المؤسسة العامة للتدريب التقني والمهني
Technical and Vocational Training Corporation
Directorate General of Curricula

Training Plans for

Bachelor of Technical Colleges

Technical Civil and Architectural Engineering

Applied Civil Engineering

2024 - 1446

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Program Description

Applied Civil Engineering program is designed to ensure a high quality knowledge and training for bachelor students and to develop several skills required to meet the needs of the local labor market. This program trends to qualify technical engineers capable to operate and supervise different civil projects, to draft technical reports, to analyze and interpret data and to communicate effectively within multidisciplinary team the engineering problems.

Four semesters of training include mainly English communication, mathematics and professional ethics, communication tools and soft skills, project management in building, quality management and leadership. It also emphasizes knowledge of specialized courses in civil engineering. These courses are architectural and structural drawings, Building materials, structural analysis, reinforced concrete design, geotechnical engineering, hydraulics, highway engineering, surveying, mechanical - electrical engineering in buildings and structural faults and repair.

Graduation project take in consideration a practical idea which be concretized in reality. This project must include prerequisites of all software's used in architectural and civil engineering to simulate the mechanical behaviour. For instance, the elaboration of prototype or working in existing project in collaboration with industry should be considered as the main output of the project. It will be supervised by qualified instructors. The outcomes of this project must be a report (technical or academic) including the experiment labs and the results of the model developed.

The Theoretical and Practical Tests and Graduation Projects Determine Learning Outcomes and Trainee Levels for each program.

The training courses contain a theoretical part and a practical part. The practical part is tested as a practical test and the theoretical part is a theoretical test with different evaluation methods

The Bachelor Degree Graduate gets the seventh level in the Saudi Arabian Qualifications Framework (SAQF).

Admission Requirements: The applicant must have a diploma in Civilization Construction and Architectural construction.

توزيع الخطة التدريبية على الفصول التدريبية لمرحلة البكالوريوس بالنظام النصفي ١٤٤٦هـ

The Curriculum Framework Distributed on Semesters 2024G

	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
6th Semester	1	ENGL 301	English Language (1)	0	3	3	0	1	4	.	لغة انجليزية ١	٣٠١ انجل	١	الفصل التدريبي السادس
	2	MATH 301	Mathematics (1)	0	3	3	0	0	3	.	رياضيات ١	٣٠١ رياض	٢	
	3	PHYS 301	Physics	0	3	2	2	0	4	.	فيزياء	٣٠١ فيزي	٣	
	4	CONS 311	Soil Mechanics	0	3	2	2	0	4	.	ميكانيكا التربة	٣١١يشيد	٤	
	5	CONS 321	Architectural Drawings	0	2	2	0	0	2	.	رسم معماري	٣٢١يشيد	٥	
	6	CONS 312	Building Materials	0	3	2	2	0	4	.	خواص مواد البناء	٣١٢يشيد	٦	
	7	CONS 373	Hydrology and Water Management	0	2	2	0	0	2	.	الهيدرلوجيا والتصرف في المياه	٣٧٣يشيد	٧	
	Total Number of Units				**19**	**16**	**6**	**1**	**23**	**المجموع**				

	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
7th Semester	1	ENGL302	English Language (2)	ENGL 301	3	3	0	1	4	٣٠١ انجل	لغة انجليزية ٢	٣٠٢ انجل	١	الفصل التدريبي السابع
	2	MATH 302	Mathematics (2)	MATH 301	3	3	0	0	3	٣٠١ رياض	رياضيات ٢	٣٠٢ رياض	٢	
	3	STAT 303	Statistics and Probability	0	3	3	0	0	3	.	الإحصاء والاحتمالات	احصا ٣٠٣	٣	
	4	PHYS 361	Physics -1	PHYS 301	3	2	2	0	4	٣٠١ فيزي	فيزياء ١	٣٦١ فيزي	٤	
	5	CONS 381	Structural Drawings	CONS 321	2	2	0	0	2	٣٢١يشيد	رسم انشائي	٣٨١يشيد	٥	
	6	CONS 334	Structural Analysis	MATH 301	3	2	2	0	4	٣٠١ رياض	تحليل انشائي	٣٣٤يشيد	٦	
	7	CONS 341	Advanced Surveying	MATH 301	3	2	2	0	4	٣٠١ رياض	مساحة متقدمة	٣٤١يشيد	٧	
	Total Number of Units				**20**	**17**	**6**	**1**	**24**	**المجموع**				

8th Semester	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	الفصل التدريبي الثامن
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	GNRL 404	Quality Tools and Applications	0	3	3	0	0	3	٠	أدوات الجودة و تطبيقاتها	٤٠٤عامة	١	
	2	GNRL 402	Engineering Project Management	0	3	3	0	0	3	٠	إدارة المشاريع الهندسية	٤٠٢عامة	٢	
	3	CONS 372	Foundation Analysis and Design	CONS 311	3	2	2	0	4	٣١١يشيد	تحليل وتصميم الاساسات	٣٧٢يشيد	٣	
	4	CONS 464	Highway Engineering	CONS 311	3	2	2	0	4	٣١١يشيد	هندسة الرصف والطرق	٤٦٤يشيد	٤	
	5	CONS 374	Hydraulics	CONS 373	2	2	0	0	2	٣٧٣يشيد	هيدروليكا	٣٧٤يشيد	٥	
	6	CONS 473	Structural Faults and Repair	CONS 311	3	3	0	0	3	٣١١ يشيد	عيوب التصميم والترميم	٤٧٣يشيد	٦	
	7	CONS***	Elective Course -1	0	2	2	0	0	2	٠	مقرر اختياري (١)	***يشيد	٧	
	8	CONS 463	Computer Application in Construction Management	CONS 381	2	2	0	0	2	٣٨١يشيد	تطبيقات الحاسب الالي في إدارة مشاريع التشييد	٤٦٣يشيد	٨	
	Total Number of Units				**21**	**19**	**4**	**0**	**23**	**المجموع**				

CTH: Contact Hours **T: Tutorial** **Practical :P** **L: Lecture** **CRH: Credit Hours**

س.أ : ساعات اتصال أسبوعي **تم : تمارين،** **ورش، /عم : عملي** **مح : محاضرة،** **و.م : وحدات معتمدة،**

9th Semester	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	الفصل التدريبي التاسع
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	GNRL405	Engineering Economy	0	2	2	0	0	2	٠	إقتصاد هندسي	٤٠٥ عامة	١	
	2	GNRL 403	Communication tools and soft skills	0	2	2	0	0	2	٠	مهارات الإتصال	٤٠٣عامة	٢	
	3	CONS 476	Design of Concrete Structures	CONS 334	3	2	2	0	4	٣٣٤يشيد	تصميم الانشاءات الخرسانية	٤٧٦يشيد	٣	
	4	CONS 403	Engineering Ethics	0	2	2	0	0	2	٠	اخلاقيات مهنة المهندس	٤٠٣يشيد	٤	
	5	CONS 465	Building Information Modelling	CONS 381	2	2	0	0	2	٣٨١يشيد	نمذجة معلومات البناء	٤٦٥يشيد	٥	
	6	CONS 475	Mechanical, Plumbing and Electrical Engineering in Building	0	2	2	0	0	2	٠	هندسة ميكانيكية وكهربائية	٤٧٥يشيد	٦	
	7	CONS***	Elective Course -2	0	2	2	0	0	2	٠	مقرر اختياري (٢)	***يشيد	٧	

	8	CONS 491	Graduation Project	0	2	1	2	0	3	٠	مشروع التخرج	٤٩١يشيد	٨
	Total Number of Units				**17**	**15**	**4**	**0**	**19**		**المجموع**		

Total Number of Semesters Units	**CRH**	**L**	**P**	**T**	**CTH**	المجموع الكلي لوحدات البرنامج
	و.م	مح	عم	تم	س.أ	
	77	**67**	**20**	**2**	**89**	

Total Contact Hours × 16	**Co-operative Training**	المجموع الكلي لوحدات التدريب	**التدريب التعاوني**	**ساعات الإتصال الكلية × ١٦**
1424	**0**	**1424**	٠	١٤٢٤

Elective Courses

Elective Courses -1	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	المقررات الإختيارية - ١
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	CONS 486	Building Sustainability	0	2	2	0	0	2	٠	استدامة المباني	٤٨٦ يشيد	١	
	2	CONS 433	Design of Special Concrete	0	2	2	0	0	2	٠	تصميم الخرسانة سابقة الاجهاد	٤٣٣ يشيد	٢	
	3	CONS 404	OHSAS/Nebbish/NFPA Safety Building	0	2	2	0	0	2	٠	أساليب السلامة في المباني	٤٠٤ يشيد	٣	
	CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours									**س.أ : ساعات اتصال أسبوعي تم : تمارين، ورش، /عم : عملي مح : محاضرة، و.م : وحدات معتمدة،**				

Elective Courses -2	No.	Course Code	Course Name	Prereq	No. of Units					المتطلب	اسم المقرر	رمز المقرر	م	المقررات الإختيارية - ٢
					و.م	مح	عم	تم	س.أ					
					CRH	L	P	T	CTH					
	1	CONS 431	Design of Steel Structures	0	2	2	0	0	2	٠	تصميم الانشاءات المعدنية	٤٣١ يشيد	١	
	2	CONS 435	Advanced Concrete Technologies	0	2	2	0	0	2	٠	تقنيات الخرسانة المتقدمة	٤٣٥ يشيد	٢	
	3	CONS 405	Utilizing Solid Wastes in Construction	0	2	2	0	0	2	٠	استخدام النفايات في التشييد	٤٠٥ يشيد	٣	

	CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours	س.أ : ساعات اتصال أسبوعي تم : تمارين، ورش، /عم : عملي مح : محاضرة، و.م : وحدات معتمدة،

Brief Description

Course Name	1- Building Materials	Course Code	CONS 312	Credit Hours	3
Description	Building materials course concerns the identification of different materials used in building sector like sand, aggregates, cement, stones, steel, etc. It concerns also the elaboration of mixture design between materials such cement paste, mortar and concrete in order to evaluate their physical and mechanical properties. The question is the following: Why the student should study building materials and their properties in civil Engineering in order to be able to: • Select a material for a given use based on considerations of cost and performance • Understand the limits of materials and the change of their properties with use • Create a new material that will have some desirable properties. In second part, the student must understand concrete for using it in professional practice. The internal and external conditions for samples' preparation must be taking in consideration to ensure a sustainable concrete in structures. Moreover, this course discusses two of the most methods of concrete mix design, one American, the other is a British method.				

Course Name	2- Architectural Drawing	Course Code	CONS 321	Credit Hours	2
Description	This course aims to expand trainees' knowledge in construction drawings, to read and interpret architectural drawings by using Autodesk Revit. However, it will allow students to communicate ideas and designs faster, easier, and more beautifully. Besides that, the course develops the ability to visualize and communicate three-dimensional shapes. It is a single software application that supports a BIM workflow from concept to construction. Use Revit to model designs with precision, optimize performance, and collaborate more effectively.				

Course Name	3- Structural Analysis	Course Code	CONS 334	Credit Hours	3
Description	This course deals to classify structural systems, structural design process, computation of loads on structures, analysis of statically determinate and indeterminate structures by different methods and the influence lines for moving loads. Computer applications in structural analysis used two complementary software's such as ROBOT structural analysis and REVIT structural analysis for simulation purpose.				

Course Name	4- Advanced Surveying	Course Code	CONS 341	Credit Hours	3
Description	Surveying course contains the following parts: • Introductory Land Surveying Course: This course is generally taken at the beginning of a student's program. Students learn the definition of land surveying. They may also study the different types of tools and techniques used in this line of work. Instructors may schedule online chats where students can discuss the different careers open to graduates. • Surveying Technical Writing Course: Taken at any point in a land surveying program, students learn how to write technical specifications. Instructors provide online lectures about different types of contracts and the appropriate information to include. Students may be assessed by turning in practice specification reports through their class's website or via e-mail. • Land Surveying Legal Regulations Course: Students are provided with an overview of the legal aspects of land surveying. Instructors may schedule online chats to discuss relevant topics, such as property laws, boundary laws and professional ethics. This course is generally taken in the middle of a student's land surveying program. • Advanced Land Surveying Course: Students may take this course towards the end of a program after they have successfully completed an introductory level courses. Instructors provide online lectures on advanced surveying topics, such as geodesy, latitude and longitude and error theory. • Engineering Problem Solving with Spreadsheets: Students study the use of computer spreadsheet programs to solve engineering problems. The course teaches the use of spreadsheet features such as functions and graphing as they applies to survey work.				

Course Name	5- Structural Drawing	Course Code	CONS 381	Credit Hours	2
Description	This course aims to expand trainees' knowledge in construction drawings, to read and interpret structural drawings of the major civil, mechanical and electrical engineering by using Autodesk Revit. However, it will allow students to communicate ideas and designs faster, easier, and more beautifully. Besides that, the course develops the ability to visualize and communicate three-dimensional shapes. It is a single software application that supports a BIM workflow from concept to construction. Use Revit to model designs with precision, optimize performance, and collaborate more effectively. The objective of this course is to apply current code requirements for structural analysis and design of reinforced concrete through using ROBOT software. It concerns structural loads and load combinations, steel, concrete, materials including codes support especially, direct Analysis Method (DAM), advanced auto-meshing and structural modelling.				

Course Name	6- Design of Concrete Structures	Course Code	CONS 476	Credit Hours	3
Description	This course conduct to analyse and design reinforced concrete structures like continuous beams; continuous one-way, two-way and Flat slabs. Analysing and design of stair slabs, Column under eccentrically loads, and R.C. frames, too. Applying the principles, procedures and basic theory of pre-stressed concrete in structural design.				

Course Name	7- Hydraulics	Course Code	CONS 374	Credit Hours	2
Description	The field of study covers subjects such as drainage basin management, water quality, water conservation and water treatment. Meteorology; precipitation; stream flow, evaporation, and transpiration; subsurface flows, well hydraulics; runoff relations and hydrographs; Water management also includes treatment of drinking water, industrial water, sewage and wastewater, flood protection and the water table. The field of this study covers also subjects such as Fluid properties; hydrostatics; kinematics and dynamics of fluid flows; conservation of mass, energy, and momentum; flows in pipes and open channels. Surface and groundwater, quality control, water distribution systems, storm water collection systems, wastewater systems and sewerage, pumps and pumping stations.				

Course Name	8- Highway engineering	Course Code	CONS 464	Credit Hours	3
Description	The course is concerned with the fundamentals of highway and pavement engineering. It introduces the design process of roads and intersections, including horizontal and vertical alignment design, cross-sections and earthworks. The second half of this strand deals with pavement design and evaluation. Topics include pavement composition, pavement materials, asphalt mix design, the pavement thickness design and, defects in Flexible pavements and, failures in rigid pavements.				

Course Name	9- Structural faults and repair	Course Code	CONS 473	Credit Hours	3
Description	This course focuses in structural faults and repairs mainly in maintenance and repair strategies, serviceability and durability of concrete, materials for repair, techniques for repair and demolition, rehabilitation and retrofitting of structures.				

Course Name	10- Graduation Project	Course Code	CONS 491	Credit Hours	2
Description	Graduation project take in consideration a practical idea which be concretized in reality. This project must include prerequisites of all software's used in architectural and civil engineering to simulate the mechanical behaviour of such structure. For instance, the elaboration of prototype or working in existing project in collaboration with industry should be considered as the main output of the project. Furthermore, the outcomes of this project must be a report (technical or academic) including the experiment labs and the results of the developed model.				

Course Name	11- Mechanical, plumbing and Electrical Engineering in building	Course Code	CONS 475	Credit Hours	2
Description	This course is an overview of the mechanical and electrical systems for building, methods mainly design and implementation. These systems implemented for building such as HAVC, Firefighting, Fire alarm, Elevators, Electrical power systems, lighting, telephone and data systems ensure the quality of living and working. Computer applications should be used to simulate realty via software like AUTOCAD and REVIT.				

Course Name	12- Building Information Modelling	Course Code	CONS 465	Credit Hours	2
Description	BIM (Building Information Modelling) can deliver business benefits whether the designing of sustainable houses or reimagining the infrastructure of entire cities. This management concept is based on REVIT software and enables almost anytime, anywhere access to project data throughout the building construction lifecycle. BIM concept empowers those in the field to better anticipate and act, and those in the back office to optimize and manage all aspects of construction performance. This course concerns also the preparation of the site, earth works, formwork, scaffolding, different structural elements of the construction, precast concrete, masonry works, floors and roofs, internal and external finishes, insulation and protection, shell structures using the BIM concept.				

Course Name	13- Computer application in construction management	Course Code	CONS 463	Credit Hours	2
Description	This course focus to train students on software, like Naviswork, as a comprehensive project review solution that supports coordination, analysis, and communication of design intent and constructability taking in architectural and structural drawing that using Revit. Multidisciplinary design data created in a broad range of Building Information Modelling (BIM), digital prototype, and process plant design applications can be combined into a single integrated project model. Interference management tools help design and construction professionals anticipate and avoid potential problems before construction begins, minimizing expensive delays and rework. Manage the model coordination with project quantities and schedule to deliver simulation and analysis of time and cost.				

Course Name	14- Foundation Analysis and Design	Course Code	CONS 372	Credit Hours	3
Description	This course deals with soil as an engineering material. It includes the description of soil, the analysis of stress in soil, and soil behaviour under conditions of major engineering significance that include the characteristics of water flow through soil, consolidation settlement and shear strength. It also covers the foundation calculation and settlement in soil (Shallow and deep) and in rock from the lab and field tests.				

Course Name	15- Soil Mechanics	Course Code	CONS 311	Credit Hours	3
Description	This course aims to expand the knowledge of engineers in geotechnics, to analyse and interpret soil classification from ASTM and AASTHO standards, Besides that, the course develops analytical skills in dealing with physical properties of soils and the real effect on their behaviour. It also covers the statics of soil, soil structure and compaction of soils using proctor and CBR tests.				

Course Name	16- Hydrology and water management	Course Code	CONS 373	Credit Hours	2
Description	The field of study covers subjects such as hydrogeology, marine hydrology, drainage basin management, water quality, irrigation, water conservation and water treatment. Meteorology; precipitation; stream flow, evaporation, and transpiration; subsurface flows, well hydraulics; runoff relations and hydrographs; elements of stream flow routing, frequency and duration studies; extreme values statistics applied to flood and drought forecasting; application of hydrologic techniques. Water management also includes treatment of drinking water, industrial water, sewage and wastewater, flood protection and the water table. Opportunities after graduation cover jobs as a group manager in a private company, university lecturer, scientists in hydrology or water resources consultant. Meteorology; precipitation; stream flow, evaporation, and transpiration; subsurface flows, well hydraulics; runoff relations and hydrographs; elements of stream flow routing, frequency and duration studies; extreme values statistics applied to flood and drought forecasting; application of hydrologic techniques.				

Course Name	17- Building sustainability	Course Code	CONS 486	Credit Hours	2
Description	A sustainable building, or green building is an outcome of a design philosophy which focuses on increasing the efficiency of resource use — energy, water, and materials — while reducing building impacts on human health and the environment during the building's lifecycle, through better siting, design, construction, operation, maintenance, and removal.[1] Though green building is interpreted in many different ways, a common view is that they should be designed and operated to reduce the overall impact of the built environment on human health and the natural environment by (a) Efficiently using energy, water, and other resources, (b) Protecting occupant health and improving employee productivity, and (c) Reducing waste, pollution and environmental degradation.				

Course Name	18- Design of special concrete	Course Code	CONS 433	Credit Hours	2
Description	This course aims to design pre-stressed concrete sections. It will include basic concept of pre-stressing, pre-stressing technology, steel and concrete materials, computation of fibre stresses, pre-stress losses, flexural and shear behavior at service loads and ultimate loads, deflection and crack control, load balancing, anchorage zone, design and construction integration, and use STRUCTURAL BRIDGE DESIGN software to analyse and design pre-stressed concrete bridge.				

Course Name	19- Design of Steel Structures	Course Code	CONS 431	Credit Hours	2
Description	In this course, trainees get to know how to analyze and design tension and compression steel members, Columns under eccentric loadings, Column bases and footings, Beams for Flexure and Shear, bolted and welded Connections, Structural Steel design Project. Using software through Trusses 2D, 3D module and Frame 2D, 3D module is essential for steel design.				

Course Name	20- Advanced Concrete Technologies	Course Code	CONS 435	Credit Hours	2
Description	Advance Concrete is a computer-aided design (CAD) used for modeling and detailing reinforced concrete structures. Advance Concrete is used in the structural / civil engineering and drafting fields. The correlation between different methods of formulation and with software is essential to more understand the huge topic of concrete design.				

Core Courses Description

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering
Course Name	Building Materials	Course Code	CONS 312
Prerequisites		Credit Hours CRH	3 CTH 4
		L 2 P 2 T 0	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description: Building materials course concerns the identification of different materials used in building sector like sand, aggregates, cement, stones, steel, etc. It concerns also the elaboration of mixture design between materials such cement paste, mortar and concrete in order to evaluate their physical and mechanical properties. The question is the following: Why the student should study building materials and their properties in civil Engineering in order to be able to:

- Select a material for a given use based on considerations of cost and performance
- Understand the limits of materials and the change of their properties with use
- Create a new material that will have some desirable properties.

In second part, the student must understand concrete for using it in professional practice. The internal and external conditions for samples' preparation must be taking in consideration to ensure a sustainable concrete in structures. Moreover, this course discusses two of the most methods of concrete mix design, one American, the other is a British method.

Topics :

- The importance of building materials and its applications
- Methods for cement paste, mortar and concrete mix design
- Building materials properties properties
- Mechanical behaviour of cementitious mixtures

Concrete quality

Experiments: if applicable it will support the course topics.

References :

- Properties of concrete (2011), handbook Material properties and rehabilitation of RCC buildings. general public works dept.
- A.M.NEVILLE,J.J.BROOKS (2010), handbook on Concrete Technology (second edition) of Prentice Hall is an imprint of Pearson,London.

	Detailed of Theoretical Contents	
No	**Contents**	**Hours**
1	**Portland Cement** • Historical note • Manufacture of Portland cement • Chemical composition of Portland • Different types of Cement • Hydration of cement • Calcium silicate hydrates • Tricalcium aluminate hydrate and the action of gypsum • Cement paste Setting	**4**

	• False set • Fineness of cement • Structure of hydrated cement • Volume of products of hydration • Capillary pores • Heat of hydration of cement • Influence of the compound composition properties of cement • Effects of alkalis	
2	**Cementitious materials of different types** • Categorization of cementitious materials • Pozzolanas • Fly ash • Pozzolanic cements • Silica fume • Fillers • Cement resistant to chlorides • High performance cement	**4**
3	**Properties of aggregate** • General classification of aggregates • Classification of natural aggregates • Sampling • Particle shape and texture • Bond of aggregate • Strength of aggregate • Other mechanical properties of aggregate • Specific gravity • Bulk density • Porosity and absorption of aggregate • Moisture content of aggregate • Bulking of fine aggregate • Deleterious substances in aggregate • Organic impurities- Clay and other fine material-Salt contamination-….Alkali–silica reaction	**4**
4	**Admixtures** • Benefits of admixtures • Types of admixtures • Accelerating admixtures • Retarding admixtures • Water-reducing admixtures • Super plasticizers • Nature of super plasticizers • Effects of superplasticizers • Dosage of superplasticizers • Loss of workability • Superplasticizer–cement compatibility • Use of superplasticizers • Waterproofing admixtures	**4**

5	**Reinforcing steel** • Types of Steel Bars Cross-Section • Rolled Steel Section • Types of Steel Bars • Manufacturing of Steel Bars • Tensile test • Elastic Behavior • Anelasticity • The Proportional Limit • Yielding and the Onset of Plasticity • The Yield Point • Grain-Size Effects on Yielding • Strain Hardening and the Effect of Cold Work • Ultimate Strength • Toughness • Ductility • True Stress-Strain Relationships • Temperature and Strain-Rate Effects • Fracture Characterization	**4**
6	**Importance of Concrete and its applications** • Advanced Concrete in Industry • Different types of Concrete Preparation • Mixing Concrete, Pumped Concrete, Placing and Compacting Concrete, Vibration Concrete, Finishing Concrete, and Handling Concrete.	**4**
7	**Temperature Problem in Concrete** • Hot-Weather Problems. • Hot- Cold Weather Concreting. • Large Concrete Masses. **Strength Development** • Normal curing, methods of curing, influence of Temperature, maturity. Steam curing. **Concrete Types** • Plain, Reinforced, Prestressed, Precast, High Strength, Fibrous, Polymer, Shotcrete, Light-Weight, Heavy-Weight and Mass Concrete.	**2**
8	**Fresh Concrete Properties** • Consistency • Workability • Factors affecting workability. • Cohesion and Segregation. • Bleeding.	**2**
9	**Properties of Hardened Concrete** • Compressive, flexural and tensile Strengths • Porosity • Total Voids in Concrete • Pore Size Distribution • Stress-Strain Relationship • Water/Cement Ratio	**2**

	• Aggregate /Cement Ratio • Shear, bending and bond Strengths • Shrinkage, swelling & Creep • Young Modulus of Elasticity	
10	**Deformation and cracking independent of load** • Shrinkage and Swelling • Drying Shrinkage • Factors Influencing Shrinkage	**2**
Textbook	A.M.NEVILLE,J.J.BROOKS (2010), handbook on Concrete Technology (second edition) of Prentice Hall is an imprint of Pearson, London.	

	Detailed of Practical Contents	
No	**Contents**	**Hours**
1	**Tests on cement properties** • Fineness of cement • Consistency of standard paste • Setting time • Soundness • Strength of cement	**4**
2	**Tests on aggregates** • Sampling • Determination of Specific Weight for Coarse and Fine Aggregates • Determination of Unit Weight of Aggregates • Determination of Organic Impurities in sand • Alkali–carbonate reaction • Thermal properties of aggregate • Sieve analysis • Grading curves • Fineness modulus • Grading requirements • Practical gradings • Grading of fine and coarse aggregates • Oversize and undersize • Gap-graded aggregate • Maximum aggregate size	**4**

3	**Tests on steel**
	• Tensile test .
	  • Youngs modulus E-
	  • elastuc limit
	  • yield stress
	  • ultimate strength
	• Load-Unload Test :
	Relaxing criteria
	Creed limit
	• Bending test .
		4

	• IMPACT TESTING(To conduct Charpy V-notch impact test and determine the ductile-brittle transition temperature of steels). • HARDNESS TEST(Brinell Hardness Test- Vickers Hardness Test)	
4	**Concrete mix design** • Preparation and identification of materials for concrete design • Concrete Mix Design using American Method • Concrete Mix Design using British Method	**4**
5	**Fresh Concrete Testing** • Method of preparing Fresh Concrete Samples • Slump and Flow Tests • Ball Penetration Test • Compacting Factor Test • Vebe (VB) Test • Compacting Factor and Compactability Tests • Void ratio	**4**
6	**Hardened Concrete testing** • Preparation of prismatic, cubic and cylindrical specimens for Compressive, flexural and tensile strengths Test. • Elaboration of direct and indirect tensile Strength • Bending Strength Test. • Shear Strength Test. • Pull Out Test • Beam Test. • Modulus of Elasticity Test. • Static&Dynamic. • Elasticity test in bending • Modular Ratio • Factors Influencing the Modulus of Elasticity • Poisson's Ratio	**4**
7	**Non-Destructive Tests of Concrete** • Schmidt Hammer • Ultrasonic Pulse Velocity • Core Test • Loading Test	**4**
8	**Drying Shrinkage & Moisture Movement Tests** • Drying Shrinkage • Moisture Movement	**4**
Textbook	Properties of concrete (2011), handbook Material properties and rehabilitation of RCC buildings. general public works dept.	

Textbooks	Properties of concrete (2011), handbook Material properties and rehabilitation of RCC buildings. general public works dept.
	A.M.NEVILLE,J.J.BROOKS (2010), handbook on Concrete Technology (second edition) of Prentice Hall is an imprint of Pearson,London.

Department	Civil and Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Structural Faults and Repair	Course Code	CONS 473						
Prerequisites	CONS 321	Credit Hours CRH	3			CTH	3		
			L	3	P	0	T	0	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course Description: This course focuses in structural faults and repairs mainly in maintenance and repair strategies, serviceability and durability of concrete, materials for repair, techniques for repair and demolition, rehabilitation and retrofitting of structures.

Topics :

- Maintenance and repair strategies
- Evaluation and inspection of concrete
- Repair materials
- Techniques for repair and rehabilitation
- Repairs, rehabilitation and retrofitting of structures

Experiments: if applicable it will support the course topics.

References : Krishan Kumar ER (2002), handbook on Repair and rehabilitation of RCC buildings. general public works dept.

Detailed of Theoretical Contents		
No.	**Contents**	**Hours**
1	**Introduction** • Building systems for traditional, modern constructions and associated faults Maintenance methods • repair and rehabilitation practices, • various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration	**4**
2	**Causes of deterioration** • Structural analysis • Mechanical properties **Causes and Types of damages** • Permeability • Sulfate Attack • Corrosion Reinforcement • Attack by Sea Water • Acid Attack • Alkali-Aggregate Reaction • Resistance against fire	**7**
3	**Evaluation and inspection of existing concrete** • Inspection of damages, concrete tests: non-destructive tests • Survey of concrete • Hammer test- ultrasonic test • destructive tests • Core test- load bearing test chemical tests • corrosion evaluation	**6**

4	**Materials for repair** • Concrete repair chemicals, special strength concrete, Fiber reinforced concrete. • Parameters for selection of materials • Corrosion repair materials.	**3**
5	**Rehabilitation methods** • Mortar repair for cracks, • Methods of corrosion protection. • Engineered demolition techniques.	**3**
6	**Structural Repairs work** • Concrete removal and preparation • Repair stages • Concrete frame work • Chemical application. • corrosion protection • Structural maintenance	**6**
7	**Non-structural Repairs work** • plastering, water proofing, retrofitting , retiling etc.	**3**
8	**Conformity with Specifications** • Variability of Strength. • Acceptance and Conformity. • Conformity Requirements for Other Properties. • Quality Control Charts.	**6**
9	**Application Project**: Case study for structural faults and repair methods of existing building.	**10**
Textbook	Krishan Kumar ER (2002), handbook on Repair and rehabilitation of RCC buildings. general public works dept.	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Architectural Drawings	Course Code	CONS 321						
Prerequisites		Credit Hours CRH	2	CTH	2				
			L	2	P	0	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description: This course aims to expand trainees' knowledge in construction drawings, to read and interpret architectural drawings by using Autodesk Revit. However, it will allow students to communicate ideas and designs faster, easier, and more beautifully. Besides that, the course develops the ability to visualize and communicate three-dimensional shapes. It is a single software application that supports a BIM workflow from concept to construction. Use Revit to model designs with precision, optimize performance, and collaborate more effectively.

Topics:

- Introduction to REVIT software
- Creating an Effective Project
- Managing Content in Autodesk Revit

Experiments: If applicable, it will support the course topics.

References:

- Essentials Revit Architecture, Author: Ryan Duell, Tobias Hathorjn, Tessa Reist Hathorn.
- Revit Architecture 2018, Author: Douglas R. Seidler.
- Design Integration Using Autodesk Revit 2018**,** Author:

Detailed of practical's Contents		
No	**Contents**	**Hours**
1	**BIM Concepts** • Introducing building information modeling (BIM) • Working in one model with many views • Understanding Revit Families categories**.** **Understanding the REVIT Architecture Interface** • Understanding Revit file types and content libraries. • Using the Ribbon and the Quick Access Toolbar (QAT) • The Properties and Project Browser palettes. • Navigating different views	**2**
2	**Starting a Project** • Creating a new project from standard templates. • Configuring project settings • Adding and adjusting floor levels • Linking AutoCAD DWG files • Creating floor plan views. **Modelling Basics** • Adding and locating walls • Wall properties and types • Adding doors and windows • Edit family door/windows properties.	**2**

3	**Floors** • Creating Floors and modify boundary shape. • Copying multiple floors. • Sloped Floors and Ramps • Changing floor type. **Reflected Ceiling Plans** • Creating Ceilings • Adding Light Fixtures. • Soffits.	**2**
4	**Stairs, Ramps and Railings.** • Adding stairs and railing. • Working with component-based stairs • Modifying railings shape. **Columns Architecture** • Adding grids • Adding and changing structural columns. • Adding floor framing/beam system	**3**
5	**Rooms Objects** • Adding rooms • Tagging, naming and numbering • Understanding room bounding elements **Basic of Annotation** • Adding Callout detail view (plan and section) • Adding text • Adding dimensions • Adding symbols • Adding legend views • Adding filled and masking regions.	**2**
6	**Curtain Walls** • Creating Curtain Walls • Adding Curtain Grids • Working with Curtain Wall Panels **Coloured Room Plans** • Duplicating floor plan views. • Setting colour schemes. • Apply colouring types	**2**
7	**Working with Visibility and Graphic Controls** • Working with visibility and graphic overrides • Using object styles • Hiding and isolating objects in a model • Understanding view range • Displaying objects above and below in plan views • Using the Line work tool **Reviewing orthographic drawing** • Plans. • Elevations. • Sections.	**2**
8	**Three-dimensional graphics.**	**3**

	• Isometric drawings. • Axonometric drawings. • Oblique drawings	
9	**Type of construction Drawings** • Preliminary drawings • Presentation drawings (Architectural drawing) • Working drawings • Shop drawings • As-built drawings	**2**
10	**Site and Landscaping** • Creating topography from survey CAD points. • Adding topography land. • Adding topo-surface. • Modifying topography **Civil drawings** • Site plan. • Plat map. • Demolition plan. • Topography map. • Drainage an utility plans. • Landscaping and irrigation plans002E	**2**
11	**The Basics of Families** • Understanding Revit families and Model Hierarchy • Loading and adding different Revit families • Creating a new Table family from a template • Using reference planes, parameters, and constraints • Adding solid geometry • Cutting holes using void geometry • Adding material. • Completing the family inside the project**.**	**3**
12	**Architectural drawing** • Plans. • Elevations. • Sections. **Basic Presentation** • Rendering • Applying Material • Exporting high resolution images • Organizing Project Browser Sheets	**3**
13	**Introducing Structural drawings** • Footing Plan and schedule • Grade beam layout and beams schedule • Floors farming plans and beam and columns schedules **Creating Drawing Sets** • Understanding Schedule • Creating Schedules • Editing a Schedule	**2**
14	**Working with Massing**	**2**

	• The Conceptual mass environment • Basics 3D forms • Solids and Voids • In-Place Massing • Mass Floor and Area Schedule • Editing mass profiles • Advanced massing forms **Design Options** • Defining design options • Adding elements • Editing design options • Presenting and finalizing design options **Introduction to Dynamo**	
Textbook:	Autodesk Revit 2018 Architecture Basics, Author: ELISE MOSS	

Department	Civil And Architectural Engineering		**Major**	Applied Civil Engineering					
Course Name	Structural Drawings		**Course Code**	CONS 381					
Prerequisites	CONS 321		Credit Hours CRH	**2**		CTH	2		
				L	**2**	P	**0**	T	**0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description: This course aims to expand trainees' knowledge in construction drawings, to read and interpret structural drawings of the major civil, mechanical and electrical engineering by using Autodesk Revit. However, it will allow students to communicate ideas and designs faster, easier, and more beautifully. Besides that, the course develops the ability to visualize and communicate three-dimensional shapes. It is a single software application that supports a BIM workflow from concept to construction. Use Revit to model designs with precision, optimize performance, and collaborate more effectively. The objective of this course is to apply current code requirements for structural analysis and design of reinforced concrete through using ROBOT software. It concerns structural loads and load combinations, steel, concrete, materials including codes support especially, direct Analysis Method (DAM), advanced auto-meshing and structural modelling.

Topics:

- Introduction to REVIT software
- Type of construction drawings
- Construction details

Experiments: If applicable, it will support the course topics.

References:

- Essentials Revit Architecture.
- Blueprint Reading, Author: Sam Kubba.
- Blue Print Reading: Interpreting Working Drawings, Author: E. M. Wyatt

Detailed of practical's Contents		
No	**Contents**	**Hours**
1	**BIM Concepts** • Introducing building information modeling (BIM) • Worksets and Worksharing • Understanding Central Files. • Creating a Central File.	**2**
2	**Starting a Project** Creating a new project from standard templates. • Configuring project settings • Adding and adjusting floor levels • Linking AutoCAD DWG files • Creating floor plan views. **Modelling Basics** • Adding and locating walls • Wall properties and types • Adding doors and windows • Edit family door/windows properties.	**2**

3	**Floors** • Creating Floors and modify boundary shape. • Copying multiple floors. • Sloped Floors and Ramps • Changing floor type. **Reflected Ceiling Plans .** • Creating Ceilings • Adding Light Fixtures. • Soffits.	**2**
4	**Stairs and Ramps and Railings.** • Adding stairs and railing. • Working with component-based stairs • Modifying railings shape. **Columns Architecture.** • Adding grids • Adding and changing structural columns. • Adding floor framing/beam system	**2**
5	**Rooms Objects**. • Adding rooms • Tagging, naming and numbering • Understanding room bounding elements **Basic of Annotation .** • Adding Callout detail view (plan and section) • Adding text • Adding dimensions • Adding symbols • Adding legend views • Adding filled and masking regions.	**2**
6	**Curtain Walls.** • Creating Curtain Walls • Adding Curtain Grids • Working with Curtain Wall Panels **Colored Room Plans.** • Duplicating floor plan views. • Setting color schemes. • Apply coloring types	**2**
7	**Working with Visibility and Graphic Controls.** • Working with visibility and graphic overrides • Using object styles • Hiding and isolating objects in a model • Understanding view range • Displaying objects above and below in plan views • Using the Line work tool **Reviewing orthographic drawing.** • Plans. • Elevations. • Sections.	**2**
8	**Three-dimensional graphics.** • Isometric drawings.	**2**

	• Axonometric drawings. • Oblique drawings**.**	
9	**Type of construction Drawings.** • Preliminary drawings. • Presentation drawings (Architectural drawing). • Working drawings. • Shop drawings. • As-built drawings.	**2**
10	**Site and Landscaping** • Creating topography from survey CAD points. • Adding topography land. • Adding topo-surface. • Modifying topography **Civil drawings.** • Site plan. • Plat map. • Demolition plan. • Topography map. • Drainage an utility plans. • Landscaping and irrigation plans002E	**2**
11	**The Basics of Families.** • Understanding Revit families and Model Hierarchy • Loading and adding different Revit families • Creating a new Table family from a template • Using reference planes, parameters, and constraints • Adding solid geometry • Cutting holes using void geometry • Adding material. • Completing the family inside the project**.**	**4**
12	**Architectural drawing.** • Plans. • Elevations. • Sections. **Basic Presentation.** • Rendering • Applying Material • Exporting high resolution images • Organizing Project Browser Sheets	**4**
13	**Introducing Structural drawings.** • Footing Plan and schedule • Grade beam layout and beams schedule • Floors farming plans and beam and columns schedules **Creating Drawing Sets** • Understanding Schedule • Creating Schedules • Editing a Schedule	**2**
14	**Working with Massing.** • The Conceptual mass environment	**2**

	• Basics 3D forms • Solids and Voids • In-Place Massing • Mass Floor and Area Schedule • Editing mass profiles • Advanced massing forms **Design Options.** • Defining design options • Adding elements • Editing design options • Presenting and finalizing design options **Introduction to Dynamo.**	

Textbook:	• Understanding Construction Drawings. Author: Huth, M. • Blueprint Reading Author: Sam Kubba. • Blue Print Reading: Interpreting Working Drawings. Author: E. M. Wyatt

Department	Civil And Architectural Engineering		**Major**	Applied Civil Engineering					
Course Name	Soil Mechanics		**Course Code**	CONS 311					
Prerequisites			**Credit Hours** **CRH**	**3**			CTH	4	
				L	**2**	P	**2**	T	**0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course aims to expand the knowledge of engineers in geotechnics, to analyse and interpret soil classification from ASTM and AASTHO standards, Besides that, the course develops analytical skills in dealing with physical properties of soils and the real effect on their behaviour. It also covers the statics of soil, soil structure and compaction of soils using proctor and CBR tests.

Topics :

- Soil identification
- Physical properties of soil
- Soil permeability
- Soil structure
- Statics of soil
- Soil compaction

Experiments: if applicable it will support the course topics.

References :

- An Introduction to the Mechanics of Soils and Foundations, Atkinsom, J., McGraw-Hill Inc, 1993.

	Theoretical Content	**Hours**
1	- **Soil identification** by grain size distribution (sieve and hydrometer analysis) - **Soil classification** according to ASTM and AASHTO standards	**4**
2	- **Soil consistency** States of soil Soil classification from Atterberg Chart	**4**
3	- **Physical properties of soil** Dry and bulk densities Void ratio, porosity and permeability Relative density, saturation degree	**4**
4	- **Soil permeability** Darcy law Velocity and quantity of water flow Intrinsic permeability	**4**
5	- **Statics of soil** Stress tensor in soil Deformation ellipsoid Mohr circle	**4**
6	- **Soil structure** Cohesive soils Non-cohesive soils Determination of cohesion and friction angle	**6**
7	- **Compaction of soil** Proctor test (Standard and modified)	**6**

	Capacity bearing calculation from California Bearing Ratio, CBR Field tests for soil compaction	
Textbook:	Atkinsom, J. (1993) "An introduction to the mechanics of soils and foundations", McGraw-Hill Inc.	

Detailed of Theoretical And Practical Contents		
weeks	**Practical Content**	**Hours**
1	Sieve analysis	**3**
2-3	Hydrometer analysis	**3**
4	Exploiting of grain size analysis results	**3**
4	Atterberg limits	**3**
5	Exploiting of Atterberg limits results	**3**
6	Permeability tests	**3**
7	Standard Proctor test	**1**
8	Modified Proctor test	**1**
10	Exploiting of Proctor test	**1**
11-12	CBR (Californian Bearing Ratio) test	**1**
13	Exploiting of CBR test	**2**
14	Cone sand test	**4**
15-16	Swelling test by CBR	**4**
Textbook:	Engineering Properties of soils based on laboratory testing, Prof. Krishma Reddy, UIC	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Foundations Analysis and design	Course Code	CONS 372						
Prerequisites	CONS 311	Credit Hours CRH	3	CTH	4				
			L	2	P	2	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

This course deals with soil as an engineering material. It includes the description of soil, the analysis of stress in soil, and soil behaviour under conditions of major engineering significance that include the characteristics of water flow through soil, consolidation settlement and shear strength. It also covers the foundation calculation and settlement in soil (Shallow and deep) and in rock from the lab and field tests.

Topics :

- Stress distribution in soils
- Shear strength of soils
- Consolidation of soil
- Shallow and deep foundations design from labs and field
- Rock foundations
- Settlement

Experiments: if applicable it will support the course topics.

References :

- Coduto, D.P., "Geotechnical Engineering Principles and Practices", Prentice Hall of India Private Limited, New Delhi, 2002.
- McCarthy D.F., "Essentials of Soil Mechanics and Foundations Basic Geotechniques", Sixth Edition, Prentice-Hall, New Jersey, 2002.
- . Das, B.M, "Principles of Geotechnical Engineering", (fifth edition), Thomas Books/ cole, 2002.

Muni Budhu, "Soil Mechanics and Foundations", John Willey & Sons, Inc, New York, 2000.

	Detailed of Theoretical Contents	Hours
1	- **Soil description** Disturbed and undisturbed samples Labs and field description Types of soils Natural problem of soils	4
2	- **Stress distribution in soils** Equations of static equilibrium Hooke's law Relations between moisture content, effective pressure and strength The Boussinesq method for soil stresses	4
3	- **Shear strength of soils** Components of shear strength Soil tests to determine shear strength Soil types according to shear strength Mohr-Coulomb failure theory	2
4	Consolidation of soil Types of ground movements Compressibility Terzaghi's theory of consolidation Consolidation test	2

	Determination of consolidation coefficient Settlements	
5	**Lateral earth pressure** Lateral earth pressure at rest Active earth pressure Passive earth pressure Active lateral pressure on inclined soil surface Coulomb theory Rankine theory Retaining wall	**4**
6	**Slope stability** Types of movement slopes Factors in instability Analysis of stability of slopes Method of slices Friction-circle method Taylor's stability number Analysis of a plane translational slip	**4**
7	**Shallow foundations calculation Form laboratory and field tests** Types and bearing capacity Design of isolated footings Design of strip foundations Design of combined footings Design of rafts Numerical analysis of foundations	**2**
8	**Settlement calculation from field tests**	**3**
9	**Deep foundations Form field tests** Design of pile foundations Design of piers and caissons Sheet Pile Walls (SPW) Foundations for offshore structures	**3**
10	**Rock foundation**	**2**
11	**Field tests**	**2**

Textbook:	• Coduto, D.P., "Geotechnical Engineering Principles and Practices", Prentice Hall of India Private Limited, New Delhi, 2002. • McCarthy D.F., "Essentials of Soil Mechanics and Foundations Basic Geotechniques", Sixth Edition, Prentice-Hall, New Jersey, 2002. • Das, B.M, "Principles of Geotechnical Engineering", (fifth edition), Thomas Books/ cole, 2002. • Muni Budhu, "Soil Mechanics and Foundations", John Willey & Sons, Inc, New York, 2000.

Detailed of practical's Contents		
weeks	**Contents**	**Hours**
1-2	Consolidation test	**4**
3	Unconfined compression test	**4**
3	Direct shear test	**4**
4-5	Triaxial shear test : Explanation : CD – CU – UU Execution : UU	**8**
7-10	Field soil tests : Standard penetration test SPT Cone Penetration Test CPT Non-destructive Tests: SASW	**8**
10-14	Elaboration of Geotechnical report	**4**
Textbook:	Engineering Properties of soils based on laboratory testing, Prof. Krishma Reddy, UIC	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Hydrology and water management	Course Code	CONS373						
Prerequisites		Credit Hours CRH	2		CTH	2			
			L	2	P	0	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

The field of study covers subjects such as hydrogeology, marine hydrology, drainage basin management, water quality, irrigation, water conservation and water treatment. Meteorology; precipitation; stream flow, evaporation, and transpiration; subsurface flows, well hydraulics; runoff relations and hydrographs; elements of stream flow routing, frequency and duration studies; extreme values statistics applied to flood and drought forecasting; application of hydrologic techniques. Water management also includes treatment of drinking water, industrial water, sewage and wastewater, flood protection and the water table. Opportunities after graduation cover jobs as a group manager in a private company, university lecturer, scientists in hydrology or water resources consultant.

Meteorology; precipitation; stream flow, evaporation, and transpiration; subsurface flows, well hydraulics; runoff relations and hydrographs; elements of stream flow routing, frequency and duration studies; extreme values statistics applied to flood and drought forecasting; application of hydrologic techniques.

Topics :

- Coastal Engineering
- Subsurface Hydrology
- Sediment Transport Engineering
- Computational River Hydraulics
- Transport Processes in Surface Waters
- Computational Watershed Hydrology
- Water Resources Systems Engineering
- Environmental Fluid Mechanics
- Statistical Hydrology
- Advanced Hydrology
- Advanced Problems in Hydromechanics and Hydraulic Engineering

Experiments: if applicable it will support the course topics.

References :

Lin, Shun D. and Lee, C. C. (2001) "Water and wastewater calculation manual", McGraw-Hill Professional.

Detailed of Theoretical Content		
	Contents	**Hours**
1	**Coastal Engineering** An introduction to coastal engineering with emphasis on the interaction between oceanic dynamic processes (waves, currents, and tides) and coastal regions (beaches, harbors, structures, and estuaries) and on the engineering approaches necessary to prevent adverse effects caused by this interaction.	2
2	**Subsurface Hydrology** Basic principles of fluid flow in saturated and unsaturated materials. Darcy's law, well hydraulics, determination of hydraulic properties of aquifers. Infiltration theory. Discussions of artificial recharge, land subsidence, saltwater intrusion, ground water quality and contamination.	2

3	**Sediment Transport Engineering** Sediment properties and the mechanics of sediment transport. Threshold of movement. Riverbed load and suspended load theories. Regime theory and stable channel design. River diversion problems. Erosion. Geomorphologic and water quality aspects.	**2**
4	**Computational River Hydraulics** Use of professional computer programs for the solution of river hydraulics problems. General formulation of energy losses in a river reach. Methods of handling the presence of bridges; software for handling bridges only. Channel modifications. Floodway determination. Flow around islands. River networks analysis.	**2**
5	**Transport Processes in Surface Waters** Four main topics are covered: (1) density-stratified two-layer systems in lakes and channels, with applications to mixed-layer growth, oil-spill containment, salinity intrusions, (2) advection-diffusion modeling in channels, including analytical and numerical solutions to steady and unsteady, one- and two-dimensional problems, (3) mechanisms of diffusional transport, including turbulence in channels and longitudinal shear dispersion, and (4) near-field analysis of discharges, including similarity analyses of jets and plumes.	**2**
6	**Computational Watershed Hydrology** Use of professional computer programs for the calculation of the runoff from complex basins. Generation of unit hydrographs. Calculation of losses, channel and reservoir routing, parameter optimization, and application of Kinematic wave technique to urban catchments.	**3**
7	**Water Resources Systems Engineering** Systems analysis, modeling, and optimization in water quantity and water quality management; linear, nonlinear, and dynamic programming models; stochastic models; risk analysis; simulation. Application to engineering problems found in the areas of water supply, water quality and process control, residuals, urban drainage, and river basin development and management.	**3**
8	**Environmental Fluid Mechanics** Advanced fluid mechanics associated with environmental flows, with variable focus. Possible focus includes density-stratified flows (internal waves, plumes, estuarine circulation); rotational flows (geostrophic flows, Kelvin waves, Eckman layers); turbulence and mixing in the environment; dynamics of lakes.	**4**
9	**Statistical Hydrology** Probability distributions applicable to hydrologic events; analysis of extremes, floods and droughts; statistical association between hydrologic variables. Analysis of hydrologic time series. Spectral and parametric formulation of stochastic models of rainfall, runoff, rainfall-runoff transfer, and other hydrologic variables. Application of Markov chains and point processes to the sequence of rainfall and other hydrologic events.	**4**
10	**Advanced Hydrology** Flood routing and overland flow theory. Parametric hydrology, linear and nonlinear analysis of rainfall-runoff systems, unit and instantaneous unit hydrographs. Conceptual and digital models for the simulation of the hydrologic processes in watersheds and for runoff prediction	**4**
11	**Advanced Problems in Hydromechanics and Hydraulic Engineering** Ideal fluid flow theorems and examples, conformal mapping, turbulence, transients, wave theory; transport processes; and other topics selected by the instructor.	**4**
Textbook:	Nazih K. Shammas, Lawrence K. Wang (2011) "Water supply and wastewater removal". John Wiley and Sons, Inc. USA.	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering
Course Name	Hydraulics	Course Code	CONS 374
Prerequisites	CONS 373	Credit Hours CRH	2 CTH 2
		L 2 P 0 T 0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description: Fluid properties; hydrostatics; kinematics and dynamics of fluid flows; conservation of mass, energy, and momentum; flows in pipes and open channels. Formal laboratory experiments.

- Sources and distribution of water in urban environment, including surface reservoir requirements, utilization of groundwater, and distribution systems. Analysis of sewer systems and drainage courses for the disposal of both wastewater and storm water. Pumps and lift stations. Urban planning and storm drainage practice.
- Review of governing equations for fluid flow; Nondimensionalization and scaling; boundary layer formulation and application to rivers and lakes; water waves and oscillatory flows; flow around objects, drag, and sediment transport; introduction to turbulence; effects of density stratification, including internal waves and estuaries.
- Energy and momentum principles, design of open channels for uniform and nonuniform flow, boundary layer and roughness effects, flow over spillways, energy dissipation, flow in channels of nonlinear alignment and nonprismatic section.

Topics :

- **Urban Hydraulics**
- **Introductory Environmental Fluid Mechanics**
- **Open Channel Hydraulics**

Experiments: if applicable it will support the course topics.

References :

Lin, Shun D. and Lee, C. C. (2001) "Water and wastewater calculation manual", McGraw-Hill Professional.

Detailed of Theoretical And Practical Contents		
	Contents	**Hours**
1	**Hydraulics:** Sources and distribution of water in urban environment, including surface reservoir requirements, utilization of groundwater, and distribution systems. Analysis of sewer systems and drainage courses for the disposal of both wastewater and storm water. Pumps and lift stations. Urban planning and storm drainage practice.	2
2	**Water sources** Surface water Groundwater Quality control	2
3	**Water distribution works** Purposes of water uses Rates of water consumption Design population Predicting demand for water Fire demand Types of tanks and reservoirs Period of design Types of distribution systems Pressure zones and pressure in pipes Types of pipes Design of distribution systems	6

	Appurtenances : joints pipes, valves, water meters… Management, operation and maintenance of distribution system	
4	**Storm water and wastewater collection systems** Collection of hydrological data Precipitation Evaporation and transpiration Runoff Rainfall and runoff analysis Frequency of intense storms Intensity-duration-frequency relationships Collection of storm waters Hydraulic design Appurtenances Operation and maintenance of drainage systems	3
5	**Sewerage systems** Domestic and industrial wastes Collection of sanitary wastewater Choice of collecting system flow through sewers Design of sewers Gravity sewer pipe material Building connections Manholes Trenchless technology Appurtenances Maintenance and sewer system rehabilitation	5
6	**Pumps and pumping stations** Types of pumps Pump characteristics Pumps and their applications Pumping station types Pumping equipment Inspection and maintenance	3
7	**Wastewater Treatment** Wastewater characteristics Wastewater treatment processes Levels of wastewater treatment Reuse of wastewater	3
8	**Introductory Environmental Fluid Mechanics**: Review of governing equations for fluid flow; Nondimensionalization and scaling; boundary layer formulation and application to rivers and lakes; water waves and oscillatory flows; flow around objects, drag, and sediment transport; introduction to turbulence; effects of density stratification, including internal waves and estuaries.	3
9	**Open Channel Hydraulics:** Energy and momentum principles, design of open channels for uniform and nonuniform flow, boundary layer and roughness effects, flow over spillways, energy dissipation, flow in channels of nonlinear alignment and nonprismatic section.	5
Textbook:	Nazih K. Shammas, Lawrence K. Wang (2011) "Water supply and wastewater removal". John Wiley and Sons, Inc. USA.	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Building Information Modelling	Course Code	CONS 465						
Prerequisites	CONS 381	Credit Hours CRH	2	CTH	2				
			L	2	P	0	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description: BIM (Building Information Modeling) can deliver business benefits whether the designing of sustainable houses or reimagining the infrastructure of entire cities. This management concept is based on REVIT software and enables almost anytime, anywhere access to project data throughout the building construction lifecycle. BIM concept empowers those in the field to better anticipate and act, and those in the back office to optimize and manage all aspects of construction performance. This course concerns also the preparation of the site, earth works, formwork, scaffolding, different structural elements of the construction, precast concrete, masonry works, floors and roofs, internal and external finishes, insulation and protection, shell structures using the BIM concept.

Topics :

- Building Information Modeling
- REVIT software
- Management concept
- Aspects of construction performance

Experiments: if applicable it will support the course topics.

References :

- Roy Chudley, 5th edition, (2012) "Advanced Construction", Pearson, Prentice Hall.
- Tony Bryan (2010), " Construction". John Wiley and Sons.
- Eric Fleming (2009) " Construction". John Wiley and Sons.

Detailed of Theoretical Contents		
No	**Contents**	**Hours**
1	**Understanding the BIM Concept** • Introducing building information modeling (BIM) • Building Information Modeling • What Is BIM • Why Is BIM Important • Understanding BIM • Basic Benefits of BIM	**1**
2	• A Change in Method and Approach • Beyond Documentation. • Migrating to BIM • BIM as a Workflow • Ranges of BIM	**1**
3	• Integrated Design Teams • The Shift in Responsibility • Why an Integrated Design • The Team Members • The Designers • The Owner	**5**

	• The Contractor • The Community	
4	**Collaboration, Commitment, and Passion.** • Collaboration • Owner Commitment • Project Team Passion • Facilitating Integration in Process • Design Phase Workshops • Predesign	**1**
5	• Schematic Design • Design Development • Construction Delivery Method • Design-Bid-Build • Negotiated Guaranteed Maximum Price • Design-Build • Construction Delivery Method the Best	**1**
6	**Energy Modeling**. • Using Renewable Energy. • Using BIM for Sustainable Materials • The future of BIM and Sustainable Design • Moving Forward with Sustainable Design.	**1**
7	**Worksets and Worksharing** • Creating a New Workset • Working with Local Files. • Creating a Local File • Synchronizing a Local File with the Central File. • Managing and Using the Power of Worksets • Taking Ownership of Worksets. • Working with Model Elements and Their Worksets. • Controlling Visibility and Worksets. • Enhancing Communication.	**4**
8	**Expected Challenges** • Multiplatform Interoperability: Working with 2D • and 3D Data • BIM Tools and Parametric Modeling	**6**
9	**Parameters** • Understanding Parameter • Choosing the Correct • Naming Parameters • Using Type Parameters • Using Instance • Working with Formulas • Sample Conditional Statements	**5**
10	• BIM Implementation with coordinate • coordinate system • Clashing	**1**

	• Handling Clashing classification	
11	**Communication Collaboration** • Accounts • Powers • The active workes	**1**
12	• The Evolution to Object-Based Parametric Modeling	**1**
13	• Introducing Navisworks softwares • Basics Navisworks softwares • Project Management Navisworks softwares	**4**
Textbook:	Roy Chudley (2011) "Construction", Pearson, Prentice Hall. BIM Handbook A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors", Pearson, John Wiley & Sons, Inc.	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Structural Analysis	Course Code	CONS 334						
Prerequisites	Math 301	Credit Hours CRH	3				CTH	4	
			L	2	P	2	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description: This course deals to classify structural systems, structural design process, computation of loads on structures, analysis of statically determinate and indeterminate structures by different methods and the influence lines for moving loads. Computer applications in structural analysis used two complementary software's such as ROBOT structural analysis and REVIT structural analysis for simulation purpose.

Topics :

- Force : Analytical and Graphical method
- Moment of Force and Couple of moment
- Free body and Equilibrium equations
- Statically analysis of simple Beam
- Trusses and Frame analysis methods
- Affecting Loads
- Indeterminate Structures
- Strain and stresses analysis
- Stiffness Matrix Method
- Finite Element Method

Experiments: if applicable it will support the course topics.

References :

- HibblerRussel C., Structural analysis, 8th SI edition, Pearson, 2012.ISBN 981-06-8007-4
- Kennet M. Leet, Chia Ming Uang, Anne M. Gilbert, Fundamentals of Structural Analysis, 4thedition, McGraw-Hill.
- C.H.Morris, J.B. Willbur, and S. Utku, Elementary Structural Analysis, 3th edition, McGraw-Hill,1976
- Autodesk Robot Structural Analysis Professional 2015: Essentials Paperback – October 24, 2014 by Ken Marsh ISBN-13: 978-0991518111

Detailed of Theoretical and Practical Contents		
No	**Contents**	**Hours**
1	**Free body diagram and Equilibrium equations** • Different types of Supports • statically determinate structures, • statically indeterminate structures, • Condition of indeterminacy and geometric stability.	4
2	**Statically analysis of simple Beam** • Calculi of reaction coordinate • Internal forces and Moment • Analysis and behavior of beams	6
3	**Trusses analysis methods** • Roof trusses / Bridge trusses • Sign convention • Joints method • Section Method	6
4	**Frame Analysis** • System of forces • Moment of Couple	4

	• Varignon's Theorem	
5	**Affecting Loads** • Load Distribution Analysis • Load on Slab • Load on beam • Load on column • Load on foundation	10
6	**Indeterminate Structures** • Slope deflection Method • Moment distribution method.	8
7	**Strain and stresses analysis of structural elements** • Moment of Inertia • Strain and Stress of axial force • Strain and Stress of shear forces • Strain and Stress of moment	10
8	**Stiffness Matrix Method** • Element and Global Stiffness Matrices • Analysis of continuous Beams • Co-ordinate transformation • Rotation Matrices • Transformations of Stiffness Matrices, Load Vectors and displacements Vectors	8
9	**Finite Element Method using Robot and Revit software** • Reinforced Concrete Design – 2D frame steel design • Moving Loads 2D - 3D frame • 3D Steel Structure with Steel Connections • 3D Steel Frame with Masses	8
Textbook:	• HibblerRussel C., Structural analysis, 8th SI edition, Pearson, 2012.ISBN 981-06-8007-4 • Kennet M. Leet, Chia Ming Uang, Anne M. Gilbert, Fundamentals of Structural Analysis, 4thedition, McGraw-Hill. • C.H.Morris, J.B. Willbur, and S. Utku, Elementary Structural Analysis, 3th edition, McGraw-Hill,1976 • Autodesk Robot Structural Analysis Professional 2015: Essentials Paperback – October 24, 2014 by Ken Marsh ISBN-13: 978-0991518111	

Department	Civil And Architectural Engineering		**Major**	Applied Civil Engineering					
Course Name	Design of Concrete Structures		**Course Code**	CONS 476					
Prerequisites	**Cons334**		**Credit Hours** **CRH**	**3**		CTH	4		
				L	2	P	2	T	0

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description: This course conduct to analyse and design reinforced concrete structures like continuous beams; continuous one-way, two-way and Flat slabs. Analysing and design of stair slabs, Column under eccentrically loads, and R.C. frames, too. Applying the principles, procedures and basic theory of pre-stressed concrete in structural design.

Topics :

- Analysis and Design of R.C. frames.
- Design of Combined R.C. Footings.
- Analysis and Design of retaining walls.
- Principles, procedures and basic Design of Pre-stressed concrete members.
- Structural reinforced Concrete design Project (Apply computer calculation)
- Review of knowledge gained in Reinforced Concrete Structures (I)
- Analysis and design of continuous beams using moment's coefficients method, and direct design method.
- Analysis and Design of floor systems: continuous one-way, two-way, ribbed and Flat slabs.
- Design of Stair Slabs.
- Design of rectangular R.C. columns under eccentrically loads.

Experiments: if applicable it will support the course topics.

References :

- " Structural Concrete – Theory and Design ", Hasson M.N. and Al- Manseer A. , 4th edition, John Wiley and Sons, Inc. 2008.
- " Reinforced Concrete- Design theory and Examples ", Third Edition, by Prab Bhatt, Thomas J.MacGinley& Ban sang Choo.
- Code Requirements for Environmental Engineering Concrete Structures and Commentary (ACI 350-06) by ACI American Concrete Institute
- Design of Reinforced Concrete: ACI 318-05 Code, Wiley; 7th edition, Jack C. McCormac and James K. Nelson

Detailed of Theoretical and practical Contents		
No	**Contents**	**Hours**
1	**Review of knowledge gained in Reinforced Concrete Structures (I):** • Structural design and limit states • Concepts of structural design for structural elements • Checking existing sections • Affecting loads on concrete loads • Analysis and design of simply one-solid slab, simply supported beam, column under axial load, separate concrete footings.	8
2	**Analysis and design of continuous beams:** • using moments coefficients method • using direct design method • Draw longitudinal and cross-sections for beams, and show details of reinforced steel.	8

3	**Analysis and Design of floor systems:** • Types of slabs and design methods • Analyze and Design of one-way solid slab • Analyze and Design of two-way solid slab • Analyze and design of one-way spanning ribbed slabs: design procedure and reinforcement • Analyze and design of Flat Slabs: General code prevision, design for internal and edge panels and reinforcement details.	8
4	**Design of Stair Slabs:** • Building regulations • Types of Stair slabs • Code design requirements • Example of design of stair slab	8
5	**Design of rectangular R.C. columns under eccentrically loads:** • Combined axial load and bending moments • Moment strength of column • Interaction diagram for combined bending and axially load • Design of column reinforcement	8
6	**Analysis and Design of R.C. frames:** • Analysis of frames: Normal diagram, Shear diagram, Moment diagram • Draw longitudinal and cross-sections for frames, and show details of reinforced steel.	8
7	**Design of Combined R.C. Footings:** • Types of combined footings • Centroid of combined footings • Procedure to find out the footing dimensions • Design the steel reinforcement • Show the construction section and elevation with the reinforcement information.	8
8	**Analysis and Design of retaining walls:** • Types of retaining walls • Effective loads • Retaining wall dimensions: Proportioning • Stability against Overturning • Stability against Sliding • Bearing Pressure Analysis • Design of Cantilever retaining Walls • Draw details of reinforced steel.	8
Textbook:	" Structural Concrete – Theory and Design ", Hasson M.N. and Al- Manseer A. , 4th edition, John Wiley and Sons, Inc. 2008.	

Department	Civil And Architectural Engineering	**Major**	Applied Civil Engineering						
Course Name	Mechanical, Plumbing and Electrical Engineering in building	**Course Code**	CONS 475						
Prerequisites		**Credit Hours** **CRH**	**2**	CTH	2				
			L	**2**	P	**0**	T	**0**	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description : This course is an overview of the mechanical and electrical systems for building, methods mainly design and implementation. These systems implemented for building such as HAVC, Firefighting, Fire alarm, Elevators, Electrical power systems, lighting, telephone and data systems enssure the quality of living and working. Computer applications should be used to simulate realty via software like AUTOCAD and REVIT.

Topics:

- Building Mechanical Systems.
- Building Electrical Systems.

Experiments: if applicable it will support the course topics.

References :

- Mechanical and Electrical Systems in Buildings , Author: Richard R. Janis, William K. Y. Tao
- Mechanical and Electrical Equipment for Buildings, 10th Edition , Author: Benjamin Stein , John S. Reynolds , Walter T. Grondzik , Alison G. Kwok
- Building Services Engineering (5th, 07) , Author: Chadderton, David V

Detailed of Theoretical Contents		
	Contents	**Hours**
1	**Understanding Natural and industrial ventilation** **Introduction to Mechanical Systems**	**2**
2	**Mechanical Design. HVAC Cooling and Heating Load Analysis** • Modeling Spaces for Building Load Analysis Creating Spaces • Placing Spaces Creating a Space Properties Schedule • Modifying Space Properties Creating Zones • Setting Building Construction Options Performing Heating and Cooling Load Analysis • Load Analysis Weather Data • Outdoor Air Infiltration Sliver Spaces • Details Heating and Cooling Loads Report • Performing Conceptual Energy Analysis on Your Building Setting Up the Model • Keeping It Simple Performing Energy Simulation • Analyzing Duct and Pipe System Pressure Exporting gbXML Data to Load-Simulating Software	**2**
3	**Creating Logical Systems** • Managing Systems Why Are Systems Important? • Mechanical Settings System Browser • Setting Up Air Systems Understanding Parameters • Creating Mechanical Systems Setting Up Piping Systems • Understanding Parameters Creating Pipe Systems	**2**

	• Creating Fire-Protection Systems • Setting Display Properties of Systems • Understanding Child and Parent Relationships in Revit Systems • Using System Filters	
4	**HVAC Equipment and Delivery** **Mechanical Systems and Ductwork** • Air Distribution Components • Mechanical Equipment Components • Air Conditioning/Handling Units • VAV Boxes • Ductwork • Duct Types and Routing • Creating New Duct Types • Using Automatic Duct Routing • Using Manual Duct Routing • Duct Sizing • Choosing a Duct Sizing Method • Using the Duct Routing Tools	**4**
5	**Plumping** **Mechanical Piping** • Mechanical Pipe Settings • Creating Piping Systems • Creating Pipe Types • Defining Fitting Angles • Selecting Fittings for Routing Preferences Choosing Pipe Materials and Sizes • Adjusting the Pipe Sizing Table Using the Fluids Table • Pipe Routing Options • Automatic Pipe Routing • Manual Pipe Routing Pipe Fittings • Using Pipe Fitting Controls • Placing Valves • Adding Piping • Defining Systems Visibility through Filters The Bottom Line	**4**
7	**Elevators and Escalator Systems** **Natural movement and industrial movement** **Movement anchored and horizontal movement in buildings** Components of elevators Components of Escalator	**3**
8	**Other Mechanical Systems**	**6**
	Introduction to Electricity **Electrical Design Lighting** • Efficient Lighting Design • Spaces and Lighting • The Reflected Ceiling Plan • Lighting Worksets • Lighting Analysis • Hosting Options for Lighting Fixtures and Devices • Lighting Fixtures in a Ceiling • Lighting Fixtures in Sloped Ceilings	

	• Ceiling Changes • Overhead Fixtures in Spaces with No Ceiling • Wall-Mounted Lights • Switches • Site Lighting • The Site Plan • Site Lighting Layout • Site Lighting Analysis	
10	**Principles of electric grounding Electrical Power System Lighting** • Modeling Methods for Power and Systems Devices • Using Annotation Symbols • Using Face-Hosted Families Avoiding Interference of Symbols • Creating Circuits • Placing Devices and Equipment Connections • Disconnect Switches • Distribution Equipment and Transformers • Switchboards • Panels • Other Equipment • Creating Power Distribution Systems • Power Diagrams • Tips for Creating Power Diagrams • Creating a Fire Alarm System Model • Fire Alarm Riser Diagram Fire Alarm Diagram Using Drafting Tools and Symbols • Modeling Conduit and Cable Tray • Defining Electrical Settings • Placing Conduit in a Model • Placing Cable Tray in a Model • Creating Family Types	**3**
11	**Fire Alarm Systems Telephone, Data and Sound System** • Creating Fire-Protection Systems • Fire Fighting Systems	**3**
13	**Computer applications Project in Mechanical and Electrical System** • AUTOCAD and REVIT MEP (Mechanical, Electrical, and Plumbing) software • HVAC for big building	**3**
Textbook:	1-Mechanical and Electrical Systems in Buildings Author: Richard R. Janis, William K. Y. Tao 2- Mechanical and Electrical Equipment for Buildings, 10th Edition Author: Benjamin Stein , John S. Reynolds , Walter T. Grondzik , Alison G. Kwok 3- Building Services Engineering (5th, 07) Author: Chadderton, David V 4- Building Services Handbook [Paperback] Author: Fred Hall , Fred Hall (Author) 5-Autodesk Revit 2018 MEP Mechanical Review for Professional Certification: Autodesk Authorized Publisher , Author: ***Autodesk® Revit®***	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Highway Engineering	Course Code	CONS 464						
Prerequisites	CONS 311	Credit Hours CRH	3		CTH	4			
			L	2	P	2	T	0	

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description: The course is concerned with the fundamentals of highway and pavement engineering. It introduces the design process of roads and intersections, including horizontal and vertical alignment design, cross-sections and earthworks. The second half of this strand deals with pavement design and evaluation. Topics include pavement composition, pavement materials, asphalt mix design, the pavement thickness design and, defects in Flexible pavements and, failures in rigid pavements.

Topics:

- Terminology used in the design/construction of highways and roadway pavements.
- Application of analytical Methods in the Geometric design of a highway Project
- Drainage design, soil improvement and earthwork for roadways and highways.
- Properties of pavement materials, pavement mix design and thickness for asphalt and concrete pavements.
- Pavements evaluation.

Experiments: If applicable, it will support the course topics.

References :

- Traffic and Highway Engineering, Fourth Edition, Nicholas J. Garber, Lester A. Hoel, University of Virginia. 2009, Cengage Learning, 1120 Birchmount Road, Toronto ON M1K 5G4 Canada
- O'Flaherty, C.A. (ed) Highways: The Location, Design, Construction and Maintenance of Road Pavements. Butterworth Heinemann.

Detailed of Theoretical Contents

	Contents	Hours
1	History of Road Construction, Highway Development in Saudi Arabia. Highway Development Programmers at National Level in Saudi Arabia.	3
2	The Highway planning process and principles of route location.	3
3	Factors controlling roadway and Highway alignment .Engineering surveys for alignment - Conventional methods and Modern methods (Remote sensing, GIS and GPS techniques)	3
4	Geometric design of roadways and Highways.	3
5	Roadways and Highways drainage.	3
6	Classification, Improvement and Stabilization of soil and Earthworks for roadways and Highways.	3
7	Sources description properties and uses of Bituminous binders. Asphalt mix design. Asphalt plants.	3
8	Design of flexible pavement by gyratory compaction	3
9	Design of rigid Pavements. Pavement management.	3
10	Types of defects in Flexible Pavements, failures in Rigid Pavements and Pavement Evaluation.	3

11	Factors for pavement Sustainability	**2**
Textbook:	O'Flaherty, C.A. (ed) Highways: The Location, Design, Construction and Maintenance of Road Pavements. Butterworth Heinemann Design of Highway Bridges, Authors: Richard Barker & Jay Puckett, Publisher: Wiley Interscience.	

Detailed of practical Contents		
	Contents	**Hours**
1	Rotational Viscosity	**3**
2	Asphalt extraction from pave analyser	**2**
3	LosAngelos test for test abrasion	**3**
4	Dynamic fragmentation for toughness test	**3**
5	Ductility of Asphalt	**3**
6	Dynamic Shear Rheometer.	**3**
7-8	Bending Beam Rheometer.	**3**
9-10	Gyratory Compaction test.	**3**
11-12	Wheel Trucker test	**3**
13	Fire point test	**3**
14	Flash point test	**3**
Textbook:	O'Flaherty, C.A. (ed) Highways: The Location, Design, Construction and Maintenance of Road Pavements. Butterworth Heinemann	

Department	Civil And Architectural Engineering		**Major**	Applied Civil Engineering					
Course Name	Advanced Surveying		**Course Code**	CONS 341					
Prerequisites	MATH 301		**Credit Hours** **CRH**	**3**		CTH	4		
				L	**2**	P	**2**	T	**0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description:
This course covers basic surveying topics that construction engineer deal with regularly. These topics include: cross – sections, leveling and global poisoning system. Trainees will handle these topics theoretically and practically.

Topics:

- Longitudinal and cross sections
- Leveling net
- Applications of Global Positioning System

Experiments: if applicable it will support the course topics.

References : Fundamentals of Surveying by S. K. Roy.

Detailed of Theoretical Contents		
	Contents	**Hours**
1	**Introduction to survey** • Definitions and types of surveying • Topographic maps and characteristics of contour lines • Principle of levelling surveying • Types of laveling	**8**
2	**Longitudinal and cross sections:** • leveling work required along longitudinal and along cross sections of the project. • Computation of designed project levels along center line. • Compute and draw Longitudinal and cross sections along the project. • Compute fill and cut volumes by using software.	**8**
3	**Leveling net**: • requirements leveling net. • Methods of leveling nets. • Land leveling on average level. • Compute and draw contour lines.	**8**
4	**Applications of Global Positioning System**: • Main components of the system. • Coordinate systems. • Observation methods. • Errors resources.	**8**
Textbook:	Surveying for Engineers by: John Uren and Bill Price	

Detailed of practical's Contents		
	Contents	**Hours**
1	**Introduction to survey** Setting of instruments (level, total station) Find the level of points by using surveying instruments	4
2	**Longitudinal and cross sections:** • Perform field leveling along longitudinal section (Center line) and along cross sections of road. • Compute designed project levels along center line. • Compute and draw Longitudinal and cross sections along the project. • Compute fill and cut volumes by using Magnet office and sierra soft software.	8
3	**Leveling net:** • Determine borders of the project area, and perform survey measurements of the border lines. • Divide the area of the project into a net of squares. • Determine levels of points of intersections along squares net. • Draw area of the project with appropriate scale. • Write levels on the map points. • - Compute quantities of cut and fill on the project area based on the average level by using software.	8
4	**Applications of Global Positioning System:** • Get to know available GPS receivers and applied program. • Setting GPS Receivers for operations. • Performing planimetric Surveying using (Stop and Go Method) • Transferring data from receivers to computer, and performing data processing and adjustment and computing coordinates and drawing map.	12

Department	**Civil And Architectural Engineering**		**Major**	Applied Civil Engineering					
Course Name	Graduation Project		**Course Code**	CONS 491					
Prerequisites			**Credit Hours** **CRH**	**2**		CTH	3		
				L	**1**	P	**2**	T	**0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description : Graduation project take in consideration a practical idea which be concretized in reality. This project must include prerequisites of all software's used in architectural and civil engineering to simulate the mechanical behaviour of such structure. For instance, the elaboration of prototype or working in existing project in collaboration with industry should be considered as the main output of the project. Furthermore, the outcomes of this project must be a report (technical or academic) including the experiment labs and the results of the developed model.

Topics :

- Literature review.
- Project schedule and management.
- Project execution
- Validation of the project and elaboration of report

Experiments: If applicable, it will support the course topics.

Detailed of Theoretical And Practical Contents		
	Contents	**Hours**
1	Literature review	**10**
2	Project schedule and management	**10**
3	Project execution	**18**
4	Validation of the project and elaboration of report	**10**
Textbook:		

Department	Civil And Architectural Engineering	**Major**	Applied Civil Engineering
Course Name	Computer applications in construction management	**Course Code**	CONS 463
Prerequisites	Cons 381	**Credit Hours CRH**	**2** CTH 2 L **2** P **0** T **0**

CRH: **Credit Hours** L: **Lecture** P: **Practical** T: **Tutorial** CTH: **Contact Hours**

Course description :

Training on Subscription software is a comprehensive project review solution that supports coordination, analysis, and communication of design intent and constructability. Multidisciplinary design data created in a broad range of Building Information Modeling (BIM), digital prototype, and process plant design applications can be combined into a single integrated project model. Interference management tools help design and construction professionals anticipate and avoid potential problems before construction begins, minimizing expensive delays and rework. Manage combines model coordination with project quantities and schedule to deliver simulation and analysis of time and cost. Entire project models can be published and freely viewed .

Topics :

- Navisworks Manage software.
- Integration with Autodesk BIM 360 Glue
- Bidirectional workflow between Navisworks and Glue
- Quantification
- Add quantification from an aggregated model
- Create more realistic results.
- Autodesk ReCap Point Cloud Support
- Supports more formats and access to large data sets.
- Model File and Data Aggregation

Experiments: if applicable it will support the course topics.

References :

- Autodesk Navisworks 2018 Using Autodesk Navisworks in a BIM Workflow: Autodesk Authorized Publisher, Pearson, DEEPAK MAINI.
- Project Management Training, Pearson, Bill shacke lford.

Detailed of Theoretical Contents

	Contents	Hours
1	Introduction BIM	2
2	• Selection Tree and Selecting Objects • Setting Selection Resolution and Sorting Structures • 3D Model Review • Hiding Objects and Overriding Materials • Hide Items & Change Object Color and Transparency • Object Properties • Add a New Custom Property Tab and Property • Enable and Customize Quick Properties • Enable and Customize Quick Properties • Measuring and Moving Objects • Using the Measuring and Move Tools	2

	• Selection and Search Sets • Selection and Search Sets • Add and Organize Viewpoints • Comments, Redlining, and Tags	
3	• Working with Animations in Navisworks • Sectioning • All copying and reuse strictly forbidden. • View and Add Links • Comparing Models • Navisworks Real-Time Rendering • Compare Two Model Files • Setting Lighting and Rendering Options	**2**
4	• TimeLiner • TimeLiner Overview • Run a Basic TimeLiner Simulation • Creating Tasks • Creating Tasks Manually • Gantt View • Working with a Gantt View • Import Tasks from External Project File • Importing Tasks	**2**
5	• Configuring and Defining a Simulation • Customizing a Simulation • Simulation Export • Exporting a TimeLiner Simulation • Animator • Animator Overview • Creating a Basic Animation • Adding a Camera and Camera Viewpoints	**2**
6	• Manipulate Geometry Objects in an Animation Set • Manipulating Geometry Objects in an Animation Set • Section Plane Sets • Adding a Section Plane Set and Captured Sectioned Views • Controlling Animation Scene Playback	**2**
7	• Adjust the Way an Animation Scene Plays • Scripter • Scripter Overview • Creating and Managing Scripts • Create and Organize Scripts • Creating and Configuring Events • Create and Configure Events • Creating and Configuring Actions • Create and Configure Actions	**2**
8	• Quantification • Quantification Overview • Setting up a Quantification Project • Item and Resource Management	**2**
9	• Sample provided by ASCENT for review only • All copying and reuse strictly forbidden	**2**

	• Setting up a Quantification Workbook	
10	• 3D Model and Virtual Takeoff • Managing Takeoff Data • Creating and Working with 3D Model Takeoff Data • Creating and Working with 2D Takeoff Data • Analyzing Changes	**3**
11	• Exporting Takeoff Data • Analyzing and Updating Takeoff Data	**3**
12	• Clash Detective • Clash Detective Overview • Conduct Simple Clash Tests • Clash Results • Clash Testing, Viewing Results, & Adding Comments • Clash Test Reporting • Clash Testing and Creating a Report • Working with Clash Tests • Clash Testing After Clashes are Corrected • Exporting and Importing Clash Tests • Exporting, Importing, and Custom Clash Tests • Laser Scan Data Clashing • Clash Testing Geometry Against Laser Scan Data	**3**
13	• Clash Testing and Moving Objects • Time-Based Clashing • Conducting and Reporting a Time Based Clash Test • Autodesk Rendering • Autodesk Rendering Overview • Adding Materials to a Model • Creating and Editing Materials • Material Mapping • Adding Materials to a Model • Adding Lights to a Model • Sun and Sky Lights	**3**
14	• Control • Planes • Ground • Photorealistic Rendering • Data Tools • Database Support (Data Tools) • Linking to an External Database	**2**
Textbook:	Mastering Autodesk Navisworks, Pearson, Jason Dodd & Scott Johnson.	

Electives courses

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Design of Steel Structures	Course Code	CONS 431						
Prerequisites	Structural Analysis	Credit Hours CRH	2	CTH	2				
			L	2	P	0	T	0	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description : In this course, trainee get to know how to analyze and design tension and compression steel members, Columns under eccentric loadings, Column bases and footings, Beams for Flexure and Shear, bolted and welded Connections, Structural Steel design Project; Apply computer calculation using ROBOT STRUCTURAL ANALYSIS software through Trusses 2D, 3D module and Frame 2D, 3D module.

Topics :

- Design of welded Connections.
- Design of Beams for Flexure and Shear.
- Industrial building Project.
- Structural Steel design Project (Apply computer calculation)
- Review of knowledge gained in Steel Structures (I)
- Design of Tension and Compression members: Analysis and design of roof Trusses.
- Design of Columns under eccentric loadings.
- Design of Column bases and footings.
- Design of bolted Connections.

Experiments:if applicable it will support the course topics.

References :

- " Design of Steel Structures" , 3rd Edition, by Edwin, H. Gaylord, Jr. , Charles, N. Gaylord & James, E. Stallmeyer; McGraw-Hill, 1992.
- Steel Structures Design: ASD/LRFD Code, McGraw-Hill Education 1st Edition, Alan Williams,
- " Applied Structural Steel Design ", by L. Spiegel & G. F. Limbrunner.
- " Simplified Design of steel structures " 7th Edition, by James Ambrose, John Wiley & sons,Inc ; 1997.

Detailed of Theoretical Contents		
	Contents	**Hours**
1	**Review of knowledge gained in Steel Structures (I):** • Mechanical properties of steel • The manufacturing of steel structures • Advantages and disadvantages of steel structures • Principles of limit state design	2
2	**Design of Tension and Compression members:** • Behavior of tension/compression members • Design strength of tension/compression members • Design Procedure • Analysis and design of roof Trusses	4
3	**Design of Columns under eccentric loadings:** • Types of eccentric loading of columns • Bending moment for eccentricity • Superposing The stresses due to centric load and Couple • Design of eccentric loading: the Secant Formula.	4

4	**Design of Column bases and footings:** • Types of column bases • Slab Base • Gusset base • Design of welded column bases.	**4**
5	**Design of bolted Connections:** • Advantages and disadvantages of bolted connections • Specifications for spacing and edge distances of bolt holes • Assumptions in design of bearing bolts • Design strength of bearing bolts • Design criteria for bolt subjected to combined shear and tension	**4**
6	**Design of welded Connections:** • Advantages and disadvantages of welded connections • Important Specifications for welding • Design stresses in welds • Reduction in design stresses for long joints	**2**
7	**Design of beams for Flexure and Shear:** • Plastic moment carrying capacity of a section • Classification of cross-sections • Design procedure • Bending strength of a laterally supported beam • Shear strength of a laterally supported beam • Deflection limits • Design Principles of bolted beam connections • Design Principles of welded beam connections	**4**
8	**Industrial building Project:** • Modeling of essential structure systems • Analyze of elements and components of the steel structure • Methods of shifting and transferring loads • Understand how the elements of the steel structures were designed.	**4**
9	**Structural Steel design Project (Apply computer calculation):** The project let the trainee practice the skills which he had gained during this course. • Study subject of the project and determine its goals, and its benefits in work market. • Determine required work in the project • Analyze and Design essential elements of the project steel structure using ROBOT STRUCTURAL ANALYSIS software through the Trusses 2D – 3D module; and Steel Structure Deseign Module.	**4**
Textbook:	" Applied Structural Steel Design ", by L. Spiegel & G. F. Limbrunner. " Simplified Design of steel structures " 7th Edition, by James Ambrose, John Wiley & sons,Inc ; 1997.	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Design of Special Concrete	Course Code	CONS 433						
Prerequisites		Credit Hours CRH	2		CTH	2			
			L	2	P	0	T	0	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description : Design and construction of pre-stressed concrete sections. This course will include basic concept of pre-stressing, pre-stressing technology, steel and concrete materials, computation of fibre stresses, pre-stress losses, flexural and shear behavior at service loads and ultimate loads, deflection and crack control, load balancing, anchorage zone, design and construction integration, and use STRUCTURAL BRIDGE design software to analyze and design pre-stressed concrete bridge.

Topics :

- Pre-stressed concrete section
- Pre-stressing technologies
- Fibre stress
- Anchorage zone

Experiments:

References :

- Prestressed Concrete Fifth Edition Upgrade: ACI, AASHTO, IBC 2009 Codes Version (5th Edition) 5th Edition, Edward G. Nawy
- Prestressed Concrete Analysis and Design Third Edition. Naaman, Techno Press; 3rd edition (2012), Antoine E
- Prestressed Concrete Bridges (Structures and Buildings) 2nd Revised Edition, ICE Publishing; (June 30, 2011) Nigel Hewson
- The Design of Prestressed Concrete Bridges , Concept ande Principle, Taylor and Francis, London and New York, Robert Benaim

Detailed of Theoretical Contents		
	Contents	**Hours**
1	**Basic Principle of Prestressing :** - Types of pre-stressed concrete structures - Advantages of Prestressed Concrete - Materials Methods of Prestressing	**3**
2	**Design of PSC Members:** - Basic Principle of Prestressed Concrete. - Stresses in Prestressed Members - Minimum Section Modulus	**3**
3	**Ultimate Limit State Design of PSC:** - Losses in Pre-Tensioned PSC - Losses in Post-tensioned PSC - Ultimate Moment Capacity - Ultimate Shear Design	**3**
4	**Prestressing for statically determinate beams** - Section properties - Bending moments, bending stresses and shear force - Centre of pressure - Calculation of the prestress force - Bonded and unbonded cables	**3**
5	**Pre-stressing for continuous beams** - Details of the sample bridge deck	**3**

	- Section properties - Bending moments - Considerations on the choice of tendon size - Calculating the prestress force - Pres-tress scheme	
6	**Articulation of bridges and the design of substructure** - Design parameters - Concrete hinges - The articulation of decks with mechanical bearings - Deck on laminated rubber bearings - Integral bridges and examples of bridge articulation	**3**
7	**The general principles of concrete deck design** - Transverse bending - Transverse distribution of live loads - Material quantities and costs - Choice of most economical span	**2**
8	**The design of bridge deck components** - Side cantilevers - Top and Bottom slabs - Webs - Expansion joints	**2**
9	**Precast beams** - Standard precast beams - Customised precast beams	**2**
10	**Solid slabs, voided slabs and multi-cell box girders** - Slab bridges, general - Reinforced concrete slab bridges - Prestressed concrete slab bridges - Solid slab portal bridges	**2**
11	**Cable-supported decks** - Undertrussed and Cable-stayed bridges - Stressed ribbon and Steel cable catenary bridges - Flat suspension bridge	**2**
12	**The construction of girder bridges** - Cast-in-situ span-by-span construction of continuous beams - Precast segmental span-by-span erection - Cast-in-situ balanced cantilever construction - Precast segmental balanced cantilever construction - Progressive erection of precast segmental decks - Construction programme for precast segmental decks - Incremental launching - Prefabrication of complete spans	**2**
13	- **Structural Pre-stressed Concrete for Bridge Project using ROBOT** STRUCTURAL ANALYSIS and STRUCTURAL BRIDGE DESEIGN software - Prepare drawings and write technical report using computer.	**2**
Textbook:	The Design of Prestressed Concrete Bridges , Concept ande Principle, Taylor and Francis, London and New York, Robert Benaim	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Building Sustainability	Course Code	CONS 486						
Prerequisites		Credit Hours CRH	2				CTH		2
			L	2	P	0	T	0	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description: The built environment is a major source of society's environmental impact, and is a major opportunity to find solutions. Recent attention to "green construction" emerges in many domains including energy
Systems, water use, construction processes, architectural design, site planning and brownfield development, just to name a few. At present, environmental issues can be considered in seemingly unlimited areas of the design and construction process. Yet, advances are slow. General perceptions assert that green construction costs too much money; that the technologies are not available for meaningful change, and opportunities are rare.

Topics :

- Ethic and Sustainability
- Ecological design and Economics
- Green Building Assessment
- The green Building Design Process
- Energy and Carbon Footprint Reduction
- Indoor Environmental Quality
-

Experiments:

References :

- Kibert, C. (2005) Sustainable Construction: Green Building Design and Delivery
- *Green Buildings and the Bottom Line* (Oak Brook, IL: Building Design + Construction). Go to: http://www.bdcnetwork.com/article/CA6390371.html

Detailed of Theoretical Contents		
	Contents	**Hours**
1	**Ethic and Sustainability:** • Sustainable development and sustainable construction: Sustainable development requires a more extensive set of ethical principles to guide behavior because it addresses relationships between generations, calling for what is sometimes referred to as intergenerational justice. • Ethics between people by providing rules of conduct that are generally agreed to govern the good behavior of contemporaries.	**6**
2	**Ecological design and Economics**: Each approach seeks to acknowledge, facilitate, and/or preserve the interrelationship of natural system components and buildings. In doing so, particular questions and problems recur, such as: • What can be learned from nature and ecology that can be applied to • buildings? • Should ecology serve as model or metaphor for green buildings? • How can natural systems be directly incorporated to improve the functioning • of the built environment? • How can the human-nature interface best be managed for the benefit of • both systems? • When does the natural system metaphor break down and is another • approach required?	**6**

3	**Green Building Assessment:** • The most demanding of all building assessment systems is the Living Building Challenge. Its intent was to push the envelope of high-performance building much further than it was likely to be pressed by LEED and other building assessment systems. • The Living Building Challenge is based on a few simple but very powerful concepts, among them that a building should produce as much energy as it consumes, provide all the required water, and process all its sewage.	**6**
4	**The green Building Design Process:** • This chapter addresses the high-performance green building delivery system as a distinctly identifiable construction delivery system, analogous to individually recognized design-build systems. • A hallmark of the high-performance green building delivery system is the high level of coordination and integration required of the design and construction team members. Additional measures, such as building commissioning and the charrette, are necessary to fully implement this new delivery system. • Performance-based design contracts provide financial incentives to implement certain sustainable design features, such as relying on nature for some building services, thus enabling a downsizing of mechanical and electrical systems to reduce energy consumption and cost.	**6**
5	**Energy and Carbon Footprint Reduction:** • Perhaps of all the challenges facing the development of high-performance green buildings, significantly reducing the energy and carbon footprints of the built environment is the most daunting. • The environmental impacts of extracting and consuming nonrenewable energy resources such as fossil and nuclear fuels are profound. Pronounced land impacts from coal and uranium mining, acid rain, nitrous oxides, particulates, radiation, ash disposal problems, and long-term storage of nuclear waste are just some of the consequences of energy consumption by the built environment. • Building energy consumption in the United States is at about the same scale as energy consumption by automobiles, with about 40 percent of primary energy being consumed by buildings and about the same quantity by transportation.1 In fact, much automotive energy consumption is caused by the placement of buildings on the landscape.	**4**
6	**Indoor Environmental Quality:** Providing excellent indoor environmental quality (IEQ) has emerged as one of the key goals in the design of high-performance green buildings, on a par with energy efficiency and ecological system restoration.	**4**
Textbook:	Kibert, C. (2005) Sustainable Construction: Green Building Design and Delivery	

Department	Civil And Architectural Engineering	Major	Applied Civil Engineering						
Course Name	Advanced Concrete Technology	Course Code	CONS 435						
Prerequisites		Credit Hours CRH	2	CTH	2				
			L	2	P	0	T	0	

CRH: Credit Hours L: Lecture P: Practical T: Tutorial CTH: Contact Hours

Course description : Analysis and design of unreinforced and reinforced masonry: non-bearing walls, bearing walls, shear walls, masonry building systems

Topics :

- Brik's properties
- Prescriptive design of masonry wall systems
- Properties of Masonry
- Masonry design code

Experiments:

References :

- TH1199.B85 2011: MSJC 2011 Building Code Requirements and Specifications for Masonry Structures, TMS 402-11/ACI 530-11/ASCE 5-11. The Masonry Society, Boulder, CO.
- TA670.M344 2003: Masonry Designers' Guide, 5th Edition. The Masonry Society, Boulder, CO.
- TA683.T25 2010: Design of Reinforced Masonry Structures, Narendra Taly. 2010.

Detailed of Theoretical Contents		
	Contents	**Hours**
1	**Introduction**	**2**
2	**Brik's properties** • Compressive strength • Absorption • Frost resistance • Dimensional changes • Fire resistance	**10**
3	**Prescriptive design of masonry wall systems** • Cellular wall systems • Simple or double cross-wall systems • Complex arrangements	**9**
4	**Properties of Masonry** • Strength of Masonry in combined compression and shear • The tensile strength of masonry	**7**
5	**Masonry design code** • The basis and structure of BS5628 of ordinary Masonry • The basis and structure of BS5628 of reinforced and prestressed Masonry	**4**

Textbook:	• 2009 Design of Reinforced Masonry Structures (Sixth Edition) by Gregg E. Brandow, Ekwueme, C.G. & Hart, G.C.; Concrete Masonry Association of California and Nevada, 2011. MSJC 2011 Building Code Requirements and Specifications for Masonry Structures, TMS 402-11/ACI 530-11/ASCE 5-11. The Masonry Society, Boulder, CO.

Appendix Laboratory Equipment, Workshops and Laboratories

No.	Laboratory name / workshop	Capacity of training	Number of trainers	Training courses benefiting from the laboratory / workshop / lab
1	Concrete Lab	5	15	Building Materials
2	Soil Lab	5	15	Geotechnical Engineering
3	Pavement Lab	5	15	Highway Engineering
4	Drawing Lab	5	20	Architectural drawing
5	Structural Lab	5	20	Structural drawing
6	Skechtup lab	2	5	Graduation project

List of Detailed Equipment for Each Laboratory, Workshop or Lab

No.	Pavement lab	Quantity
1.	Gyratory compactor	1
2.	Dynamic Shear Rheometer DSR	2
3.	Bending Beam Rheometer BBR	3
4.	Rotational Viscosity RV	4
5.	Los Angolos Test	3
6.	Wheel trucker Hamburg	1
7.	Ductility Test of Asphalt	1
8.	Pave Analyser	2
9.	California Bearing Ratio CBR	1

No.	Soil Lab	Quantity
1.	Proctor	2
2.	Hydrometer and Sieve Analysis	2
3.	Casagrande for attaerberg limits	3
4.	Direct shear test	1
5.	Triaxial shear test	1
6.	Consolidation test	1
7.	Permeability test	2
8.	Sand cone	3
9.	Penetrometer test	1

No.	Concrete lab	Quantity
1.	Compression machine for concrete	2
2.	Flexural machine for concrete	2
3.	Brazilian Test	1
4.	Tensile steel test	1
5.	Young Modulus of Elasticity of concrete	1
6.	Ultrasonic tester	1
7.	Shmidit hammer	2
8.	Vicat machine	3
9.	Blaine Instrument	2
10.	Mortar blender	3
11.	Concrete blender	2

References

Textbooks	**1.**	Autodesk Robot Structural Analysis Professional 2015: Essentials Paperback – October 24, 2014 by Ken Marsh ISBN-13: 978-0991518111
	2.	Engineering Properties of soils based on laboratory testing, Prof. Krishma Reddy, UIC
	3.	Properties of concrete (2011), handbook Material properties and rehabilitation of RCC buildings. general public works dept.
	4.	A.M.NEVILLE,J.J.BROOKS (2010), handbook on Concrete Technology (second edition) of Prentice Hall is an imprint of Pearson, London.
	5.	Krishan Kumar ER (2002), handbook on Repair and rehabilitation of RCC buildings. general public works dept.
	6.	Blue Print Reading: Interpreting Working Drawings. Author: E. M. Wyatt
	7.	A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors", Pearson, John Wiley & Sons, Inc.
	8.	5-Autodesk Revit 2018 MEP Mechanical Review for Professional Certification: Autodesk Authorized Publisher , Author: ***Autodesk® Revit®***
	9.	O'Flaherty, C.A. (ed) Highways: The Location, Design, Construction and Maintenance of Road Pavements. Butterworth Heinemann
	10.	Surveying for Engineers by: John Uren and Bill Price
	11.	Autodesk Navisworks 2018 Using Autodesk Navisworks in a BIM Workflow: Autodesk Authorized Publisher, Pearson, DEEPAK MAINI.
	12.	Nazih K. Shammas, Lawrence K. Wang (2011) "Water supply and wastewater removal". John Wiley and Sons, Inc. USA.
	13.	Krishan Kumar ER (2002), handbook on Repair and rehabilitation of RCC buildings. general public works dept.