E., M., "Earthquake engineering for structural design", CRC Press, 2005,
- 8- Bozorgnia, Y., and Bertero, V., V., "Earthquake engineering: From engineering seismology to performance-based engineering", CRC Press, 2004,
- 9- Paulay, Th. and Priestley, M., J., N., "Seismic design of reinforced and masonry buildings", John Wiley & Sons, Inc., 2013,
- 10- Naeim, F., "The seismic design handbook", 2nd edition, Kluwer Academic Publisher, 2013,

<b>Course name:</b> Training	نام فارسی درس: کارآموزی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 240	90 Credits		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Getting familiar with construction projects on-site and practicing the theoretical concepts learned in university			
<b>Course contents:</b>			
<b>(Theoretical section):</b> None			
<b>(Practical section):</b>			
Students should spend the specified time in a construction project. The course should have practical aspects. Various types of civil engineering projects are acceptable. The student is supposed to prepare a report upon completion of the course, which will be evaluated by a supervisor.			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
%	%	%	<b>100%</b>
<b>References:</b>			
-			



<b>Course name:</b> Engineering Economics	نام فارسی درس: اقتصاد مهندسی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Passing 45 credits		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The purpose of this course is to familiarize civil engineering students with the ways in which they choose the best (or most cost-effective) project from among several mutually exclusive alternatives available to them. By completing this course, students will be able to understand the technical and economic aspects of engineering projects and master the fundamental concepts of engineering economics analysis.			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
1. Introduction and basic concepts			
2. The decision-making process in engineering economics			
3. Financial factors (cash flow, compound annual and continuous)			
4. Techniques and their application (NPV, NEUA, NFV, ROR, B/C, Payback period, and capital return rate)			
5. Depreciation			
6. Economic analysis considering income tax			
7. Replacement analysis			
8. Sensitivity analysis			
9. Economic analysis under uncertainty			
10. Inflation and its application in engineering economics			
11. Application of mathematical programming to engineering economics			
12. Economic justification and price analysis in civil engineering plans			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b>			
1. Oskunezhad, M. (2019). Engineering Economy-Economic Evaluation of Industrial Projects, new edition: Amirkabir University Publication, Tehran (in Persian).			
2. Sullivan, W. G., Wicks, E. M., & Koelling, C. P. (2015). Engineering economy, Sixteenth edition: Pearson Higher Education, Inc., Upper Saddle River, NJ.			
3. Blank, L. T., & Tarquin, A. J. (2008). Basics of engineering economy, McGraw-Hill Higher-Education, Boston.			
4. Newnan, D. G., Lavelle, J. P., & Eschenbach, T. G. (2002). Essentials of engineering economic analysis, Oxford University Press, New York.			

<b>Course name:</b> Environmental Engineering	نام فارسی درس: مهندسی محیط زیست		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Passing 65 credits		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> In this course, students get familiar with principles of environmental engineering and its applications in environmental impact assessment of civil engineering projects.			
<b>Course contents:</b> <b>(Theoretical section):</b> Principles of environmental engineering Review of environmental issues of civil engineering projects Sustainable development and its history Water quality assessment Principles of water treatment Principles of wastewater treatment Solid waste management Principles of air pollution control Principles of noise pollution control  <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b> 1- Richard, O. and Mines Jr (2014), "Environmental Engineering: Principles and Practice", Wiley-Blackwell Publisher. 2- Davis, M. and Cornwell, D. (2012), "Introduction to Environmental Engineering", McGraw-Hill Inc. 3- Sincero, A. P., and Sincero, G. A., (1996), "Environmental Engineering", Prentice Hall.			

<b>Course name:</b> Introduction to Construction Project Management and Scheduling	نام فارسی درس: مبانی برنامه‌ریزی و کنترل پروژه		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Mandatory	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Passing 65 credits		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b>			
<ul style="list-style-type: none"> <li>- Introduction to basic management concept at construction projects;</li> <li>- Introduction to Construction Industry Law, Management Engineering and Construction Techniques;</li> <li>- Introduction to Project Controlling and Scheduling at Civil Engineering</li> <li>- Introduction to Project Delivery Systems at Construction Projects.</li> </ul> <p>Upon successful completion of the course, students will be able</p> <ol style="list-style-type: none"> <li>1- To develop management skills at construction projects;</li> <li>2- To understand Work Breakdown Structure of Construction Project activities;</li> <li>3- To understand Critical Path Method (CPM), PERT, and GERT analysis at Civil Projects;</li> <li>4- To develop conflict management and negotiation skills at Construction Projects;</li> <li>5- To develop project schedules and perform scheduling calculations;</li> <li>6- To understand the basic elements and processes involved in controlling project costs, and Time-Cost Tradeoff.</li> </ol>			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1- Introduction to Project Management;</li> <li>2- Introduction to Project Leadership and Structure;</li> <li>3- Introduction to Project Strategic Management at Construction Projects;</li> <li>4- Project Planning, Crashing and Control;</li> <li>5- Conflict Management and Negotiation;</li> <li>6- Introduction to Project Management Quality Control;</li> <li>7- Introduction to Software of Project Control and Management.</li> </ol>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
1- Chitkara, K. K., Construction Project Management, Published by Mc. Graw-Hill (2011)			

<b>Course name:</b> Environment Laboratory	نام فارسی درس: آزمایشگاه محیط زیست										
<b>Credits:</b> 1	<b>Credit type:</b> Practical										
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>										
<b>Number of hours:</b> 32	Environmental Engineering (Corequisite)										
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>											
<b>Type of advanced training:</b>											
<b>Course description and objectives:</b> The purpose of this course is that students will be familiar with environmental parameters, methods and measurement techniques of organic and inorganic pollutants in different medium.											
<b>Course contents:</b> <b>(Theoretical section):</b> None  <b>(Practical section):</b> Safety in Laboratory Field analyses (conductivity, dissolved oxygen, pH) Alkalinity of surface water Hardness of ground water Chloride and Sulphate in soil Chemical Oxygen demand of organic wastewater Determination of Nitrate in drinking water with spectrophotometer Determination of heavy metal in industrial wastewater with Atomic absorption Determination of Ibuprofen in waste water with HPL											
<b>Evaluation method:</b> final test\ written test\ practical test											
<table border="1"> <thead> <tr> <th>Final test (writing\ operational)</th> <th>Midterm</th> <th>Continuous evaluation</th> <th>Project</th> </tr> </thead> <tbody> <tr> <td>50%</td> <td>30%</td> <td>20%</td> <td>0%</td> </tr> </tbody> </table>				Final test (writing\ operational)	Midterm	Continuous evaluation	Project	50%	30%	20%	0%
Final test (writing\ operational)	Midterm	Continuous evaluation	Project								
50%	30%	20%	0%								
<b>References:</b>											
<ol style="list-style-type: none"> <li>1. 2ASTM international Standards, Available in ASTM.org</li> <li>2. P.R. Sreemahadevan Pillai, A comprehensive Laboratory Manual for Environmental Science and Technology, New Age International Ltd., 2009.</li> <li>3. M. Csuros, Environmental Sampling and Analysis: Lab Manual, CRC press, 1997</li> <li>4. F. M. Dunnivant, Environmental Laboratory Exercises for Instrumental Analysis and Environmental</li> <li>5. Chemistry, John Wiley &amp; Sons, Inc., 2004.</li> </ol>											

<b>Course name:</b> Introduction to Finite Element Method	نام فارسی درس: اجزاء محدود مقدماتی		
<b>Credits:</b> 3	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 48	Basics of structural equation modeling		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:-</b>			
<b>Course description and objectives:</b> Students who pass the course will be able: - How to choose and apply one-dimensional, two-dimensional and three-dimensional elements to analyze various problems with finite element method - Understand basic concepts in finite element analysis of structures - Identify solvable problems using finite element method - Application of finite element method to solve solid mechanics problems - Using the finite element method in projects			
<b>Course contents:</b> <b>(Theoretical section):</b> 1. Theoretical Foundations of Finite Elements 2. Lagrangian elements 3. Hermetian elements 4. Triangular Elements in 2D Elasticity 5. Introduction to numerical integration methods and the use of higher-order elements 6. Introduction to Dynamic Analysis by Finite Element Method 7. perform project  <b>(Practical section):</b> Introductory programming of Finite Elements			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>25%</b>	<b>15%</b>	<b>10%</b>
<b>References:</b> 1. An Introduction to Finite Element computational; E. Hinton, D.R.J Owen 2. Finite Element Procedure; K. J. Bathe 3. Logan, D.L., 2011. A first course in the finite element method. Cengage Learning. 4. The Finite Element Method, Its Basis & Fundamentals; O. C. Zienkiewicz, R.L. Taylor & J. Z. Zho.			

<b>Course name:</b> Building Equipment	نام فارسی درس: تاسیسات ساختمانی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Engineering Drawing , Fluid Mechanics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> In this course, students get familiar with electrical and mechanical equipment of buildings and some details of design, construction and maintenance of these equipment.			
<b>Course contents:</b> <b>(Theoretical section):</b> 1- Water supply and wastewater collection systems in buildings 2- Cooling Systems Design and installation 3- Heating Systems Design and installation 4- Plumbing Systems & Fire Protection System overview 5- Plumbing Systems Design and installation 6- Fire Protection Systems Design and installation 7- Gas supply systems 8- Electrical Systems Design 9- Electrical Systems installation 10- Related building codes and standards.  <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b> 1- Soltandoust, M.R. (2014) Electrical equipment for architects, Yazdan Publication (In Persian). 2- Tabatabaie, M. (2002) Building equipment calculations, Roozbahan Publication (In Persian).			

<b>Course Name:</b> Site investigation	نام فارسی درس: تحقیقات محلی		
<b>Credits:</b> 2	<b>Credit Type:</b> Theoretical: 1, Practical: 1		
<b>Course Type:</b> Elective	<b>Prerequisite Courses:</b>		
<b>Number of hours:</b> 32	Foundation Engineering (Corequisite)		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> In this course, the students will be familiar with different stages of a standard geotechnical site investigation and will learn how to plan an appropriate site investigation program according to the project type and objectives.			
<b>Course contents (Theoretical Section):</b> Chapter 1. Objectives of site investigation Chapter 2. Description and classification of soils and rocks Chapter 3. Subsurface exploration methods Chapter 4. Soil sampling and sample disturbance Chapter 5. Undisturbed sampling techniques Chapter 6. Laboratory testing Chapter 7. In situ testing Chapter 8. Field equipment for site investigation Chapter 9. Description of a typical site investigation procedure in a real project			
<b>Course contents (Practical Section):</b> None			
<b>Evaluation method:</b> final test\written test\practical test			
Final test (writing\operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b> 1- Clayton C.R.I., Matthews M.C., Simons N.E., <i>Site Investigation</i> , Wiley-Blackwell, 2nd Edition, 1995. 2- Mayne P.W., Christopher B.R., DeJong J., <i>Manual on Subsurface Investigations</i> , National Highway Institute, Publication No. FHWA NHI-01-031, Federal Highway Administration, Washington DC, July 2001. 3- Hunt R.E., <i>Geotechnical Engineering Investigation Handbook</i> , CRC press, 2nd Edition, 2005.			

<b>Course name:</b> Rehabilitation of Structures	نام فارسی درس: ترمیم و تقویت سازه‌ها		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Steel Structures II, Reinforced Concrete Structures II		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Familiarity of students with the concepts and principles of assessing the current condition of building structures and methods of repairing and rehabilitation			
<b>Course contents:</b> <b>(Theoretical section):</b> 1. Introduction - The importance and role of repair and rehabilitation during the life of the building 2. Recognition and mechanism of various damages in the building 3. Assess the current condition of the building using theoretical and inspections methods 4. Assess the current condition of the building using various tests and measurements 5. Factors affecting the choice of different methods of repairing buildings 6. Recognizing the properties and application of different materials for repairing different buildings 7. Rehabilitation of structural and non-structural elements of different buildings 8. Tests and verification methods of repairs in various buildings 9. Rehabilitation of non- building structures such as bridges, wharf and quay - and special structures  <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b> Parmay, A. (2014) Repair and Rehabilitation of Structures, Mahajan Publishing House			



<b>Course name:</b> Sustainable Development in Civil Engineering	نام فارسی درس: توسعه پایدار در مهندسی عمران			
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical			
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>			
<b>Number of hours:</b> 32	Environmental Engineering			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>				
<b>Type of advanced training:</b>				
<b>Course description and objectives:</b> In this course, students get familiar with principles of the sustainable development and environmental impacts of civil engineering projects.				
<b>Course contents:</b> <b>(Theoretical section):</b> Principles of sustainable development History of sustainable development Different types of natural resources Water, energy and carbon footprints Socio-economic and environmental impacts of engineering projects Sustainable development indices Assessment of sustainability Life cycle assessment Recycling and reuse Sustainability in different disciplines of civil engineering  <b>(Practical section):</b> None				
<b>Evaluation method:</b> final test\ written test\ practical test				
	Final test (writing\ operational)	Midterm	Continuous evaluation	Project
	50 %	30 %	20 %	0 %
<b>References:</b> 1- Bry Sarté, Sustainable Infrastructure - The Guide To Green Engineering and Design, John Wiley. 2010. 2- Dalal-Clayton, B., Bass, S., Sustainable Development Strategies, Earthscan Publications Ltd, 2002.				

<b>Course name:</b> Tunnel Engineering	نام فارسی درس: تونل سازی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b> Soil Mechanics,		
<b>Number of hours:</b> 32	<b>Corequisite:</b> Reinforced Concrete Structures II, Loading of Structures		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The objective of this course is to familiarize the students with the main concepts of tunnel design and construction.			
<b>Course contents:</b> <b>(Theoretical section):</b> <ol style="list-style-type: none"> <li>1. History of tunneling</li> <li>2. Types of tunnels</li> <li>3. Site investigations for tunneling</li> <li>4. Stress and deformation of tunnels</li> <li>5. Excavation of tunnels by drilling &amp; blasting and Mechanical methods</li> <li>6. Ventilation and drainage of tunnels</li> <li>7. Main methods for stabilization of tunnels</li> <li>8. Empirical and numerical methods of tunnel design</li> <li>9. Use of instrumentation for monitoring of tunnels</li> </ol> <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b> <ol style="list-style-type: none"> <li>1. Tunnel Engineering Handbook, Bickel, J.O., Kuesel, T.R. and King, E.H., 1996, Chapman &amp; Hall.</li> <li>2. Handbook of Tunnel Engineering Handbook, Maidl, B., Thewes, M., Maidl, U., 2014, Ernst &amp; Sohn.</li> </ol>			

<b>Course name:</b> English for Civil Engineers	نام فارسی درس: زبان تخصصی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Passing 70 credits, General English		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course objectives:</b>			
<ol style="list-style-type: none"> <li>1. Learning technical vocabularies related to Civil Engineering major</li> <li>2. Helping students to use English textbooks related to various disciplines of Civil Engineering</li> <li>3. Helping students to get acquainted with different disciplines of Civil Engineering and teaching basic concepts related to future course work and research fields.</li> </ol>			
<b>Course contents</b>			
<b>(Theoretical section):</b>			
<ul style="list-style-type: none"> <li>- Teaching appropriate English textbooks for Civil Engineers in addition to the articles in related journals. Also using various Internet and online sources to help the students understand the concepts of the courses in Civil Engineering.</li> <li>- Showing related videos and discussing about them in the class.</li> </ul>			
<b>(Practical Section):</b> None			
<b>Evaluation method:</b> final test\written test\practical test			
Final test (writing\operational)	Midterm	Continuous evaluation	Project
<b>50 %</b>	<b>30 %</b>	<b>20 %</b>	<b>0 %</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. Mohammad Azmi (2015) "English for the Students of Civil Engineering" Samt Publisher</li> <li>2. Related journal papers, audios and two videos that are presented and discussed in the class before and after the Midterm exam.</li> </ol>			

<b>Course name:</b> Design and assessment of Masonry Structures	نام فارسی درس: طراحی و ارزیابی سازه های بنائی
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical
<b>Course type:</b> Elective	<b>Prerequisite courses:</b> Fundamentals of Structural Modeling, Reinforced Concrete Structures I
<b>Number of hours:</b> 32	
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<b>Type of advanced training:</b>	
<b>Course description and objectives:</b> Familiarity with the basics of designing unreinforced and reinforced masonry structures as well as seismic assessment and retrofitting methods of existing unreinforced masonry structures	
<b>Course contents:</b> <b>(Theoretical section):</b>	
<ol style="list-style-type: none"> <li>1- An overview of the types of masonry building used in Iran, including configuration, advantages and disadvantages, construction methods, materials used</li> <li>2- Types of materials used in masonry structures and their behavioral characteristics (brick, mortar, block, stone, brickwork in different directions of the wall) including:</li> <li>3- - compressive strength in materials and factors affecting it</li> <li>4- - Experimental relationships of compressive strength of brickwork and deformation properties of masonry samples in pressure, tension and shear</li> <li>5- Test methods and acceptance criteria of masonry materials and samples</li> <li>6- An overview of analysis methods in the design of masonry structures</li> <li>7- Introducing the methods of designing masonry structures</li> <li>8- A review of design methods based on allowable stresses, limit states, and ultimate strength</li> <li>9- Design of unreinforced building structures - vertical and lateral bearing capacity</li> <li>10- Designing reinforced masonry structures: <ul style="list-style-type: none"> <li>Introducing conventional brickwork layouts in reinforced buildings</li> <li>Application of reinforcement and pre-stressing in masonry structures</li> <li>- Design of reinforced building elements in bending</li> <li>- Design of reinforced masonry elements in the axial-flexural load</li> <li>- Design of reinforced masonry elements in shear forces</li> <li>- design requirements of bond, developing length, splice, ...</li> <li>- Design of reinforced masonry shear walls</li> </ul> </li> <li>11- Seismic assessment and rehabilitation methods in existing masonry buildings <ul style="list-style-type: none"> <li>- Conventional structural defects in existing masonry structures</li> <li>- Behavioral characteristics of materials in existing structures, introduction of test methods to determine the behavioral characteristics of masonry specimens in compressive, shear, and diagonal tension. <ul style="list-style-type: none"> <li>- Determining the expected behavior in existing masonry elements, behavioral modes, and lateral capacity of existing masonry walls</li> <li>- Evaluate the deformation capacity of existing masonry building elements</li> <li>- Methods of analysis of existing building structures under earthquakes and its performance</li> </ul> </li> </ul> </li> <li>12- - A review of retrofitting methods in existing masonry walls and practical methods in Iran</li> <li>13- An overview of the prescribed requirement of Standard 2800 in the design of unreinforced tied</li> </ol>	

masonry buildings

**(Practical Section):** None

**Evaluation method:** final test\ written test\ practical test

Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

1. Masonry Designers' Guide, Masonry society, 2009
2. Structural masonry, Arnold W. Hendry, 1990
3. Structural masonry, J.G.Rots, 1998
4. Design of reinforced and prestressed masonry, W.G.Curtin, G.Shaw, J.K.Beck 1988
5. Structural masonry designers manual, W.G.Curti, G.shaw, J.K.Beck, W.A.Bray, 1991
6. Seismic design of reinforced concrete and masonry buildings, T. Paulay, M.N.J. priestley 1992
7. FEMA-306, FEMA 356,
8. ACI 530-02/ASCE 5-02/TMS 402-02
9. ASTM, c270-02, C1196-92, C1531-02, C1072-00a, C1197-92
10. Eurocode-8 masonry part,
11. 13. BS, UBC-97, IBC 2006,

<b>Course name:</b> Structural Systems	نام فارسی درس: سیستم‌های ساختمانی
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>
<b>Number of hours:</b> 32	Steel Structures I , Reinforced Concrete Structures I
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<b>Type of advanced training:</b>	
<b>Course description and objectives:</b> Introduction to modern structural systems Understanding structural behavior of buildings New materials and construction methods The most recent architectural projects with modern structural systems Selection of the most appropriate structural system for a given architecture	
<b>Course contents:</b> <b>(Theoretical section):</b> The application of structural systems and the effect of geometry on structural behavior of structures are described and the students will get familiar with the most recent findings in this area. They will learn the analysis and evaluation of the behavior of buildings under imposed loads and to select the most proper structural solutions for architectural projects.	
<b>Different structural systems will be analytically introduced including the below mentioned systems:</b>	
<ul style="list-style-type: none"> <li>- Tension Structure</li> <li>- Membranes</li> <li>- Air Supported Structures</li> <li>- Arches</li> <li>- Trusses</li> <li>- Space Frames</li> <li>- Tensegrities</li> <li>- Braced Frames</li> <li>- Grids</li> <li>- Rigid Frames</li> <li>- Hyperbolic Paraboloid Shells</li> <li>- Domes</li> <li>- Cylindrical Shells</li> <li>- Space Structures</li> <li>- Timber Structures</li> <li>- Hi-Rise Buildings</li> <li>- Mega Structures</li> <li>- Future Systems</li> </ul>	
The course will be presented by the emphasis on the analysis and understanding of structural behavior of different structural systems.	
Course will be presented by the introduction of new materials, advances construction methods and new architectural projects to provide the knowledge and understanding for selection of the appropriate	

structural systems in architectural projects.

At the end of the course students will have the opportunity of experience this procedure in an architectural project and select the most suitable structural system in a given project.

**(Practical section):** None

**Evaluation method:** final test\ written test\ practical test

Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

- 1- Mainstone, R. (2015), Development in Structural Form, Architectural Press.
- 2- Lyall, S. Remarkable Structures: Engineering Today's Innovative Buildings 1st Edition
- 3- Chudley, R., Greeno, R., (2017), Building Construction Handbook, Sixth Edition, Elsevier.
- 4- Addington, M., Schodek, DL.,(2014). Smart Materials and Technologies in Architecture, Architectural Press.
- 5- Harris,James B. Pui-Kli,Kevin,(2016). Master Structures in Architecture (Butterworth Architecture New Technology Series), Architectural Press.
- 6- Sebestyen,G,(2016). New Architecture and Technology, Architectural Press.
- 7- Salvadori, M, (1986). Structures in Architecture, 3<sup>rd</sup> Edition, Prentic Hall.
- 8- Allen,E., (2015), How Buildings Work: The Natural Order of Architecture, 3<sup>rd</sup>Edition, Oxford University Press, USA.
- 9- Moore,F.,(2009), Understanding Structures, McGraw-Hill.

<b>Course name:</b> Chemistry for Civil Engineering	نام فارسی درس: شیمی برای مهندسی عمران										
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical										
<b>Course type:</b> Elective	<b>Prerequisite courses:</b> None										
<b>Number of hours:</b> 32											
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>											
<b>Type of advanced training:</b>											
<b>Course description and objectives:</b> The purpose of this lesson is that students will be familiar with the applications of chemistry in various field of civil engineering. In addition, students will be taught applicable areas of chemistry in civil engineering such as corrosion, polymers and composites, and chemistry of pollutants in water and soils too.											
<b>Course contents:</b> Basic concepts in Chemistry (Mole, Equivalent, Titration, Solution) Measurement techniques and traditional Experiments Chemical reactions Kinetics of reactions Corrosion and its control -Basic of Electrochemistry - Types of corrosion and mechanisms -Influencing factors -Methods of controlling corrosion Polymers -Chemical structure of polymers and its effect on polymer properties -Types of polymers and properties -Application of polymers in civil Engineering Composites -Components of composites -Reinforced composites (types and failure conditions) - Advantages of composites Nanotechnology -Nanomaterials and properties -Application of nanomaterials in civil Engineering Chemistry of pollutants in water and soils											
<b>Evaluation method:</b> final test\ written test\ practical test											
<table border="1"> <thead> <tr> <th>Final test (writing\ operational)</th> <th>Midterm</th> <th>Continuous evaluation</th> <th>Project</th> </tr> </thead> <tbody> <tr> <td>50%</td> <td>30%</td> <td>20%</td> <td>0%</td> </tr> </tbody> </table>				Final test (writing\ operational)	Midterm	Continuous evaluation	Project	50%	30%	20%	0%
Final test (writing\ operational)	Midterm	Continuous evaluation	Project								
50%	30%	20%	0%								
<b>References:</b> 1. Palanna, O.G., (2009), Engineering Chemistry, Tata McGraw-Hill Education, New Delhi, India. 2. Jain and Jain, (2015), Engineering Chemistry, Dhanpat Rai Publishers, Delhi, India. 3. Chawla, Sh., (2003), A Text Book of Engineering Chemistry, Dhanpat Rai Publishers, Delhi, India.											



<b>Course name:</b> Engineering Application GIS and RS In Civil	نام فارسی درس: کاربرد GIS و RS در مهندسی عمران										
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical										
<b>Course type:</b> Elective	<b>Prerequisite courses:</b> None										
<b>Number of hours:</b> 32											
<b>Advanced training:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>											
<b>Type of advanced training:</b> Working with ArcGIS and ENVI software											
<b>Course description and objectives:</b> Introduction to Geographic Information System (GIS), data management and spatial analysis in civil engineering Introduction to Remote Sensing principle and satellite imagery and fundamentals of image processing and interpretation											
<b>Course contents:</b> <b>(Theoretical section):</b> <ul style="list-style-type: none"> <li>• Basic concepts of Geographic Information System (GIS) and its capabilities</li> <li>• General concept of geographic information system (definitions, components, spatial data structure, vector and raster data)</li> <li>• Image Coordinate Systems</li> <li>• Descriptive data and their application in the geographic information system</li> <li>• Georeferencing, Digitization and data editing</li> <li>• Spatial data analysis and geostatistical analysis</li> <li>• Preparing maps and layout</li> <li>• Different application of GIS in civil engineering</li> <li>• General concepts of Remote sensing (Introduction, History, Elements of Remote Sensing System, Fundamental Concepts of Remote Sensing)</li> <li>• Fundamentals of remote sensing physics (characteristics of the electromagnetic spectrum, solar energy interaction with the atmosphere and the earth, optical and thermal remote sensing and introduction of basic equations)</li> <li>• Introduction of different satellites and sensors (types of satellites and sensors and their characteristics and operation)</li> <li>• Characteristic of satellite imagery (structure of satellite imagery and different image resolution types)</li> <li>• Familiarity with the spectral characteristics of various objects and how to extract this information from satellite imagery</li> <li>• Principles of digital image processing (pre-processing, atmospheric and radiometric correction, image classification and post-processing)</li> <li>• Application of remote sensing and satellite imagery in civil engineering</li> </ul> <b>(Practical section):</b> None											
<b>Evaluation method:</b> final test\ written test\ practical test											
<table border="1" style="width: 100%; text-align: center;"> <tr> <td>Final test (writing\ operational)</td> <td>Midterm</td> <td>Continuous evaluation</td> <td>Project</td> </tr> <tr> <td><b>50%</b></td> <td><b>30%</b></td> <td><b>20%</b></td> <td><b>0%</b></td> </tr> </table>				Final test (writing\ operational)	Midterm	Continuous evaluation	Project	<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
Final test (writing\ operational)	Midterm	Continuous evaluation	Project								
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>								
<b>References:</b>											

- 1- Dixon, B., & Uddameri, V. (2016). GIS and Geocomputation for Water Resources Science and Engineering. Chichester West Sussex, UK: Wiley and Sons. Doi: 10.1002/9781118826171.
- 2- Jensen. J, R. 2007. Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Edition. Upper Saddle River, NJ: Pearson Prentice Hall.

<b>Course name:</b> Foundations of Urban Planning	نام فارسی درس: مبانی شهرسازی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b> None		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b>			
<ul style="list-style-type: none"> <li>- Understanding basic concepts in urban planning</li> <li>- Understanding the importance of the urban context for designing buildings</li> <li>- Understanding the importance of urban infrastructure in buildings' design requirements</li> </ul>			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ol style="list-style-type: none"> <li>1. History of urban planning in Iran and in the World</li> <li>2. Basic concepts in urban planning</li> <li>3. City types and urban and rural development</li> <li>4. Analyzing land-use in urban plans</li> <li>5. Urban planning laws and regulations</li> <li>6. Regional, comprehensive and detailed plans</li> <li>7. Impact of the social and economic factors on urban planning</li> <li>8. Introducing examples of urban plans and projects</li> <li>9. Analyzing the interaction between buildings and their urban context</li> <li>10. Evaluating building projects considering the site and surrounding built environment</li> </ol>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
<p>Godschalk, E., Kaiser, E. J., Chapin, S. (1995). Urban land use planning (4<sup>th</sup> edition). Tabibian, M. (Translator). The University of Tehran Press.</p> <p>Hanachi, P., PoorSerajian, M. (2014). Urban restoration of historical built environment. The University of Tehran Press.</p> <p>Lynch, K. (1960). The image of the city. Mozayeni, M. (Translator). The University of Tehran Press.</p> <p>Catanese, A.J., (1972). Scientific Methods of Urban Analysis. Mozayeni, M. (Translator). The University of Tehran Press.</p> <p>American Planning Association (2007). Planning and Urban Design Standards. Behzadfar, M., (Translator). Azarakhsh Press.</p>			

<b>Course name:</b> Building Information Modeling (BIM)	نام فارسی درس: مدل سازی اطلاعات ساختمان		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b> Passing 65 credits		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Introduce students to the concepts of Building Information Modeling (BIM) throughout the life cycle of a project			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
<ul style="list-style-type: none"> <li>• Information Systems</li> <li>• Concepts of Building Information Modeling (BIM) Systems</li> <li>• How to develop the rich 3D models containing information</li> <li>• How to extract and manipulate information in BIM models</li> <li>• A brief introduction to the principles of simulation modeling for efficient management of BIM models</li> <li>• Four-dimensional (4D) scheduling models (including 3D geometric and time dimensions)</li> <li>• Five-dimensional (5D) models - 5D models (including 3D geometric dimensions and time and cost)</li> <li>• A brief introduction to the concepts of sustainable development by considering the construction and facility management (i.e., operation) stages employing BIM models</li> <li>• Introduction to BIM software</li> <li>• Develop a BIM model for a construction project</li> <li>• Extracting and managing information from the BIM model developed in the first step to a database</li> <li>• Development of 4D schedule and 5D estimating models for BIM model developed in the first step</li> </ul>			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1. Hardin, Brad, and Dave McCool. BIM and construction management: proven tools, methods, and workflows. John Wiley &amp; Sons, 2015.</li> <li>2. Kensek, Karen M. Building information modeling. Routledge, 2014.</li> <li>3. Kymmell, Willem. Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations. McGraw-Hill, 2008.</li> <li>4. Epstein, Erika. Implementing Successful Building Information Modeling. Artech House, 2012.</li> <li>5. Eastman, Chuck, Charles M. Eastman, Paul Teicholz, and Rafael Sacks. BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley &amp; Sons, 2011.</li> <li>6. Smith, Dana K., and Michael Tardif. Building information modeling: a strategic implementation guide for architects, engineers, constructors, and real estate asset managers. John Wiley &amp; Sons, 2009.</li> <li>7. Underwood, Jason, and Isikdag Umit. Handbook of Research on Building Information Modeling and Construction Informatics: Concepts and Technologies. IGI Global, 2009.</li> </ol>			

<b>Course name:</b> Construction issues in foundation Engineering	نام فارسی درس: مسائل اجرایی در مهندسی پی
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical
<b>Course type:</b> Elective	<b>Prerequisite courses:</b> Foundation Engineering
<b>Number of hours:</b> 32	
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<b>Type of advanced training:</b>	
<b>Course description and objectives:</b> Understanding the construction methods of various types of foundations and geotechnical works.	
<b>Course contents:</b> <b>(Theoretical section):</b> 1. Introduction: Importance of construction in foundation Engineering 2. Ground site investigation methods 2.1. Machinery and equipment of investigation 2.2. Sampling Methods in soil and rock 3. Ground Excavation 3.1. Excavation Methods 3.2. Construction of retaining structures in Excavation 3.3. Excavation below water table 3.4 Safety in Excavation works 3.5 Monitoring of Excavation 3.6 Special issues in Excavation 4. construction of shallow foundations 4.1. Waterproofing of shallow foundation 4.2. construction of shallow foundation below ground water table 4.3. construction of mat foundation 4.4. Installation of base plates 4.5. construction of underground walls 5. Construction of deep foundations 5.1. Types of deep foundations 5.2. construction of driven piles: equipment, methods, quality control 5.3. construction of cast in place piles (drilled shafts): equipment, methods, quality control 5.4. construction of ground anchors 5.5. loading tests of Piles 6. Construction of earth retaining walls 6.1. Masonary walls, gravity walls, crib walls and gabions 6.2. mass and reinforced concrete walls 6.3. sheet pile walls 6.4. reinforced earth and soil nailing 7. drainage and water proofing in foundation Engineering 7.1. Drainage methods 7.2. Waterproofing methods 8. Construction of embankments	

**(Practical section):** None

**Evaluation method:** final test\ written test\ practical test

Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

- 1- Donald P. Coduto (2001) "Foundation Design- principles and practices", Prentice-Hall, Inc.
- 2- Joseph E. Bowles (2001) Foundation Analysis and Design", McGraw-Hill Publisher
- 3- Braja M Das (2003) "Principles of Foundation Engineering", CL Engineering Publisher

<b>Course name:</b> Transportation Engineering	نام فارسی درس: مهندسی ترابری		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Geometric Road Design, Probability and Statistics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Learning the basics of transportation engineering with a focus on demand analysis, transportation systems analysis and planning.			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
1- Basics of demand analysis and modeling			
2- Four-stage models of travel demand:			
a. Trip Generation			
b. Trip distribution			
c. Mode choice			
d. Traffic assignment			
3- Demand forecasting			
4- Transportation systems:			
a. Road network systems			
b. Public transportation network systems			
5- Policy making and urban planning			
<b>(Practical section):</b> No			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b>			
1. C. S. Papacostas, Panos D. Prevedouros, Transportation Engineering and Planning, Pearson/Prentice Hall, 2005.			
2. Michael Meyer, Eric J. Miller, Urban Transport Planning -2 <sup>nd</sup> edition, McGraw-Hill Publishing Co., 2001.			

<b>Course name:</b> Railway Engineering	نام فارسی درس: مهندسی راه آهن		
<b>Credits</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Pavement Engineering (Corequisite)		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b>			
Students who successfully complete this course will be able to:			
1. Determine the capacity of different rail systems such as the subway, light rail, monorail, and commuter rail systems in a variety of different signaling systems (i.e. fixed block, moving block, and cab signaling).			
2. Understand various components and infrastructure characteristics of the rail systems (rails, traverses, ballasts, and sub/superstructure) and perform basic design for them (in terms of size and materials).			
3. Make the geometric design of rail lines.			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
In order to teach this course properly in civil engineering, it is necessary to first determine the scale and scope of the course. Therefore, it is necessary to determine what sections of railway engineering are involved. An undergraduate degree in railway engineering (not civil engineering) comprises:			
1) Rail and structural engineering (i.e. line and buildings engineering), which deals with the design and construction of railways, bridges, stations, etc., as well as, metallurgical aspects of rails;			
2) Railway car engineering, deals with the mechanical aspects of locomotives, wagons and their components, and all machines connected to the rail system;			
(3) Railway operation engineering, which deals with the management and efficient use of railway line capacity.			
This course, which is a two-credit course in civil engineering, attempts to address each of these ones: Rail and structural engineering (line and building engineering), railway machinery engineering, and rail operation engineering.			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
1. Profillidis, V A., Railway management and engineering, 3rd edition, Ashgate, Aldershot, United Kingdom, 2006.			
2. National Research Council, TCRP			
3. Report 100: Transit Capacity and Quality of Service Manual (TCQSM), 2nd ed., -Part5 (Rail Transit Capacity) Transportation Research Board of the National Academies, Washington, DC., 2003.			
4. Bonnett, C. F., Practical railway engineering, 2nd edition, Imperial College Press, London, 2005.			



<b>Course name:</b> Port Engineering	نام فارسی درس: مهندسی بندر		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Pavement Engineering (Corequisite)		
<b>Advanced training:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
<b>Type of advanced training:</b> Hydraulics, Soil Mechanics			
<b>Course description and objectives:</b> learning marine phenomena, coastal and harbors processes, ports, port functions and facilities, marine transportations, coastal development			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
1. Importance of port development			
2. General information on vessels, transport and maritime services			
3. Types of Ports and their application			
4. Principles of port positioning			
5. Principles of port planning			
6. Port infra-structures (offshore and onshore)			
7. General overview on marine hydraulics and coastal sediment			
8. Forces on marine works (waves, currents ...)			
9. Locating docks, breakers and harbors			
10. Locating Port Facilities			
11. Marine waterways			
12. Materials used in marine structures			
13. General notes on marine construction			
14. General tips on port operation, Maintenance and Repair			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	0%	20%	30%
<b>References:</b>			
1. Iran-Code 300, (2004), "Iran Standard Codes for Design of Ports and Marine Structures, IranCode300+, Volumes 1 to 11", Iran Budget and Programming Organization.			
2. Zhou Liu & Hans F. Burcharth, (1999) "Port Engineering" by (Authors), Publisher: Alborg University			
3. Per Bruun, (1989), "Port Engineering, Volume 1: Harbor Planning, Breakwaters, and Marine Terminals" 4th Edition, Gulf Professional Publishing.			
4. Per Bruun, (1989), "Port Engineering, Volume 2: Harbor Transportation, Fishing Ports, Sediment Transport, Geomorphology, Inlets, and Dredging" 4th Edition, Gulf Professional Publishing			
5. Gregory P. Tsinker,(2004), "Port Engineering: Planning, Construction, Maintenance, and Security", 1st Edition, Wiley			
6. Carl A. Thoresen, (2014), "Port Designers' Handbook", 3rd Edition, ICE Publishing.			

<b>Course name:</b> Bridge Engineering	نام فارسی درس: مهندسی پل		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b> Steel Structures I, Reinforced Concrete Structures II, Loading on Structures, Construction Methods for Civil Engineering Projects (Corequisite)		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> The purpose of this course is to acquaint students with the history and different types of bridges. In this course, the basics of loading, analysis, and construction methods of different types of bridges are taught. In addition, the hydraulic aspects related to the scour of the bridge piers are introduced.			
<b>Course contents:</b> <b>(Theoretical section):</b> <ol style="list-style-type: none"> <li>1. Introduction to bridge engineering, history, different types of bridges, and construction methods</li> <li>2. Bridge loading (according to the loading standards in Iran)</li> <li>3. Deck systems: introduction, methods of transverse analysis and load distribution</li> <li>4. Influence lines: shear force and bending moment envelope</li> <li>5. Reinforced concrete bridges: plate bridges and bridges consisting of load-bearing beams</li> <li>6. Steel bridges: bridges with load-bearing beams, Composite bridges, fatigue consideration in steel deck design</li> <li>7. Bridge supports: neoprene cushions, and bearing supports</li> <li>8. Bridge piers: span selection, pier scour, and structural design.</li> </ol> <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b> <ol style="list-style-type: none"> <li>1- Sharifpour H., Principles of Bridge Engineering, Motefakkeran Press, 2017</li> <li>2- Zhao J.J, Tonia, D. E., Bridge Engineering, MC Graw Hill, 2012</li> </ol>			

<b>Course name:</b> River Engineering	نام فارسی درس: مهندسی رودخانه		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Open Channel Hydraulics		
<b>Advanced training:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
<b>Type of advanced training:</b> Project			
<b>Course description and objectives:</b> To enable students understand and apply the fundamental principles of river system, sediment transport, river morphology, river training and flood control			
<b>Course contents:</b> <b>(Theoretical section):</b> 1- River system, river engineering and flood related studies. 2- Review of river and flood hydrology 3- Review of river hydraulics 4- Measurement of river discharge and sediment load 5- River morphology 6- Flood management 7- River training 8- River protection 9- Methods for bed erosion control 10- River and flood control project examples  <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b> 1- Manual of River Restoration Techniques, RRC (River Restoration Centre) UK, Beyond ECRR (European Centre for River Restoration), 2013. 2- Peterson, Margaret, River Engineering, Prentice Hall, 1986 3- Graf, Walter H., Fluvial Hydraulics: Flow and Transport Processes in Canal with Simple Geometry, Wiley, 1998. 4- Przedwojsk B, Blazejewsk .R, and Pilarczyk K.W. River training techniques: Fundamental .Design and Application, A.A. Balkema .Rotterdam, The Netherland. 1995. 5- Rosgen, D., Applied River Morphology, Hilton lee Silvey. 2004 6- U.S. Army corps of Engineers, The Stream Bank Erosion Control Evaluation and Demonstration Act of (1974), Find Report to Congress. 1981			

<b>Course Name:</b> Dam Engineering	نام فارسی درس: مهندسی سد		
<b>Credits:</b> 2	<b>Credit Type:</b> Theoretical		
<b>Course Type:</b> Elective	<b>Prerequisite Courses:</b>		
<b>Number of hours:</b> 32	Soil Mechanics , Open Channel Hydraulics		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Acquaintance of Students with the General Principles of Engineering of Different Dams			
<b>Course contents</b> <b>(Theoretical Section):</b> <ol style="list-style-type: none"> <li>1. Site Studies and Site Selection including Assessments of: Topography, Hydrology, Geology, Geotechnique, Hydraulics, Environmental Issues, and Engineering Economics</li> <li>2. Dam Architecture and Definition of Geometry</li> <li>3. Interaction between the Layout of the Dam and Associated Structures</li> <li>4. Dam Response under Different Loads</li> <li>5. Stability and Deformation Analyses (Limited to Methods and Software)</li> <li>6. Construction Viewpoints including: Time Schedule, Machinery, Workarounds</li> <li>7. Maintenance and Utilization</li> <li>8. It is recommended that this course would include Slide and Film Presentations and Arrangements be</li> </ol>			
<b>(Practical Section):</b> None			
<b>Evaluation method:</b> final test\written test\practical test			
Final test (writing\operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b> 1- Water Resources Technical Publication Series (Third Edition Edition,1987), "Design of Small Dams", New York University Press			

<b>Course name:</b> Coastal Engineering	نام فارسی درس: مهندسی سواحل
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>
<b>Number of hours:</b> 32	Open Channel Hydraulics
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
<b>Type of advanced training:</b>	
The goal of this course is to explain fundamental and basics of coastal engineering. The introduction of different kinds of coastal structures used for development and protection of shores and getting familiar to their basics of engineering studies and design are counted as the main goals of this course.	
<b>Course contents:</b> <b>(Theoretical section):</b> <b>Part 1: Familiarity to different kinds of coastal structures-6hrs</b> <ol style="list-style-type: none"> <li>1. Fundamentals of development and protection of shores</li> <li>2. Shore developments <ul style="list-style-type: none"> <li>• Commercial, passenger, Fishing, oil, military harbors</li> <li>• Sea tourism</li> <li>• Industrial plants</li> <li>• Power plants</li> <li>• Water intake and outtake plants</li> </ul> </li> <li>3. Shore protections <ul style="list-style-type: none"> <li>• Confrontation structures for coastal erosion</li> <li>• Confrontation structures for flood and coastal flooding</li> </ul> </li> </ol> <b>Part 2: Fundamentals of marine hydrolics-18hrs</b> <ol style="list-style-type: none"> <li>1. Waves <ul style="list-style-type: none"> <li>• Wave classification</li> <li>• Regular and irregular waves</li> <li>• Wind-generated waves</li> <li>• Wave hydrodynamics characteristics</li> <li>• Wave propagation</li> </ul> </li> <li>2. Tides <ul style="list-style-type: none"> <li>• The sources of tides generation</li> <li>• Vertical and horizontal tides</li> </ul> </li> <li>3. Sea Currents <ul style="list-style-type: none"> <li>• Wave generated currents</li> <li>• Wind generated currents</li> <li>• Currents generated by differences in salinity and temperature</li> </ul> </li> </ol> <b>Part 3: Fundamentals of performance design for samples of coastal structures-8hrs</b> <ol style="list-style-type: none"> <li>1. Breakwaters</li> <li>2. Piers and wharfs</li> <li>3. Protection structures <ul style="list-style-type: none"> <li>• Seawalls</li> <li>• Groins</li> </ul> </li> </ol>	

- Detached breakwaters

**(Practical section):** None

**Evaluation method:** final test\ written test\ practical test

Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>

**References:**

- 1- Basics of Sea Engineering, K. Bargi, 1387, University of Tehran Press
- 2- Introduction to Coastal Engineering and Management, J. W. Kamphuis, 2010, Advanced Series on Ocean Engineering: Volume 30, World Scientific, ISBN: 978-981-283-485-0
- 3- Coastal Engineering, Processes, theory and design practice, Dominic Reeve, Andrew Chadwick and Christopher Fleming, 2004, Spon Press, ISBN 0-415-26841-9
- 4- Introduction to Coastal Dynamics and Shoreline Protection, G. Benassai, 2006, WIT Press, ISBN: 1-84564-054-3.

<b>Course name:</b> Water Resources Engineering	نام فارسی درس: مهندسی منابع آب		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Engineering Hydrology		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> Introduction to the principles of planning for the development and operation of water resources systems considering sustainability agendas,			
<b>Course contents:</b> <b>(Theoretical section):</b> 1- Introduction to water resources and cycles, 2- The status of water resources and consumption in Iran and the world and the necessities to pay attention to the sustainability of water resources, 3- Water Resources Development Goals, 4- Introducing various water schemes including dams, transmission line, irrigation and drainage networks, distribution networks, sewage, etc., 5- Water Resources Development Stages (Planning, Designing, Implementing and Operating) 6- How to identify and engage stakeholders in water resource development and exploitation plans, 7- Economics of Engineering in Water Resources, 8- Basics of water resource system modeling, <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b> 1- Karamouz, M., Szidarovszky, F, and Zahraie, B. <i>Water Resources Systems Analysis</i> , Lewis Publisher, Boca Raton, Florida 33431, USA, 2003 (600 pages). 2- Loucks, D. P., Stedinger, J. R., and Haith. D. A. <i>Water Resources Systems Planning and Analysis</i> ”, Prentice-			

<b>Course name:</b> Civil Engineering Systems Analysis	نام فارسی درس: تحلیل سیستم‌های مهندسی عمران		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>		
<b>Number of hours:</b> 32	Statistics and Probability		
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
<b>Course description and objectives:</b> In this course, students get familiar with principles of the simulation, optimization and decision-making techniques and their applications in civil engineering systems analysis.			
<b>Course contents:</b> <b>(Theoretical section):</b> Principles of systems and the systems approach Review of applications of systems analysis in civil engineering Linear programming and its applications Non-linear programming and its applications Dynamic programming Evolutionary optimization techniques Data driven simulation techniques with emphasis on neural networks Principles of uncertainty analysis Multi-criterion decision making  <b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\ written test\ practical test			
Final test (writing\ operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b> 1- Dandy G, Walker D, Daniell T, Warner, R (2008), Planning and Design of Engineering Systems, CRC Press. 2- ReVelle C and McGarity AE (1997) Design and Operation of Civil and Environmental Engineering Systems, John Wiley & Sons, Inc. 3- Karamouz M and Kerachian R (2018) Water Quality Management, Amirkabir University Press (In Persian)			



<b>Course name:</b> Introduction to Engineering	نام فارسی درس: درآمدي بر مهندسي		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite courses:</b> None		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of advanced training:</b>			
Course description and objectives: The course is aimed to present the structure of engineering education and profession and also engineering professional organizations. Skills needed by engineers are described; They include data gathering, communication skills, oral presentation and engineering writing.			
<b>Course contents:</b>			
<b>(Theoretical section):</b>			
1- Fundamental definitions and concepts in engineering, engineering education, and future of engineering.			
2- Engineering communication, oral presentation, meeting participation, internet communication tools, text and visual communication tools.			
3- Engineering market, resume preparation, engineering ethics, & engineering organizations & work psychology.			
4- Research and innovation in engineering, data gathering, data banks, paper writing, & intellectual property.			
5- Engineering operations, problem solving, design process, safety principles & risk management			
<b>(Practical section):</b> None			
<b>Evaluation method:</b> final test\written test\practical test			
Final test (writing\operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b>			
1- Introduction to Professional Engineering in Canada, Fifth ed, by Gordon C. Andrews, J. Dwight Aplevich, Carolyn MacGregor, Roydon A. Fraser			
2- Introduction to the Engineering Profession, Second Edition, by John Dustin Kemper, June 1995			
3- The Successful Engineer: Personal and Professional Skills for Engineers by J. Campbell Martin			
4- Fundamental Competencies for Engineers by A. Bruce Dunwoody, Patrick J. Cramond, Susan Nesbit, Carla Paterson, Tatiana Teslenko			

<b>Course name:</b> Introduction to Project Management	نام فارسی درس: مبانی مدیریت پروژه										
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical										
<b>Course type:</b> Elective	<b>Prerequisite courses:</b>										
<b>Number of hours:</b> 32	Passing 80 credits										
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>											
<b>Type of advanced training:</b>											
<b>Course description and objectives:</b>											
This course provides students to understand:											
<ol style="list-style-type: none"> <li>1) The principles and fundamental concepts of project management.</li> <li>2) Directing, leadership and management of civil engineering projects.</li> </ol>											
<b>Course contents:</b>											
<ol style="list-style-type: none"> <li>1) Principal definitions</li> <li>2) Project creation and phases</li> <li>3) Project stakeholders</li> <li>4) Project management; Project manager role, responsibility and competency</li> <li>5) Project management process groups and knowledge areas</li> <li>6) Project success factors and criteria</li> <li>7) Project quality management (quality control (QC) and quality assurance (QA) tools)</li> <li>8) Project human resource management (human resource motivation and efficiency; project team building and leading; conflict management)</li> <li>9) Project communication management (communication canals and methods)</li> <li>10) Project procurement management (selection criteria, contract principles, and performance evaluation of project suppliers)</li> </ol>											
<b>Evaluation method:</b> final test\ written test\ practical test											
<table border="1"> <thead> <tr> <th>Final test (writing\ operational)</th> <th>Midterm</th> <th>Continuous evaluation</th> <th>Project</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><b>50%</b></td> <td style="text-align: center;"><b>30%</b></td> <td style="text-align: center;"><b>20%</b></td> <td style="text-align: center;"><b>0%</b></td> </tr> </tbody> </table>				Final test (writing\ operational)	Midterm	Continuous evaluation	Project	<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
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<b>References:</b>											
<ol style="list-style-type: none"> <li>1) Shirmohammadi, A. H. (2015). "Project Management and Control", Isfahan University of Technology, ISBA Press (Farsi).</li> <li>2) Project Management Institute (PMI). (2017). "Project Management Body of Knowledge", 6<sup>th</sup> Ed., PMI, Pennsylvania.</li> <li>3) Project Management Institute (PMI). (2016). "Construction Extension to the PMBOK Guide", 4<sup>th</sup> Ed., PMI, Newtown Square, Pennsylvania.</li> <li>4) Hendrickson, C. (2003). "Project Management for Construction", Prentice Hall.</li> <li>5) Kerzner, H. (2017). "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", 12<sup>th</sup> Ed., Wiley, New York.</li> <li>6) Halpin, D. W. and Senior B. A. (2011). "Construction Management", 4<sup>th</sup> Ed., John Wiley &amp; Sons, Inc., NJ.</li> </ol>											

<b>Course Name:</b> Engineering Ethics	نام فارسی درس: اخلاق مهندسی		
<b>Credits:</b> 2	<b>Credit type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite Courses:</b> None		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
<b>Type of Advanced Training:</b>			
<b>Course description and objectives:</b> This course provides students to understand concepts, theory, principles and practices of engineering ethics (professional ethics in civil engineering).			
<b>Course contents (Theoretical Section):</b>			
<ol style="list-style-type: none"> <li>1. Ethics principles, professionalism, and responsibility in engineering</li> <li>2. Moral frameworks</li> <li>3. Trust and reliability</li> <li>4. Social and value dimensions of engineering</li> <li>5. Risk and liability in engineering</li> <li>6. Responsibilities and rights of engineers in workplace and organization (confidentiality and conflicts of interest; teamwork and rights)</li> <li>7. Ethical problem-solving techniques</li> <li>8. Engineers and the environment</li> <li>9. Codes of ethics</li> <li>10. Case studies</li> </ol>			
<b>Course contents (Practical Section):</b> No			
<b>Evaluation method:</b> final test\written test\practical test			
Final test (writing\operational)	Midterm	Continuous evaluation	Project
<b>50%</b>	<b>30%</b>	<b>20%</b>	<b>0%</b>
<b>References:</b>			
<ol style="list-style-type: none"> <li>1- Bahadorinejad, M. (2015). "Engineering ethics and ethical engineering", 3<sup>rd</sup> Ed., Yazdan Press.</li> <li>2- Code of Ethics in Civil Associations.</li> <li>3- Harris, C. E., Pritchard, M. S., Rabins, M. J., James R. and Englehardt E. (2013). "Engineering Ethics: Concepts and Cases", 5<sup>th</sup> Ed., Cengage Learning.</li> <li>4- Martin, M. W. and Schinzinger, R. (2009). "Introduction to Engineering Ethics (Basic Engineering Series and Tools)", 2<sup>nd</sup> Ed., McGraw-Hill Education.</li> <li>5- Martin, M. W. and Schinzinger, R. (2004). "Ethics in Engineering", 4<sup>th</sup> Ed., McGraw-Hill Education.</li> <li>6- Codes of Ethics (ASCE, PMI, AIA).</li> <li>7- Davis, M. (2005). "Engineering Ethics (The International Library of Essays in Public and Professional Ethics)", Routledge.</li> </ol>			

<b>Course Name:</b> Computational Geotechnics	نام فارسی درس: ژئوتکنیک محاسباتی		
<b>Credits:</b> 2	<b>Credit Type:</b> Theoretical		
<b>Course type:</b> Elective	<b>Prerequisite Courses:</b> Soil Mechanics, Numerical Analysis, Principles of Numerical Analysis of Structures		
<b>Number of hours:</b> 32			
<b>Advanced training:</b> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
<b>Type of Advanced Training:</b> Computer Programming			
<b>Course description and objectives:</b> The major goal of this course is introducing and teaching preliminary concepts for numerical modeling of geotechnical problems. Generally, these goals can be categorized as follows: 3) Modeling concepts in on geotechnical engineering problems. 4) Learning Finite Difference method for modeling geotechnical engineering problems. 5) Learning preliminary concepts and basics of Finite element method and teaching a robust commercial finite element software for modeling geotechnical engineering problems.			
<b>Course contents (Theoretical Section):</b> 1) Modeling concepts in geotechnical engineering 2) Finite Difference numerical method 3) Modeling consolidation and seepage problems using finite difference method 4) Introduction to Finite Element method 5) Modeling pore water pressure and infinite boundaries in geotechnical engineering problems 6) Total and effective stress analysis in geotechnical engineering 7) Modeling consolidation and seepage problems using finite element method 8) Modeling elastoplastic behavior of soil – calculating settlements under a shallow foundation; stability analysis and deformations during ground excavations 9) Dynamic problems – Dynamic behavior of a beam on an elastic foundation			
<b>Course contents (Practical Section):</b> No			
<b>Evaluation method:</b> final test\written test\practical test			
Final test (writing\operational)	Midterm	Continuous evaluation	Project
50%	30%	20%	0%
<b>References:</b> 1- Mahmoudzadeh-Kani, I. (2007) “Introduction to Finite Element Analysis”, University of Tehran Press. 2- Mahmoudzadeh-Kani, I. (2007) “Finite Element Method”, University of Tehran Press. 3- Trefethen, L. N. (1996), Finite Difference and Spectral Methods for Ordinary and Partial Differential Equations, Cornell University 4- Potts, D.M. and Zdravkovic, L. (1999). Finite Element Analysis in Geotechnical Engineering: Application, Thomas Telford Publishing, 1999 5- Helwany, S. (2007) Applied Soil Mechanics with ABAQUS Applications, John Wiley. 6- ABAQUS Theory Manual (2014). 7- PLAXIS Scientific Manual (2015).			