Majmaah University
College of Engineering

Course Description

Civil and Environmental Engineering

Engineering Geology	
Code:	CE 101
Credits:	2 (2-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Principles of physical and structural geology, Geology of Saudi Arabia, The influence of geological factors on planning design and construction of works- Geological and geophysical exploration for structures in rocks, Natural aggregate for engineering constructions, Geological engineering of underground openings, Earthquakes, Groundwater, Tunnels, Foundations, Evaluation of dams sites.

Module Aims

The aim of this course is to teach the student the basics and elements of general geology including the earth sciences, minerals, rocks and their physical, chemical and Mechanical properties.

In the second part of the course, focus is on the importance of engineering geology study in different civil engineering applications including, tunnels, foundations, groundwater, earthquake, and others structures. This will be achieved through understanding the geological structures, mechanical properties of rocks and reading, understanding and drawing geological maps.

Outcomes:

The student is expected to be able to:

- distinguish between the different types of minerals and rocks.
- point out the desired natural materials for the construction purposes according to the geotechnical properties of rocks.
- be aware of the geological problems facing engineering projects.
- recognize the relation between the groundwater and foundation.
- study the mechanical properties of construction and ornamental stones.
- understand important information about Earth sciences.
- decide on appropriate geophysical method for rocks and groundwater exploration.
- appreciate the geological conditions of tunnels, foundation, dams' sites and the groundwater wells.
- read and understand simple geological maps.
- draw geological maps on the pre-developed contour maps.

Textbooks and References:

- Goodman, R., "Engineering Geology", John Wiley & Sons, 1993.
- Bangar, K.M., "Principles of Engineering Geology", Standard Publishers Distribution, New Delhi, 1997.
- Singh Parbin, "A Text Book of Engineering and General Geology", (Latest edition).

Civil Engineering Drawing	
Code:	CE 102
Credits:	3 (1-0-4)
Pre-requisite:	GE 102
Co-requisite:	NA

Module Description:

Introduction, The principal components of Civil Engineering construction, Components of a building, Civil Engineering Drawing for Walls and columns , Brick walls (Stretcher bond, Header bond, English bond, French bond), Masonry walls, Concrete footings, Retaining walls , Details of reinforced concrete sections, Buildings (plans, elevations, sections, foundations, plan and working drawings), Geometric design of stairs, Steel construction, Wood construction, Selected Civil Engineering works. Architectural drawings. Roads and earth works. Culverts and bridges.

Module Aims:

To introduce the different types of Civil construction elements including: Earth work, walls, R. C. structures, Steel structures, Sanitary engineering construction and its representation in engineer's language i.e drawing.

Outcomes:

The student is expected to be able to:

- draw different types of civil construction elements
- deal with any type of civil construction.
- solve earth works problems.
- draw the different elements of structures and connection
- Understand relation between earth works with different types of wing, closing walls in underground structures
- draw the different views of the civil construction and how to represent details

Textbooks and References:

- Elsheikh, "Introduction to Drawing for Civil Engineering", McGraw-Hill, (Latest edition).
- Singh & Sharma, "Civil Engineering Drawing", Standard Publishers & Distributers, 1980.
- M.G. Shah, C.M. Kale, S.Y. Patki, “Building Drawing”, Tata McGraw Hill, Delhi, (Latest edition).
- V.K. Jain, “Services in Building Complex”, Khanna Publishers, (Latest edition).
- Shah M.G., Kale C.M., Patki S.Y., “Building Drawing”, Tata McGraw Hill, Delhi, (Latest edition).
- Chakraborty M., “Civil Engineering Drawing”, (Latest edition).

Soil Mechanics and Foundation Engineering 1	
Code:	CE 210
Credits:	3 (2-1-2)
Pre-requisite:	CE 101
Co-requisite:	NA

Module Description:

Introduction, Soil Identification, Index properties of soils,
Soil classification, Water in soil, Stress within the soil, Settlement and consolidation of soils, Compaction of soils, Stability of slopes, Earth pressure and retaining wall, Settlement of structures. Shear strength of soils, Stability of slopes, Excavaton and bracing, Site investigation

Module Aims:

The graduation of a Civil Engineer Capable to deal with different types of:
Soils (boulder, Cobble, gravel, sand, silt, clay…) and determine the properties of these soils.

Outcomes:

The student is expected to be able to:

- determine the types of soil by different laboratory tests.
- understand the effect of soil properties on the engineering characteristics of soils.
- classify the soil according to origin and properties.
- evaluate the shear strength udder different conditions of drainage and apply the results to problems of slope stability, cuts etc.
- find the specific weights of soils under the various conditions.
- understand the concept of total stress, neutral stress and effective stress.
- Find the effect of soil type on the stress distribution within the soils.
- calculate the settlement and consolidation of soils under construction.
- understand the slope stability problems for different civil engineering structures.

Textbooks and References:

- **Das, B. M., "Principles of Geotechnical Engineering", Thomson-Engineering, (Latest edition).**
- Boweles, J. E., "Engineering Properties of Soils and their Measurements", McGraw-Hill, (Latest edition).
- Berry, P. L. and Reid, D., "An Introduction to Soil Mechanics", McGraw-Hill, 1987
- B.C. Punmia, "Soil Mechanics and Foundation Engg." (2005).

Structural Analysis 1	
Code:	CE 214
Credits:	3 (3-1-0)
Pre-requisite:	GE 103
Co-requisite:	NA

Module Description:

Types of structures, Supports and loads. Idealization of structures and loads. Geometric stability and determinacy. Analysis of determinate trusses, beams, plane frames and arches; reaction computation; axial force, shear force and bending moment diagrams. Influence lines of determinate structures.

Module Aims:

To introduce concepts to analysis different types of statically determinate structures (beams, frames, arches, trusses) due to dead loads and moving loads.

Outcomes:

The student is expected to be able to:

- analyze of statically determinate structures (beams, frames, arches and trusses).
- draw normal force, shearing force and bending moment's diagrams.
- construct influence lines for certain functions at critical sections and determination the maximum values of these functions due to different types of moving loads in statically determinate structures.
- calculate the forces at truss members using section and joint method.
- design and analyze different statically determinate and to get an idea about indeterminate structures.

Textbooks and References:

- Russell G. Hibbele, "Structural Analysis", 2nd edition, Prentice – Hall.
- Chajes, "Structural Analysis", 2nd edition, Prentice – Hall, 1990.
- Reddy C.S., "Basic Structural Analysis", Tata McGraw Hill, (Latest edition).
- Pandit & Gupta, "Matrix Methods in Structural Analysis", Tata McGraw Hill.
- Junnarkar S.B., "Structural Mechanics", Vol II, Charotar Publishers, (Latest edition).
- Dr. Thadani B.N. & Dr. Desai J.P., "Modern Methods in Structural Analysis",
- Weinall Book Corporation, (Latest edition).
- Wang C.K., "Intermediate Structural Analysis", Tata McGraw Hill, (Latest edition).
- Gupta & Pandit, "Structural Analysis", Vol. I & II, Tata McGraw Hill, (Latest edition).
- Negi L.S. & Jangid R.S., "Structural Analysis", Tata McGraw Hill, (Latest edition).
- Yuan Yu Hsieh, "Elementary Theory of Structures", Prentice Hall, (Latest edition).
- Chajes A., "Structural Analysis", Prentice Hall, (Latest edition).

Hydraulics 1	
Code:	CE 240
Credits:	3 (2-1-2)
Pre-requisite:	GE 104
Co-requisite:	NA

Module Description:

Fluid properties, Fluid static and hydrostatic forces, buoyancy and floation Kinematics of fluid, Fluid Dynamics, Energy equation and momentum equation and thier applications, Viscous effect and fluid resistance, Fluid measurements, dimensional analysis and similarity.

Module Aims:

To know the fundamentals of Engineering fluid mechanics and hydraulics.

Outcomes:

The student is expected to be able to:

- analyze pressure measurements.
- design the gates and walls subjected to hydrostatic forces.

- apply the Bernoulli's equation to different flow situations.
- design and analyze the pipe flow problems.
- conduct dimensional analysis and similarity.

Textbooks and References:

- Munson, "Fundamentals of Fluid Mechanics", 4th. Edition, John Wily & Sons.
- Larry Mays, "Hydraulic Design Handbook", (Latest edition).
- Featherstone & Nalluri, "Civil Engineering Hydraulics", 3rd. Edition, Blackwell Science.
- Frank M. White, "Fluid Mechanics", 6th Edition, McGraw Hill.
- Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, "Introduction to Fluid Mechanics", 6th Edition, Wiley International Edition.
- V.L. Streeter and E.B. Wylie, "Fluid Mechanics", McGraw Hill, (Latest edition).

Surveying 1	
Code:	CE 370
Credits:	3 (2-1-2)
Pre-requisite:	MATH 107
Co-requisite:	NA

Module Description:

Definitions and concepts in land surveying, divisions and importance of surveying, Types of measurements, Units of measurements, Linear measurements, Angular measurements, Directions, Compass surveying, Leveling and contouring, International and local arrangement of maps, Reading of different maps and standard specifications, Traverses, Planimeter and its applications, Plate table surveying, Leveling, Profiles, Earthwork quantities.

Module Aims:

Provide the student with the principles of surveying and training on surveying instruments, in addition to acquire him skills in the following main topics :

- Technical knowledge about different surveying's.
- Reading & drawing Cadastral maps for different projects.
- Operating Surveying instruments to get data for establishing a formal map.
- Computing areas on maps & from field measurements.

- Computing the co-ordinates of the positions & setting the positions on map.

Outcomes:

The student is expected to be able to:

- get accurate measurements using the recent surveying instruments and operating surveying software programs.
- get field observations for traverse surveying.
- specify the trends and deviations of lines.
- compute any area from maps or field measurements and conduct territory division.
- compute cut & fill or materials volumes for any project.
- conduct land settlement using leveling methods and draw longitudinal and cross sections.
- understand, read and prepare or establishing cadastral maps.
- conduct accurate measurements and function in a team work.

Textbooks and References:

- Barry, F.K. and Gelnnbind, S.J., "Surveying, Principles and Applications", 5th Edition, Prentice – Hall**.**
- Benton, A.R., and Philip, J.T., "Elements of Plane Surveying", International Edition, McGraw – Hill, 1991.
- Davis, R.E., and Francis F.F., "Surveying - Theory and Practice", McGraw – Hill, (Latest edition).
- Kanetkar and Kulkarni, "Surveying and Levelling", Vol I and II, Pune Vidyarthi Griha, (Latest edition).
- N.N. Basak, "Surveying and Leveling", Tata McGraw Hill, (Latest edition).
- R. Agor, "Surveying", Khanna Publishers, (Latest edition).

Reinforced Concrete Design 1	
Code:	CE 217

Credits:	3 (3-2-0)
Pre-requisite:	CE 214
Co-requisite:	NA

Module Description:

Fundamentals and design theories based on ultimate (Limit) strength design and elastic concept. ACI Code requirements. Load factors. Analysis and design of reinforced concrete members subject to flexure, shear and diagonal tension in accordance to ACI strength method. Development length of reinforcement. Deflection and crack controls. The course should have also some drawing part. The course will therefore design and draw RC structures.

Module Aims:

Enable the student to design the major R. C. elements of ordinary buildings.

Outcomes:

The student is expected to be able to:

- understand different elements of R. C. in buildings. (excluding tall buildings)
- determine the different loads on each element and design them.
- select appropriate methods of analysis studied in the theory of structures relevant to reinforced concrete buildings.
- choose appropriate material properties studied in the Strength of material course and relevant to reinforced concrete buildings.

Textbooks and References:

- Steven H. Kosmatka, "Design and Control of Concrete Mixture, Portland", Portland Cement Association, (Latest edition).
- ChuKia Wang, *et. al.,* "Reinforce Concrete Design", 7th Edition, John Wiley & Sons, 2006.
- El-Dakhakhni, W.M., "Modern Design of Reinforce Concrete", The Anglo Egyptian Bookshop, 1990.
- Mac Gregor, J.G., "Reinforced Concrete, Mechanics and Design", Prentice Hall, 1992.

Properties and Strength of Materials 1	
Code:	CE 212
Credits:	3 (2-1-2)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Engineering materials: properties, testing, specifications, statistical evaluation; bricks, lime, gypsum, timber, wood, metals, plastics, ceramics, glasses. Testing machines. Measuring devices Tests: tension, compression, bending, shear, hardness, impact. Non destructive tests.

Laboratory Part: Aggregate tests to determine (Moisture Content of fine Aggregate, Moisture content of coarse aggregate, Specific gravity and absorption of fine aggregate, Specific gravity and absorption of coarse aggregate, Abrasion test for coarse aggregate using Los Angeles machine, Bulk density and void ratio for fine aggregate, Bulk density and void ratio for coarse aggregate, Sieve analysis for fine aggregate, Sieve analysis for coarse aggregate), Cement tests (The fineness of cement, The normal consistency, Initial and final time of set , Density and specific gravity of cement) , Bricks tests (Compressive strength, absorption test).

Module Aims:

To prepare a qualified civil engineer to deal with the engineering materials (Concrete – steel….etc) and use these materials in design of steel and concrete structures- The module also educates the student as to how the strength of material used in civil engineering is evaluated. Along with the behaviours of these materials under different types of stresses and strains undergone during such loading.

Outcomes:

The student is expected to be able to:

- analyze stress strain behavior of engineering materials as well as composite construction like RCC.
- understand experiments to achieve a quality control of materials used in construction.

Textbooks and References:

- Gere, J.M. & S.P. Timoshenko, “Mechanics of Materials”, CL-Engineering edition, Prentice Hall. 2008.
- Harmer E. Davis, “Testing of Engineering Materials”, McGraw-Hill Inc., 1983.

Structural Analysis 2	
Code:	CE 215
Credits:	3 (3-1-0)
Pre-requisite:	CE 214
Co-requisite:	NA

Module Description:

Properties of plane area, straining actions, Normal stresses, Shear stresses, combined stresses. Analysis of indeterminate structures; trusses, beams, plane frames and arches. Load –shear- moment relationship. Differential equation of elastic curve, deflections by integration, moment –area.

Module Aims:

Analyse different types of stresses such as normal, shear and combined stresses for any type of cross sections (homogeneous, heterogeneous and composite) for symmetrical and unsymmetrical sections. Solving inderminate structures.

Outcomes:

The student is expected to be able to:

- determine the properties of plane areas.
- determine the straining actions of various structures.
- analyze different sections subjected to normal, shear and combined stresses.
- Construct the normal, shear and combined stress diagrams for various sections of structures.
- solve inderminate structures.

Textbooks and References:

- Russell G. Hibbeler, “Structural Analysis”, 2nd edition, Prentice – Hall.
- Chajes, “Structural Analysis”, 2nd edition, Prentice – Hall, 1990.
- Tartaglione, L.C., “Structural Analysis”, McGraw – Hill, 1991.

Hydraulics 2	
Code:	CE 241
Credits:	3 (2-1-2)
Pre-requisite:	CE 240
Co-requisite:	NA

Module Description:

Laminar and turbulent flow in pipes, Friction factor in smooth and rough pipes. Moody's diagram, Flow in open channels, Specific energy, flow transitions, Gradually varied flow and rapidly varied flow, Introduction to pumps and turbines.

Module Aims:

Understanding of pipe flow and flow in open channels.
Capability of solving the problems of pipe flow and open channel flow
Analysis of the flow characteristics through open channels.
The student can analyze the specific energy and the hydraulic jump through open channels.
The student can analyze the Back water profiles with different types in open channels.

Outcomes:

The student is expected to be able to:

- design of pipes and open channel using different approaches.
- analysis the flow characteristics through open channels for both uniform flow and varied flow.
- analysis of the flow features through the hydraulic turbines and the turbine design.
- design and analyze the pumping machinery.
- analyze the specific energy and the hydraulic jump through open channels.
- analyze the Back water profiles with different types in open channels.

Textbooks and References:

- Hubert Chanson, "The Hydraulics of Open Chchannel Flow: an Introduction", 2nd. Edition, Elsevier.
- Featherstone & Nalluri, "Civil Engineering Hydraulics", 3rd. Edition, Blackwell Science.
- Larrt Mays, "Hydraulic Design Handbook", (Latest edition).

- Frank M White, "Fluid Mechanics", 6th Edition, McGraw Hill.
- Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, "Introduction to Fluid Mechanics", 6th Edition, Wiley International Edition.
- Ram S. Gupta, "Hydrology & Hydraulic Systems", Published by Prentice-Hall, New Jersy, U.S.A., 1989.
- Ven Te Chow, "Open Channel Hydraulics", by McGraw-Hill, Inc., U.S.A., 1959.

Soil Mechanics and Foundation Engineering 2	
Code:	CE 311
Credits:	3 (2-1-2)
Pre-requisite:	CE 210
Co-requisite:	NA

Module Description:

Soil and rock investigations, methods and properties evaluation for design of foundations.Types of foundation. Bearing capacity and design of shallow foundation (isolated, combind, strip and raft foundation). Bearing capacity and design of deep foundations. Pile foundations and caissons. Sheet piling. Retaining walls.

Module Aims:

Understand usage of different types of foundations and design them. For different types of soils.

Outcomes:

The student is expected to be able to:

- be familiarizing with the following topics: Site investigation - different methods of soil boring, and soil sampling, design foundations using different approaches. Different methods for determining soil bearing capacity.
- analyze and design different types of shallow footings.
- choose and then design suitable types of deep foundations.

Textbooks and References:

- Das, B.M., "Principles of Geotechnical Engineering", Thomson-Engineering, (Latest edition).

- Bowles, J.E., "Engineering Properties of Soils and their Measurements", McGraw-Hill, (Latest edition).
- Berry, P.L. and Reid, D., "An Introduction to Soil Mechanics", McGraw-Hill, 1987.
- Das, B.M., "Priciples of Foundation Engineering", 2 nd. Edition, PWS - KENT, Boston.

Environmental Engineering 1	
Code:	CE 360
Credits:	2 (2-0-0)
Pre-requisite:	GE 105
Co-requisite:	NA

Module Description:

Impact of Development on environment and Introduction to pollution problems, Liquid wastes and their disposals: overland, in streams, lake and sea. Solid wastes, and management, characteristics, storage, collection, disposal, and recycling. Air pollution: sources, pollutants, effects and control. Noise pollution: sources, effect and control. E-wastes, Environmental regulations, Concept of sustainable development.

Module Aims:

To expand the knowledge of the graduated civil engineers about the dangerous of the environmental pollution and to give an idea about how to control it.

Outcomes:

The student is expected to be able to:

- define of the environmental pollution and its impacts.
- understand all the available environmental legislations in KSA to protect both surface and groundwater from pollution.
- design environmental safe systems for sewage treatment and disposal for isolated buildings.
- understand well the hazardous of the environmental pollution.
- get control on the environmental pollution problems.

Textbooks and References:

- Weiner & Matthews, "Environmental Engineering", 4th Edition, Elsevier.
- Davis, and Cornwell, D., "Introduction to Environmental Engineering", McGraw-Hill, 1991.
- Hammer, "Water and Wastewater Technology", Prentice Hall, 1986.
- Metcalf and Eddy, "Wastewater Engineering, Treatmant, Disposal and Reuse", McGraw-Hill, 1993.

Water Supply and Sewage Engineering	
Code:	CE 362
Credits:	2 (2-1-0)
Pre-requisite:	CE 241
Co-requisite:	NA

Module Description:

Water quality parameters, estimating the quantity of water and wastewater, water treatment process, Planning and Design of water supply networks, wastewater characteristics, Planning and Design of sanitary and storm sewers, introduction to process of waste water treatment.

Module Aims:

To provide the understanding of the principals of water supply engineering.
Understand water purification and wastewater treatment processes.
Capable to design water supply networks.
Design sanitary and storm sewers.

Outcomes:

<u>The student is expected to be able to:</u> – understand the principals of pre-design studies for water supply networks and sanitary sewars networks.

– acquire the basic knowledge about distribution networks planning. – be familiar with the different units in the water supply networks. – design sanitary and storm sewers. – solve existing water supply networks. – deal with more advanced water supply networks and estimate the costs.

Textbooks and References:

- Weiner & Matthews, "Environmental Engineering", 4th Edition, Elsevier**.**
- Davis, and Cornwell, D., "Introduction to Environmental Engineering", McGraw-Hill, 1991.
- Hammer, "Water and Wastewater Technology", Prentice Hall, 1986.
- Metcalf and Eddy, "Wastewater Engineering, Treatmant, Disposal and Reuse", McGraw-Hill, 1993.

Surveying 2	
Code:	CE 371
Credits:	3 (2-1-2)
Pre-requisite:	CE 370
Co-requisite:	NA

Module Description:

Introduction and application of electronic surveying measuring equipment (EDM, Total Station, …), Introduction to horizontal control survey (Traversing, Intersection, resection), Horizontal curves and vertical curves, Introduction to photogrammetry and Digital mapping.

Module Aims:

Provide the student with the principles of topographic surveying.
Practical training on using Teodolites, Total station and Tacheometers in different surveying observations.
Adjusting theodolite traverses (closed and tied traverses).
Know how to design the horizontal and vertical curves for road networks and railways.
Present the most recent GPS instruments and understand how they work in identifying locations and introduction to aerial photogrammetric.
An introduction to digital mapping.

Outcomes:

The student is expected to be able to:

- use theodolits, Tacheometers and Total station.
- Understand and apply the Theory of traverse adjustment
- design vertical and horizontal curves.
- understanding the Digital mapping system.
- carry out accurate observations using modern surveying instruments.
- use modern surveying instruments probably in civil engineering projects.

Textbooks and References:

- Burr, F.K. and Glemen Bird, S.J., "Surveying, Principles and Applications", Prentice Hall, 2000.
- Moffitt, F.H. and Bouchard, H., "Surveying", Harper & Row, Publishers Inc.,, 1987.
- Paul R. Wolf, "Elements of Photogrammetry", Mc Graw Hill, 1983.
- Kanetkar and Kulkarni, "Surveying and Leveling", (Latest edition).

Highway and Traffic Engineering	
Code:	CE 380
Credits:	3 (3-1-0)
Pre-requisite:	CE 270
Co-requisite:	NA

Module Description:

Highway planning and capacity. Design controls and criteria. Cross sectional elements. Sight distances. Horizontal and vertical alignments. Intersections. Highway materials characterization. Bituminous mixtures design. Flexible pavement design. Highway drainage. Pavement evaluation and maintenance. Components of Traffic system, Traffic-stream characteristics, Traffic studies, Parking, Pedestrians, Traffic safety, Traffic signals, Signs and Markings, Capacity of urban streets and Intersections, Congestion management.

Module Aims:

To enable students to plan and design all components of highways that are safe and economical for traffic operation and can sustain traffic loads and satisfy their intended function and specification.

Outcomes:

The student is expected to be able to:

- plan and design highway geometrics
- study pavement materials characteristics and methods of pavement design
- study different methods of pavement construction for roads and airports.
- design elements of roads to satisfy their intended function and sustain traffic loads.

Textbooks and References:

- Bent Thagesen, "Highway and Traffic Engineering in Developing Countries", Chapman & Hall, (Latest edition).
- Martin Rogers, "Highway Engineering", Blackwell Science, (Latest edition).
- Robinson & Thagesen, "Road Engineering for Development", 2nd. Edition.
- L.R. Kadiyali, "Principles and Practice of Highway Engineering", Khanna. Publications, (Latest edition).
- Khanna S.K. and Justo C.E.G., "Highway engineering", Nem Chand, (Latest edition).

Reinforced Concrete Design 2	
Code:	CE 318
Credits:	3 (3-2-0)
Pre-requisite:	CE 217
Co-requisite:	NA

Module Description:

Design of slabs and different floor systems, one way, two ways, ribbed and flat slabs. Design for torsion, combined shear and torsion by the strength method. Design of continuous beams. ACI moment redistribution for minimum rotation capacity. Design of columns under axial and eccentric loadings, short and long columns. Staircases. Types of footings and their structural designs

Module Aims:

To enable the student to design different elements of R.C. structures such as slabs, beams, columns, flat slabs, hollow blocks slabs, stairs and panneled beams.

Outcomes:

The student is expected to be able to:

- design reinforced concrete sections subjected to combined axial force and bending moment.
- design both flat and hollow block slabs.
- design reinforced concrete arched slab and arched girders.
- design reinforced concrete trapezoidal and triangular sheds.

Textbooks and References:

- Steven H. Kosmatka, "Design and Control of Concrete Mixture, Portland", Portland Cement Association, (Latest edition**).**
- Charles, G.S. and Chu-Kia W., "Reinforced Conocrete Design", 5th Edition, Harper and Row Pub., 1994.
- El-Dakhakhni, W.M., "Modern of Reinforced Conocrete", The Anglo Egyptian Bookshop, 1990.
- Mac Gregor, J.G., "Reinforced Conocrete, Mechanics and Design", Prentice Hall, 1992.

Structural Steel Design 1	
Code:	CE 320
Credits:	3 (3-2-0)
Pre-requisite:	CE 214
Co-requisite:	NA

Module Description:

Analysis and design of roof trusses. Design of tension and compression members, columns under eccentric loadings, column bases and footings. Design of beams. Welded and bolted connections. Design of building frames. Introduction to plastic analysis. Industrial building project. All according to AISC specifications.

Module Aims:

This course enables students to learn the behavior and design structural steel components, for example, members and connections in two dimensional roof trusses, steel beams and frame structures.

Outcomes:

The student is expected to be able to:

- analyze and design steel structures.
- design roof trusses with adequate safety and that can resist the loads and satisfy the intended function.
- design welded and bolted connections.

Textbooks and References:

- AISC Manual of Steel Construction.
- Leonard Spiegel & Limbrunner, "Applied Structural Steel Design", 4th edition, Prentice Hall.
- Charles salmon, John Johnson, "Steel Structures", 4th edition, Harper Collins College Publisher.
- Vazirani and Rawtani, "Design of Steel Structures", (Latest edition).
- Dayaratnam, "Design of Steel Structures", (Latest edition).
- Negi L.S., "Design of Steel Structures", Tata McGraw Hill, (Latest edition).
- Kazimi S.M. A. & Jindal R.S., "Design of Steel Structures", Prentice Hall of India, (Latest edition).
- Arya and Ajmani, "Design of Steel Structures", New Chand & Bros., (Latest edition).
- Ramchandran "Design of Steel Structures", Vol I & II., (Latest edition).

Properties and Strength of Materials 2	
Code:	CE 313
Credits:	3 (2-1-2)
Pre-requisite:	CE 212
Co-requisite:	NA

Module Description:

Definitions and classification of Fresh concrete (Consistency, Workability, Bleeding), Segregation of aggregate, Hardened Concrete Strength (Compressive Strength, Tensile Strength, Shear Strength, Bond with reinforcement, Factors affecting strength), Elasticity, Durability, Creep and Shrinkage of concrete , Mix Design (Trial Method, ACI Method, British Method).

Laboratory Part: Cement Mortar Tests (Compressive Strength of Cement Mortar, Tensile Strength of Cement Mortar), Fresh Concrete Tests (Slump Test, Compacting

Factor Test) Hardened Concrete Tests (Cubic Compressive Strength, Cylinder Compressive Strength, Split Cylinder Test) Trial Mix Design , ACI Method for Mix Design.

Module Aims:

Impart knowledge about the properties of plain concrete in the different stages.
Understand the role of each of the constituent materials to the obtained properties of concrete.
Unserstand the effect of the different parameters on the properties of concrete.
Understand the induced stresses and deformation when the concrete element subjected to the impact or repeated loading or static loading.
Know the design of mixed concrete.

Outcomes:

The student is expected to be able to:

- analyze the stresses and the corresponding strains due to bending.
- determine the primary properties of plain concrete in the different stages which will use design concrete mixes.
- know the effect of the different parameters on the properties and strength of concrete.
- analyze the stresses and the corresponding strains due to impact and repeated loading as well as static loading.

Textbooks and References:

- **Gere & Timoshenko, "Mechanics of Materials", SI edition, Prentice Hall, (Latest edition).**
- Harmer E. Davis, "The Testing of Engineering Materials", McGraw-Hill, (Latest edition).
- Jain O.P. & Jaikrishna, "Plain & Reinforced Concrete", Vol. I., (Latest edition).
- Shetty M.S., "Concrete Technology: Theory and Practice", (Latest edition).

Structural Analysis 3	
Code:	CE 316
Credits:	3 (3-1-0)
Pre-requisite:	CE 215

Co-requisite:	NA

Module Description:

Analysis of indeterminate structures; trusses, beams, plane frames and arches.

Deflection of statically determinate beams: double integration method moment – area method, elastic weight method.

Analysis of statically indeterminate Beams and frames by equation of three moments due to: Transverse loads Settlement of supports.

Analysis of continuous beams by fixed points, Analysis of beams under moving loads. Buckling of columns.

Method of consistent deformation; flexibility matrix formulation; prestrain, temperature change and support movement effects. Sway consideration. Analysis of non-prismatic members.

Module Aims:

Enabling the student to use method and procedures of analysis of indeterminate structures and complex structures with using computer analysis.

Outcomes:

The student is expected to be able to:

- analysis of indeterminate structures with different method of solution mentioned above.
- apply learned methods of solution to different structures.
- represent the absolute curves of shear and moment for statically determinate and indeterminate beams graphically.
- study buckling phenomenon of columns.

Textbooks and References:

- **Russell G. Hibbeler, "Structural Analysis", 2nd edition, Prentice – Hall.**
- Chajes, "Structural Analysis", 2nd edition, Prentice – Hall, 1990.
- Tartaglione L.C., "Structural Analysis", McGraw – Hill, 1991.

Engineering Practice	
Code:	CE 399
Credits:	0 (0-0-0)
Pre-requisite:	90 Units
Co-requisite:	NA

Module Description:

Field training conducted under the supervision of a college member. The student must submit a detailed technical report by the end of the training period, explaining what did he learn during this training.

Module Aims:

The course is designed to give seniors in engineering hands-on and design experience through working on engineering projects. The training period should be at least 200 hours.

Outcomes:

The student is expected to be able to:

- function on multi-disciplinary teams.
- understand professional and ethical responsibility.
- use skills and modern engineering tools necessary for engineering practice.
- communicate effectively.
- recognize the need to engage in life long learning.

Computer Applications in Structural Engineering	
Code:	CE 425
Credits:	2 (1-0-2)
Pre-requisite:	CNE 206
Co-requisite:	NA

Module Description:

Part A: Writing Computer Programs using BASIC or VISUAL BASIC, C++or Excel in Civil Engineering (Structuarl Analysis, Reinforced Concrete Design, Steel Structures Design, Foundation Engineering, hydraulics and water engineering). Part B: Training on using Ready Softwares (for example STAAD-III , EXCEL , AUTOCAD and other useful softwares) Part C: Use of INTERNET in Search about Civil Engineering Topics.

Module Aims:

To introduce the student to the computer applications in Civil engineering.
writing programs using visual Basic and C++.
Using computer in designing different RC elements.
Be familiar with the recent software's in structural engineering.

Outcomes:

The student is expected to be able to:

- write programs in C ++ or VB or excel for design of simple element of structures.
- use application programs like STAAD for design and analysis of structures commonly used in the industry.

Textbooks and References:

- **Leland Blank, P.E., and Anthony Tarquin, P.E., "Engineering Economy", McGraw-Hill, 6e, 2005.**
- Steven Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", McGraw – Hill, 2nd Edition, 2006.
- E. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw – Hill, 4th Edition, 2008.
- Barr, A., Cohen, P.R. and Feigenbaum, E.A., "Artificial Intelligence" The Handbook, Vol. 5, Addison Wesley, (Latest edition).
- Dayoff, J.E., "Neural Networks Architecture: An Introduction", Van Nostrand Reinhold, 1990.
- Robert Lafore, "Object Oriented Programming in Turbu C++", Galgotia Publications, (Latest edition).

Reinforced Concrete Design 3	
Code:	CE 419

Credits:	3 (3-2-0)
Pre-requisite:	CE 318
Co-requisite:	NA

Module Description:

Design of long R.C. columns, Design of deep Beams, Corbels, Analysis of R.C. sections using Working Stress Method, Serviceability, Deflections and Cracking, Design of frames and special R.C. structures, Desidn of doms and revolution structures, Design project.

Module Aims:

Enables the student to design long columns, deep beams, frames and doms.

Outcomes:

The student is expected to be able to:

– different elements of buildings. This course along with the earlier courses fully equips the student to design various elements of RCC structures.

Textbooks and References:

- **Steven H. Kosmatka, "Design and Control of Concrete Mixture, Portland", Portland Cement Association, (Latest edition).**
- Charles, G.S. and Chu-Kia W., "Reinforced Conocrete Design", 5th Edition, Harper and Row, Pub., 1994.
- El-Dakhakhni, W.M., "Modern of Reinforced Conocrete", The Anglo Egyptian Bookshop, 1990.
- Mac Gregor, J.G., "Reinforced Conocrete, Mechanics and Design", Prentice Hall, 1992.

Structural Steel Design 2	
Code:	CE 421
Credits:	3 (3-2-0)
Pre-requisite:	CE 320
Co-requisite:	NA

Module Description:

Compound Beams, Crane Beams, Purlins, Sheeting Rails, Plate Girders, Beam Columns, Slide Column for a Single Storey Industrial Building, Crane Columns, Column Bases, Trusses.

Module Aims:

To enable students to design compound beams, crane beams, all components of steel railway and highway bridges that safely and economically can resist the loads and satisfy their intended function.

Outcomes:

The student is expected to be able to:

- design compound beams.
- design plate girder or truss steel bridges.
- design crane beams.
- design industrial buildings.

Textbooks and References:

- **AISC Manual of Steel Construction.**
- **Leonard Spiegel & Limbrunner, "Applied Structural Steel Design", 4th edition, Prentice Hall.**
- Negi L.S., "Design of 25Steel Structures", Tata McGraw Hill, (Latest edition).

Earthquake Engineering	
Code:	CE 426
Credits:	3 (3-2-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Introduction to earthquake engineering, origin and characteristics of earthquakes, introduction to structural dynamics, vibration characteristics of buildings, periods and mode shapes, response spectrum, earthquake induced forces and displacements. Introduction to inelastic behavior, force reduction and ductility requirements for concrete and steel material, seismic and design and provisions of reinforced concrete frames and shear walls according to ACI Code and international building seismic codes like UBC code.

Module Aims:

Introduction to the basics of earthquake engineering.
Undrstand the behavior of structures towards the earthquake.
Design of resistant earthquake structures.
In traduce elements like shear walls meant to resist earthquakes.

Outcomes:

The student is expected to be able to: – design resistance structure to earthquake according to codal requirements.

Textbooks and References:

- **Ail K. Chopra, "Earthquake Engineering and Structural Dynamics" John Wiley & Sons. (Latest edition).**
- W. F. Chen, E. M. Lui, "Earthquake Engineering for Structural Design", CRC. (Latest edition).

High-Rise Buildings	
Code:	CE 427
Credits:	3 (3-2-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Introduction, High - rise buildings structural frames, Loadings on High Rise Buildings, Analysis methods for high - rise building, Safe lateral deflection for H.R.B. , Stability of H.R.B.

Module Aims:

Understand the steps for designing and constructing tall structures.
To introduce the student to the favorite code among the different designed codes.

Outcomes:

The student is expected to be able to:

- appreciate the difference in design between the normal height and tall structures, say <70m and > 70 m.
- evaluate the loads on the tall structures.
- design and analysis tall structures using per codal provisions and evaluate the structures service.

Textbooks and References:

- Hiroyuki, A., "Design of Modern High-rise Reinforced Concrete Structures", World Scientific Company, 2002.

Bridges Design	
Code:	CE 428
Credits:	3 (3-2-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Types of bridges; loads on bridges, analysis and design of reinforced concrete slab and girder type bridges, precast prestressed concrete bridge, metallic bridges. Substructure design. Construction details.

Module Aims:

The module aims to introducing concepts of bridge designing.
Studying the types of bridges and their characteristics.
Study the loads on bridges as per codal provisions.
Study the design of different elements of bridges including substructures design as per codal provisions.

Outcomes:

The student is expected to be able to:

- identify the different types of bridges and the usage of each type under different circumstances.
- evaluate loads on bridges as per codal provisions.
- design different bridge elements as per codal provisions.
- design of substructures elements.

Textbooks and References:

- Vector, D.J., "Textbook of Bridge Engineering", (Latest edition).
- Sehgal, S.E., and Bhanot, K.L., "A Textbook on Highway Engineering and Airports", S. Chand & Co. (Latest edition).
- Khanna, S.K., and Justo, C.E.G., "Highway Engineering", Nemchand Bros, (Latest edition).
- Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khann Tech Publications, (Latest edition).
- Khanna and Justo, "Highway Material Testing", Nemchand Bros, (Latest edition).
- Phatak, D.R., " Bridge Engineering", Satya Prakashan, (Latest edition).
- Oglesby and Hicks, "Highway Engineering". (Latest edition).
- Ponnuswamy, "Bridge Engineering", Tata McGraw Hill, (Latest edition).

Rainforced Concrete Design 4	
Code:	CE 429
Credits:	3 (3-2-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Introduction, design of sections of liquid containers (section subject to axial tension, simple bending and eccentric tension or compression), Design of elevated, rest and under ground water tanks and pumping rooms. Design of different elements and method of constructions of swimming pools. Design of different elements and method of constructions of diving pools.

Module Aims:

To enable students to design all components of water tanks (circular and rectangular), swimming pools and pumping station.

Outcomes:

The student is expected to be able to:

- design of reinforced concrete for water structures.
- design of R. C. elevated tanks.
- design of swimming pools.
- design of pumping stations.

Textbooks and References:

- **Steven H. Kosmatka, "Design and Control of Concrete Mixture, Portland", Portland Cement Association, (Latest edition).**
- Charles, G.S. and Chu-Kia W., "Reinforced Conocrete Design", 5th Edition, Harper and Row, Pub., 1994.
- El-Dakhakhni, W.M., "Modern of Reinforced Conocrete", The Anglo Egyptian Bookshop, 1990.
- Mac Gregor, J.G., "Reinforced Conocrete, Mechanics and Design", Prentice Hall, 1992.

Methods and Equipment of Construction	
Code:	CE 422
Credits:	2 (2-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Overview of the construction industry. Earthmoving machinery and operations. Excavation and lifting. Loading & hauling. Compacting & finishing. Concrete construction. Concrete form design. Construction economics. Contract construction.

Module Aims:

The module aims to introduce for equipment and construction and details for various constructions activities, like concrete, compaction, earthmoving, ready mix concrete, and casting, etc.

Outcomes:

The student is expected to be able to:

– produce a project, involves different elements like quarrying, compaction, earthmoving, transfer and tins of concretes.

– economical evaluation for the usage of construction equipment.

Textbooks and References:

- S.W. Nunnally Phillips C., "Construction Methods and Management", Prentice-Hall, (Latest edition).
- R.L. Peurifoy and W.B. Ledbetter, "Construction Planning, equipment and Methods", McGraw –Hill. (Latest edition).

Contracts and Specifications	
Code:	CE 423
Credits:	2 (2-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Legal aspects of engineering public works, general and special conditions, tenders, different types of tenders, estimation of rates. Rate analysis, Depreciation, Arbitration. Professional ethics. Specifications of construction materials according to different standards. Quantity surveying for civil engineering works.

Module Aims:

Introduce and equip to the student to determine the quantities of different types of constructions and knowledge its tenders, specifications and contracts conditions.

Outcomes:

The student is expected to be able to:

– acquire all types of engineering contracts.
– evaluate the quantities of excavation and filling plain and reinforced concrete.
– estimate the quantities of all types of foundations.
– calculate the quantities all types of bricks and blocks.
– understand all types of R. C. elements.
– lay specifications of engineering constructions.

Textbooks and References:

- **R. H. Cloug & G. A. Sears, "Construction Contracting", 6th edition.**
- Charles S. Phillips, "Construction Contract Administration", 1999.
- Charborty,"Estimating and Costing Specifications & Valuation", (Latest edition).
- Macmiian, "Hand book of Construction Management", (Latest edition).

Building Construction	
Code:	CE 524
Credits:	3 (3-1-0)
Pre-requisite:	CE 419
Co-requisite:	NA

Module Description:

Building structures, main buildings elements, engineering drawings required in design and implementation stages. Reading and analyzing architectural drawings. Reviewing studies and research work about engineering projects such as economical studies, soil and water research, etc. Studying some building elements as ladders, beams, installation materials in buildings.

Module Aims:

Prepare the student to read drawings ready for excursion.
Learn how to translate the drawings to actual construction.
Evaluate soil and water reports for a site.
Study different elements in actual construction including materials.

Outcomes:

The student is expected to be able to:

- read architectural drawings in fine details enabling him to translate it to actual construction.
- understand the intricacies of construction of typical elements in buildings.
- assess different construction materials within the region.

Textbooks and References:

- **Francis D.K. Ching, "Building Construction Illustrated", John Willy & Sons, (Latest edition).**
- Merritt, F.S., Rickatts, J.T., "Building Design and Construction Handbook", McGraw- Hill, (Latest edition).

Finite Element	
Code:	CE 430
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

What are finite elements? What are boundary elements? Frames, Plane problems, Slabs, shells, theoretical details.

Module Aims:

Introduce the basic concepts of FEM.
Understand and solve plane strain, plane stress and ax symmetric problems.
Understand the process of calculating the stress and strain at a point in a given problem.
Use application software for solving simple problem.

Outcomes:

The student is expected to be able to:

- understand techniques of using FEM methods in civil engineering problems.
- understand the methodology behind the solutions, while using software application.
- fully understand the pre process of the solution.

Textbooks and References:

- Reddy, S.C- FEM
- **Stagg and Ziebkiwcch, "The Finite Element Method", (Latest edition).**

Dynamics of Structures	
Code:	CE 431
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Equations of motion by equilibrium and energy methods, free and forced vibration of single degree of freedom systems effect of damping transmissibility. Equations of motion of two degree freedom systems, normal modes of vibration, applications. Multi degree of freedom systems, orthogonality of normal methods, superposition technique numerical integration procedure. Idealization and formulation of mathematical models for wind, earthquake, blast and impact loading, aerodynamics gust phenomenon, principles of analysis.

Module Aims:

To expose the students the principles and methods of dynamic analysis of structures and to prepare them for designing the structures for wind, earthquake and other dynamic loads.

Outcomes:

The student is expected to be able to:

- appreciate the effects of dynamic loads on structures.
- analyze a structure for satisfactory design performance against dynamic loads.

Textbooks and References:

- **Mario Paz, "Structural Dynamics: Theory and Coputation", Kluwer Academic Publication, 2004.**
- Anil K. Chopra, "Dynamics of Structures" Pearson Education, 2001.
- Leonard Meirovitch, "Elements of Vibration Analysis", McGraw Hill, 1986.
- Kolousek V., Pirner M., Fischer O., and Naprstek J., "Wind Effect on Civil Engineering Structures", Elsevier Publications, 1984.

Concrete Structures Rehabilitation	
Code:	CE 432
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Students are acquainted with durability problems of concrete in the Gulf environment. They also study factors causing deterioration in the local conditions; manifestations and mechanisms of sulfate attack, corrosion of reinforcement, salt weathering, environmental cracking and cementaggregate reaction; deterioration of concrete in sea water; preventive measures; diagnosis andevaluation of deterioration, repair materials and techniques.

Module Aims:

Understand the effect of atmospheric parameters on building deterioration.
Know how to reduce deterioration effects on concrete.
Study the methods of rehabilitation of concrete structures.

Outcomes:

The student is expected to be able to:

- specify methods of reducing deterioration concrete.
- assess the extent of deterioration.
- understand the methods of repairs and rehabilitation.

Textbooks and References:

- **Santhakumar A.R., "Concrete Technology" Oxford University Press, 2007.**

- Denison Campbel, Allen and Harold Roper, " Concrete Structures: Materials, Maintenance and Repair", Longman Scientific and Technical, UK, 1991.
- Allen R.T. and Edwards S.C., " Repair of Concrete Structures", Blakie and Sons, UK, 1987.
- Peter H. Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications pvt. Ltd., 2001.

Prestressed Concrete	
Code:	CE 433
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Properties of P.R.C, Prestressing methods, Development of prestressed R.C. Theory , Properties of materials used in P.R.C, Losses in prestressing ,Study of determinate P.R.C. elements subjected to bending and shear , Study of Indeterminate P.R.C. elements, End-Blocks for P.R.C. elements.

Module Aims:

To introduce concepts of PSC.
Study the properties of materials in PSC.
Design and analyze PSC elements.

Outcomes:

<u>The student is expected to be able to:</u> – design and analyze PSC elements. – specify materials used for PSC.

Textbooks and References:

- **Krishna Raju, N., "Prestressed Concrete Structures", TMH; Lhi, 1981**.
- Lin, T.Y. and Burns, N.H., "Prestressed Concrete Structures", 3rd Edition, John Wiley & Sons, NY, 1981.

Soil Mechanics and Foundation Engineering 3	
Code:	CE 434
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Design of Retaining Walls, Introduction to Deep Foundation, Pile Foundation (Classification of Piles, Description of Pile Types, Structural Design of Piles, Static Pile Capacity, Single Piles, Dynamic Analysis, Pile Load Test, Pile Groups) Walls for Excavations, Drilled Piers or Caissons.

Module Aims:

Knowing the different types of piles and how to design it and choose the suitable type from it and design of retaining walls and caissons.

Outcomes:

The student is expected to be able to:

- site investigation- different methods of soil boring, soil sampling.
- determine the shear strength parameters for different types of soil.
- Understand different methods for determining soil bearing capacity.
- classify different types of soil and determine its properties.
- analyze and design different types of deep foundations.
- choose suitable types of deep foundations and make its design.

Textbooks and References:

- **Das, B.M., "Principles of Geotechnical Engineering", Thomson-Engineering, (Latest edition).**

- Bowells, J.E., "Engineering Properties of Soils and their Measurements", McGraw-Hill, (Latest edition).
- Berry, P.L. and Reid, D., "An Introduction to Soil Mechanics", McGraw-Hill, 1987
- Das, B.M., "Priciples of Foundation Engineering", 2 nd. Edition, PWS - KENT, Boston.

Senior Design - Part 2	
Code:	CE 499
Credits:	2 (1-0-2)
Pre-requisite:	CE 498
Co-requisite:	NA

Module Description:

Continuation of Part-I of the project including: running and finalizing the experimental program or the mathematical/computer model, analyzing the results and findings and drawing the conclusion, writing the complete project report, presenting and defending the project.

Module Aims:

- Provide guidance to the student to complete the first part of the project.
- Produce a self-contained technical report.
- Introduce the necessary skills to communicate concepts and experimental results in clear and logical fashion, both verbally and in writing.
- Provide the student with the skills of good technical writing.
- Present the work in a seminar.

Outcomes:

The student is expected to be able to:

- understand and practice the basic concepts and elements of engineering design for a multidisciplinary civil engineering project.
- practice group learning and teamwork by working on a multidisciplinary project.
- improve oral and written communication skills.
- carry out an integrated project planning, scheduling, and cost analysis for a moderately-sized, civil engineering project.

Textbooks and References:

- Selected reference related to the project and data collection.

- Using Internet for enhancing the literature review.

Hydraulic Structures 1	
Code:	CE 342
Credits:	3 (3-1-0)
Pre-requisite:	CE 241
Co-requisite:	NA

Module Description:

Theory of subsurface flow, Khosla's theory, Bligh's creep theory, Canal Falls, Cross Drainage Works, culverts, siphons and aqueducts. Energy dissipation downstream of hydraulic structures. Introduction to storage schemes, Design of Spillways.

Module Aims:

The student will be capable to deal with different design methods and theory for hydraulic Structures, including cross works (Bridges, Siphons, Culverts, Escapes, and Aqueducts).

Outcomes:

The student is expected to be able to:

- identify seepage under hydraulic structures and protection methods.
- analyze and design different hydraulic structures.
- uderstand theories of storage.

Textbooks and References:

- **Novak, Moffat, Nalluki, and Nararyanan, " Hydraulic Structures", Taylor and Francis, (Latest edition).**
- Varshney Rs, Gupta Sc, Gupta Rl, "Theory and Design of Irrigation Structures", Nem Chand & Brothers, 2007.
- G.L. Asawa, "Irrigation Engineering", New Age International, 2005.

Irrigation and Drainage Engineering	
Code:	CE 343
Credits:	3 (3-1-0)
Pre-requisite:	CE 241
Co-requisite:	NA

Module Description:

Fundamentals of Irrigation Engineering. Crop water relationships. Consumptive use of water and water application schedule. Sprinkler, trickle, surface and subsurface irrigations. design of water conveyance and measurement structures: weirs, Partial flume and culverts, Water logging, remedial measures. Different types of drainage systems: Open drains, tile drainage, drainage depth and spacing and reuse of drainage waters. Soil erosion.

Module Aims:

- Design of different method of irrigations (surface irrigation, Sprinkler system, and Trickle irrigation).
- Planning of irrigation and drainage networks.

Outcomes:

The student is expected to be able to:

- understand the Soil–Water-Plant relationships, Water requirements and irrigation efficiency, Salts and its impacts on soil and irrigation water quality.
- plan and design irrigation and drainage projects.
- understand the computer applications in irrigation and drainage designs.
- design channels and other irrigation structures required for irrigation, drainage, soil conservation, flood control and other water-management projects.

Textbooks and References:

- **Israelsen, O.W., and Hansen, V.E., " Irrigation Principles and Practices", John Wiley & Sons Inc. (Latest edition).**
- Varshney Rs, Gupta Sc, Gupta R., “Theory and Design of Irrigation Structures", Nem Chand & Brothers, 2007.
- G.L. Asawa, “Irrigation Engineering", New Age International, 2005.

Computer Applications in Water Engineering	
Code:	CE 444
Credits:	2 (1-0-2)
Pre-requisite:	CNE 206
Co-requisite:	NA

Module Description:

Introduction, Computer models in water and environmental engineering, Mathematical modeling: Mathematical tools and techniques.

Artificial intelligence techniques: Artificial neural networks, Genetic algorithms, Fuzzy logic, Applications in water resources and environmental engineering, computational environmental hydraulics.

Development of computer codes for problems in hydraulics, water resources, hydrological studies, environmental engineering modeling.

Introduction to some (up-to-date) software's: MATLAB, FlowMaster, StormCAD, SewerCAD, WaterGEMS, AUTOCAD, AUTOCIVIL, STRAP, etc…)

Module Aims:

To develop the creative thinking in solving the engineering problems.
To provide an opportunity to acquaint the students with various application software in the field of water and environmental engineering.
To learn MATLAB and its utility in developing the programs for specific problems.
Be familiar with the recent software's in water and environmental engineering.

Outcomes:

The student is expected to be able to:

- write programs in C++ or VB or Excel as applied for water and environmental engineering.
- use application programs in the field of water and environmental engineering.

Textbooks and References:

- **Bentley, "Computer Applications in Hydraulic Engineering", Bentley's Haestad, 7th.**
- Steven Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", McGraw – Hill, 2nd Edition, 2006.
- E. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw – Hill, 4th Edition, 2008.
- Versteeg, H.K. and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The Finite – Volume Method", Pearson, 2nd Edition, 2007.
- Ralph A. Wurbs and Wesley P. James, " Water Resources Engineering", Prentice Hall, 2002.
- Ferziger, J.H., and Peric, M., "Computational Methods for Fluid Dynamics", 3rd Edition.
- Barr, A., Cohen, P.R. and Feigenbaum, E.A., "Artificial Intelligence" The Handbook, Vol. 5, Addison Wesley, (Latest edition).
- Dayoff, J.E., "Neural Networks Architecture: An Introduction", Van Nostrand Reinhold, 1990.
- Robert Lafore, "Object Oriented Programming in Turbu C++", Galgotia Publications, (Latest edition).

Hydrology	
Code:	CE 445
Credits:	3 (3-1-0)
Pre-requisite:	CE 241
Co-requisite:	NA

Module Description:

The hydrologic cycle. Fundamentals of meteorology, temperature, humidity, wind, precipitation, evaporation. Stream-flow and run-off. Stream-flow hydrographs. Unit hydrographs for various durations and its applications. Flood routing. Introduction to Water Resources management and its demand, Water Resources management in arid and semi-arid regions and its application in Saudi Arabia.

Module Aims:

The overall course objective is to educate students to conduct hydrological analysis including precipitation, water losses, runoff and flood analysis.

Outcomes:

The student is expected to be able to:

- define the Global Hydrologic Cycle and calculate the Hydrologic items in KSA.
- analyze the rainfall and runoff data.

- understand hydrological analysis including precipitation, water losses, runoff and flood analysis.

Textbooks and References:

- **V.T. Chow, " Hydrology", McGraw Hill, (Latest edition).**
- K. Subramanya, "Engineering Hydrology", Tata McGraw Hill, 2007.

Environmental Engineering 2	
Code:	CE 461
Credits:	3 (2-0-2)
Pre-requisite:	CE 360
Co-requisite:	NA

Module Description:

Measurements of water quality: (sampling, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, turbidity, color, taste, odor, pH, Alkalinity, solids) , Hazardous waste, Radioactive waste, Measurement of air quality, Noise pollution.

Module Aims:

Enabling the students with the principles of environmental engineering with respect to wastes and methods of treatments and how to estimate quality of treated waste water.

Outcomes:

The student is expected to be able to:

- define environmental quality standards.
- quantify environmental quality.
- measure environmental quality parameters.
- use different environmental instruments to measure air, water and noise pollution.
- understand the principles involved in environmental engineering.

Textbooks and References:

- **Weiner & Matthews, " Environmental Engineering", Elsevier, (Latest edition).**

- Davis, and Cornwell, D., " Introduction to Environmental Engineering", McGraw-Hill, (Latest edition).
- Hammer, " Water and Wastewater Technology", Prentice Hall, (Latest edition).
- Metcalf and Eddy, "Wastewater Engineering, Treatment, Disposal and Reuse", McGraw-Hill, (Latest edition).

Hydraulics 3	
Code:	CE 446
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Pipeline and pumping systems, pipe networks, unsteady flow in pipeline- water hammer and surge, unsteady free surface flow, loose boundary hydraulics, stable channel design.

Module Aims:

This course aims to applying the theories which have been studied in hydraulics on some applied subjects, studying unsteady flow and fluvial hydraulics.

Outcomes:

The student is expected to be able to:

- apply the available equations for the description of open channel and pipe flow.
- solve simple pipe networks using appropriate methods.
- select a pump to meet a specified duty.
- apply rigid and elastic water hammer theory to analysis of pipeline system.
- predict the sediment load in open channel or natural channel.

Textbooks and References:

- **Hanif Chaudhry, "Applied Hydraulic Transients", Van Nostrand Reinhold Company, (Latest edition).**
- Wylie & Streeter, "Fluid Transients", McGraw-Hill, (Latest edition).
- Basak, "Irrigation Engineering", McGraw Hill, 1999.

Hydraulic Structures 2	
Code:	CE 447
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Definition of dams and the purpose of its construction, factors governing the selection of particular type and site of dams, Planning for reservoirs, Design and construction of gravity dams, Construction of drainage gallery in gravity dams, Design and construction of earthen dams, Seepage through earthen dams and seepage control, Arch dams, Outlet works through dams Reservoirs . river training works.

Module Aims:

This course aims to know the students by the different types of dams and how to plan it and choose its site, type and design it.

Outcomes:

The student is expected to be able to:

- identify technical, economical and social factors affecting dam type, site selection, forces of gravity dams and factors cause dam failure.
- design of embankment dams and studying its stability and seepage analysis.
- design of concrete dames and drainage gallary.
- design of dam outlet works.

Textbooks and References:

- **Novak, Moffat, Nalluki, and Nararyanan, "Hydraulic Structures", Taylor and**
- **Francis, (Latest edition).**
- Kraatz and Mahajan, "Small Hydraulic Structures", FAO Publication, (Latest edition).

Environmental Hydraulics	
Code:	CE 448
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Convection and dispersion of pollutants in surface and ground water. Studying water quality in water supply pipes networks. Effect of hydraulic structures on environment. Hydraulic methods for domestic and industrial waste water discharge in water courses and coastal regions. Soil erosion by floods runoff.

Module Aims:

- The course will introduce theoretical pollutants transport theories and establish its relevance in civil engineering.
- Develop the fundamental principles underlying the subject.
- Demonstrate how these are used for the design of environmental hydraulic system.

Outcomes:

The student is expected to be able to:

- understand the fundamental physical processes of pollutant movement and spreading in groundwater systems, pipes, surface water bodies and the atmosphere.
- accumulate skills to be able to apply theory to solve problems and make estimates of pollution levels in the environment.
- have the ability to undertake environmental studies, analyze the data and report the results in pollution problems in the environment.

Textbooks and References:

- **Hubert Chanson, "Environmental Hydraulics of Open Channel Flows", Elsevier, 2004.**
- Mays, L.W., "Water Resources Handbook", McGraw-Hill, (Latest edition).
- Walski, T.M., Chase, D.V., "Advanced Water Distribution Modeling and Management", Haestad Press, 2003.

Groundwater Hydrology	
Code:	CE 449
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Groundwater, Porous -media porosity, Groundwater motions, Flow net and solving methods, Hydraulic of wells, Design of wells, Pumping Tests, Analysis and evaluation of pumping test data . Sea water intrusion. Unsaturated groundwater flow. Groundwater in KSA.

Module Aims:

This course is designed to give civil engineering students the ability to understand the principles of groundwater flow hydraulics and to apply it appropriately in well design and evaluating ground water reservoirs.

Outcomes:

The student is expected to be able to:

- identify and formulate the groundwater flow, aquifers and wells.
- provide a rigorous understanding of subsurface hydrological processes
- understand the fundamentals of saturated zones, and saturated subsurface flow
- recognize the role of groundwater in the hydrological cycle and groundwater - surface water interactions.

Textbooks and References:

- **Todd & Mays, "Groundwater Hydrology", John Wiley & Sons, (Latest edition**).
- Jacques Delleur, " The Handbook of Groundwater Engineering", CRC Press, (Latest edition).

Ports and Coastal Engineering	
Code:	CE 450

Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Harbor planning and construction, theory of periodic waves, wave energy, power, refraction, diffraction and reflection, winds, tides and waves, wave-structure interaction, wave forces on structures, design of coastal structures, coastal zone processes, long shore sediment transport.

Module Aims:

Understand the general field of Coastal Engineering and the basic design of Harbor and port Engineering

Outcomes:

The student is expected to be able to:

- plan and design of ports.
- determine the different loads , static and Dynamic loads on breakwater.
- design the different elements of the breakwater.
- understand the factors affecting the design of Harbors Structures as Winds, soil, surveying, , wave forces and tides.
- select structures type of the Break Waters (B.W.) as the Rubble- mound or vertical breakwater.

Textbooks and References:

- **Mehante, " Hydrodynamics and Water waves", Springer-Verlag, (Latest edition).**
- Silvester, " Coastal Engineering", Elsevier, (Latest edition).
- US Army Coastal Eng, Research Center, " Shore Protection Manual", 4th, edition.

Water Resources Engineering	
Code:	CE 451
Credits:	3 (3-1-0)
Pre-requisite:	NA

Co-requisite:	NA

Module Description:

Planning, organizing, leading, controlling. Planning stages and levels, decision making techniques. Water demand and supply: water demand estimation methods, water supply estimation methods, water balance between supply and demand. Important aspects in water resources planning: economic, legislative, environmental, social and political aspects. Case study: Water resources planning and management in KSA.

Module Aims:

To introduce senior students in civil engineering to the principles of Water Resources planning and management of basic projects. Also to develop students' ability to apply these principles to water projects.

Outcomes:

The student is expected to be able to:

- identify the Importance of water for human activities and the water resources engineering.
- understand and review the global water resources especially KSA.
- estimate water demand and supply.

Textbooks and References:

- **Neil, S. Grigg., "Water Resources Planning", McGraw Hill, Latest edition).**
- Alvin, S. Goodman, "Principles of Water Resources Planning", Prentice-Hall, Inc., Latest edition).
- Neil, S. Grigg, "Water Resources Management", McGraw Hill, (Latest edition).

Water and Wastewater Treatment	
Code:	CE 463
Credits:	3 (3-1-0)

Pre-requisite:	CE 362
Co-requisite:	NA

Module Description:

Water quality and standards. Design of surface Water and groundwater treatment process including clarification, sedimentation, filtration, disinfection and softening. Characteristics of wastewater. Design of Sewage treatment process, including solids removal chemical and biological processes.

Module Aims:

This course aims to enable the student to deal with the principals of designs for works of water treatment and wastewater treatment systems. Understanding the environmental problems and issues such as: quality, standards and water contamination.

Outcomes:

The student is expected to be able to:

- estimate the present and future water and wastewater flow.
- design of water works (intakes, treatment units, ground and elevated tanks).
- design of wastewater treatment units.
- design of wastewater pumping stations, rising mains and treatment units.

Textbooks and References:

- Weiner and Matthews, "Environmental Engineering", Butterworth-Heinemann, (Latest edition).
- Salvato, Nemerow and Agardy, "Environmental Engineering", John Wiley & Sons, (Latest edition).
- Spellman & Whiting, "Environmental Engineer's Mathematics Handbook", CRC press, 2005.

Solid Waste Management	
Code:	CE 464
Credits:	3 (3-1-0)
Pre-requisite:	NA

Co-requisite:	NA

Module Description:

Sources of solid waste and models of its quantity prediction. Define components of solid waste and collection system. Design of functional elements of solid waste management (transfer station, material recovery facilities, landfills, treatment plants).

Module Aims:

Be able to understand the data requirements for, and then be able to prepare concept designs of common functional elements (e.g. transfer stations, material recovery facilities, landfills, treatment plants) in solid waste management system.

Outcomes:

The student is expected to be able to:

- describe a regional urban solid waste management system.
- characterize the waste generation in a region and make predictions.
- prepare concept design of the waste facilities.

Textbooks and References:

- **Weiner and Matthews, "Environmental Engineering", Butterworth-Heinemann, (Latest edition).**
- Davis, and Cornwell, D., "Introduction to Environmental Engineering", McGraw-Hill, (Latest edition).
- Hammer, " Water and Wastewater Technology", Prentice Hall, (last edition).
- Metcalf and Eddy, "Wastewater Engineering, Treatment, Disposal and Reuse", McGraw-Hill, (Latest edition).

Groundwater Contamination	
Code:	CE 465
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Causes and sources of groundwater contamination, dispersion of contaminants in groundwater, Soil treatment technologies, Pump and treat technologies, In situ treatment technologies.

Module Aims:

This course aims to define sources of ground water pollution, methods of remediation and elimination.

Outcomes:

The student is expected to be able to:

- select and design remediation systems.
- determine capture zones, mass transport, natural attenuation, and alternative remediation designs.

Textbooks and References:

- **Todd & Mays, "Groundwater Hydrology", John Wiley & Sons, 3rd. edition 2005.**
- Jacques Delleur, "The Handbook of Groundwater Engineering", CRC Press, (Latest edition).
- U.S. Army Corps of Engineers, "Groundwater Hydrology", (Latest edition).

Water Desalination	
Code:	CE 466
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Introduction, desalination methods, Pretreatment, single effect evaporation, multiple effect evaporation, multistage flash distillation, reverse osmosis, economic analysis of desalination processes. Case study to existing desalination station, components of desalination station, application in industry.

Module Aims:

This course aims to define the principals of desalination processes, different methods of desalination and how to design and choose the suitable methods.

Outcomes:

The student is expected to be able to:

- know the methods of sea water and brackish water desalination and idea of its operation.
- design of sea water desalination system.
- identify and apply the most economic method for desalination

Textbooks and References:

- El-Dessouky & Ettouney, "Fundamental of Salt Water Desalination", Elsevier, (Latest edition).

Wastewater Reuse	
Code:	CE 467
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Potential reuse applications. Sources of water for reuse. Treatment technologies suitable for water reuse applications. Criteria for each type of reuse application. The overall procedures for determining the feasibility and planning of water reuse systems as well as the management structure of reuse projects. The management of the biosolids resulting from the treatment of wastewater and related regulations governing their use and disposal.

Module Aims:

Enable the students to plan, design and management systems of wastewater reclamation and reuse.

Outcomes:

The student is expected to be able to:

- understand the basic concepts and issues involved in wastewater reclamation, recycling and reuse.
- understand major issues involved in developing water and biosolids reclamation criteria.
- select appropriate treatment technologies for reclaiming and reusing wastewater.
- assess the suitability of reclaimed water for any reuse application.
- apply knowledge of water and wastewater engineering for designing water reclamation processes.
- understand the procedures for planning and managing water reclamation projects.

Textbooks and References:

- Donald R. Rowe, Isam Mohamed Abdel-Magid, "Handbook of Wastewater Reclamation and Reuse", CRC press, (Latest edition).

Environmental Impact Assessment	
Code:	CE 468
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Introduction – Law and legislations governing EIA – Importance of EIA studies- Planning and Management of impact studies – Simple methods for impact identifications (Matrices – network – checklists) – Description of Environmental setting- Environmental indices and indicators for describing the effected environment – Prediction and assessment of impacts on the air, surface water, groundwater, and soil environment – Environment monitoring – case study and field visit to conduct EIA.

Module Aims:

Introduce students to the most important laws and legislations related EIA
Focusing on understanding the importance of EIA.
Introduce the students to different ways of project's classification based on the degree of its environmental hazards.
To study ways to identify and define the negative effects (Matrices – Networks - Checklists)
Training on conducting a description of the current environmental situation in any project.
Understanding references and indicators for environmental impacts.
Acquiring the student the ability to make a prediction and assess the negative impacts of pollution.
Field visits: a study of EIA of different engineering projects.

Outcomes:

The student is expected to be able to:

- acknowledge of the most important laws and legislation related to the study of environmental impact.
- identify and set of environmental indicators for projects
- conduct a description of the current environmental situation in any project.
- work through an integrated team to conduct a study environmental assessment of projects in accordance with the rules and laws.

Textbooks and References:

- **John Glasson, *et. al*, "Introduction to Environmental Impact Assessment", Rutledge, 2005.**
- Peter Wathern, "Environmental Impact Assessment", Rutledge, (Latest edition).

Environment Management	
Code:	CE 469
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

The importance of environmental management systems at the international level and at the enterprise level, Recycling, Cleaner production methods, Evaluate the product life cycle, Role of technology in environmental management, Environmental management systems used in the world system (ISO 14000).

Module Aims:

Provide the student with the concept environmental management and its mechanisms.
Provide the student with the ability to participate in the planning and implementation of environmental management systems within the enterprises.
Awareness of the importance of environmental management systems at the international level and at the enterprise level.
Demonstrate applications on how to environmentally manage an organization of through recycling and cleaner production methods.
The student is familiar with the techniques used in environmental management.
Study some of global environmental management systems.

Outcomes:

The student is expected to be able to:

- follow the correct methods in the management of environmental projects.
- plan, implement and manage environmental projects.
- increase environmental awareness and follow-up with international developments in environmental management.
- have increased capacity to deal through a working team.
- criticize the implementation of environmental laws as they applied practically in different projects and companies.

Textbooks and References:

- Mary K. Theodore and Louis Theodore, "Introduction to Environmental Management", CRC Press, 2009.
- Chris Barrow, "Environmental Management for Sustainable Development", Rutledge, 2006.
- Heng Li and Zhen Chen, "Environmental Management in Construction: A Quantitative Approach", Taylor and Francis, 2006.

Geodetic Surveying	
Code:	CE 372
Credits:	3 (2-1-2)

Pre-requisite:	CE 371
Co-requisite:	NA

Module Description:

Geodetic Surveying: Intersection Methods for Computation Rectangular coordinates, Computation Elements Spherical Triangles, Computation geographic coordinates of Spherical triangles, Computation Distances between two points on spherical surface .Cartography: Coordinate References System on the Spherical, Distortions Classification of Projections and their properties, Cylindrical and Conical Projections, Project.

Module Aims:

Adjusting the wide & accurate observations taken on earth using simple & least squares methods.
Evaluate the observations using theory of probability.
Find accuracy of computed values using Error propagation formula.
Find positing coordinates of a place on earth using the fundamentals of astronomical observations.

Outcomes:

The student is expected to be able to:

- enable the students to apply least squares methods on observations.
- enable the students to apply theory of probability & Error formulas.
- enable the students on accurate observations & place astronomical.

Textbooks and References:

- **Aylmer Johnson, "Plane and Geodetic Surveying", Spon Press, 2004.**
- W. Schofield, "Engineering surveying", Elsevier, (Latest edition).

Highway Materials and Construction	
Code:	CE 381
Credits:	3 (2-1-2)
Pre-requisite:	CE 380
Co-requisite:	NA

Module Description:

Highway materials, Soils, Soil classification for Highway purposes, Testing of soil strength, Soil stabilization, Aggregates, Requirement of a good highway aggregate, Binder for Highway construction, Bituminous materials, Testing of Bituminous materials, Bituminous pavement, component parts of highway pavement structure, Types of highway pavement, Preparation of Subgrade. Design of road and street drainage works.

Module Aims:

To enable students to make structural design for all components of highways that safely and economically for traffic operation and can sustain traffic loads and satisfy their intended function and specification.

Outcomes:

The student is expected to be able to:

- design of base and sub-base.
- design of road drainage works.
- study paving materials characteristics and methods of pavement design.
- study different methods of pavement construction for roads and airports.
- design roads elements to satisfy their intended function and sustain traffic loads.

Textbooks and References:

- **Bent Thagesen, "Highway and Traffic Engineering in Developing Countries", Chapman & Hall, (Latest edition).**
- Martin Rogers, "Highway Engineering", Blackwell Science, (Latest edition).

Computer Applications in Surveying	
Code:	CE 473
Credits:	2 (1-0-2)
Pre-requisite:	CNE 206
Co-requisite:	NA

Module Description:

Introduction, Computer models in Surveying and transportation Engineering, Mathematical modeling: Mathematical tools and techniques.

Artificial intelligence techniques: Artificial neural networks, Genetic algorithms, Fuzzy logic, Applications in surveying and transportation engineering.

Development of computer codes for solving, planning, design, and operations problems in transportation.

Introduction to some (up-to-date) software's: MATLAB, AUTOCAD, AUTOCIVIL, CDS Cogo, EasySurf, etc…)

Module Aims:

To develop the creative thinking in solving the engineering problems.
To provide an opportunity to acquaint the students with various application software in the field of surveying and transportation.
To learn MATLAB and its utility in developing the programs for specific problems.
Be familiar with the recent software's in surveying and transportation engineering.

Outcomes:

The student is expected to be able to:

- write programs in C ++ or VB or excel for design of simple element of structures.
- use surveying software's to draw contour maps, cadastral surveying maps, profiles and sections, and to calculate earthworks.

Textbooks and References:

- Daganzo, C.F., "Fundamentals of Transportaion and Traffic Operations", Pergamon, Elsevier Science Inc., New York, 1997.
- McShane, W.R., Poess, P.P. and Prasses, E.S., "Traffic Engineering" Prentice hall, Englewood Cliffs, 1997.
- Steven Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", McGraw – Hill, 2nd Edition, 2006.
- E. Balagurusamy, "Object Oriented Programming with C++", Tata McGraw – Hill, 4th Edition, 2008.
- W. Torge, "Geodesy", Walter de Gruyter, Berlin-New York, (Latest edition).
- Wohl, M. and Martin, B.V., "Traffic System Analysis for Engineers and Planners", McGraw – Hill, (Latest edition).
- Lillesand, T.M. and Kieffer, R.W., "Remote Sensing and Image Interpretation", Wiley, New York, (Latest edition).
- Barr, A., Cohen, P.R. and Feigenbaum, E.A., "Artificial Intelligence" The Handbook, Vol. 5, Addison Wesley, (Latest edition).

- Huagn, Y.H., "Pavement Analysis and Design", Prentice Hall, Englewood Cliffs, 1993.
- Dayoff, J.E., "Neural Networks Architecture: An Introduction", Van Nostrand Reinhold, 1990.
- Robert Lafore, "Object Oriented Programming in Turbu C++", Galgotia Publications, (Latest edition).

Photogrammetry	
Code:	CE 474
Credits:	3 (3-1-0)
Pre-requisite:	CE 372
Co-requisite:	NA

Module Description:

The history of photogrammetry, aerial cameras and camera calibration, geometry of the aerial photograph, stereoscopy and stereoscopes, parallax and the theory and techniques of plotter orientation. Extraction of engineering information from single aerial photo and from two interfaced photos, transformation, least squares, preparation and measuring of coordinates from aerial photos, introduction to analytical photogrammetric surveying, outputs of aerial surveying, Planning a photogrammetric project, Applications using computer software's.

Module Aims:

Privide the student an introduction to the principles of photogrammetry
Data collection using Photogrammetric methods.
Applications of photogrammetry in map projection.
Applications of photogrammetry in civil engineering projects.
Training on photogrammetric instruments and one of the modern photogrammetric software's.

Outcomes:

The student is expected to be able to:

- understand the theory and applications of Photogrammetry.
- understand the geometry of aerial photographs.
- understand how data can be measured using aerial photography.
- create maps from aerial photographs using photogrammetric techniques.

– recognize the difference between remote sensing and Photogrammetry w.r.t. techniques and applications.

Textbooks and References:

- Paul R. Wolf, “Elements of Photogrammetry", Mc Graw Hill, (Latest edition).
- Burr, F. K. and Glemen Bird, S. J., "Surveying, Principles and Applications", Prentice Hall, 2000.
- Moffitt, F.H. and Bouchard, H., "Surveying", Harper & Row, Publishers Inc., (Latest edition).
- C. Burnside,"Mapping from Aerial Photographs", Tranada Publishers. (Latest edition).
- “Manual of Photogrammetry”, 5th edition, American Society of Photogrammetry.

Railway Engineering	
Code:	CE 484
Credits:	3 (3-1-0)
Pre-requisite:	CE 371
Co-requisite:	NA

Module Description:

Introduction, Resistance and tractive efforts, Railway track, Rails, Rail joints, Sleepers, Rail to sleeper fastening, Railway Curves, Ballast, Subgrade and embankments, Tack alignments, Surveying, Geometric design of track, defects and failure in railroad, subgrade embankments, Railway stations, Cross cuts.

Module Aims:

Acquire the basic information about railway system.
Acknowledge the basic information about railway components including planning, design and operation.

Outcomes:

The student is expected to be able to:

- propose and prepare geometric design for railway tracks.
- plan and design of railway stations.
- understand how the railway networks operate.
- carry out the structural design of railway track.

Textbooks and References:

- Clifford F. Bonnett, “Practical Railway Engineering", Imperial College Press, UK, 2005.

Adjustment of Survey Measurements	
Code:	CE 476
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Analysis of theory of observations as applied to surveying, Weights of the observations, Statistical analysis of survey measurements, Analysis of the nature and propagation of random errors in surveying measurements, Adjustment techniques using least squares adjustment technique, Computer application for adjustments and analysis of survey measurements.

Module Aims:

The course aims to provide the student with statistical and mathematical methods for adjustment of surveying observations.
The course aims to give the students a thorough understanding of errors in survey measurements, how they affect the values computed or derived from these measurements, and how these errors should be treated in order to obtain better results from measurements
Introduce the role of computer programming and software's in fast and accurate calculations of errors correction.

Outcomes:

The student is expected to be able to:

- understand the different errors in surveying measurements.
- apply correctly the adjustment methods for different surveying measurements.
- get control on the errors during field measurements and able to make necessary adjustments subsequently to treat random errors.
- use computer programming or software's for adjustment of survey measurements.

Textbooks and References:

- Aylmer Johnson, "Plane and Geodetic Surveying", Spon Press, 2004.
- W. Schofield, "Engineering Surveying", Elsevier, (Latest edition).
- Paul R. Wolf and Charles D. Ghilani, "Adjustment Computations - Statistics and Least Squares in Surveying and GIS", John Wiley & Sons, Inc., Latest edition).

Global Positioning System	
Code:	CE 477
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

How does GPS work? including detailed information of the satellite signals, type of signals, error sources in GPS measurements, the GPS segments, and the classification along with explanations of the different types of positioning solutions.
Determination of coordinates from space and its applications – Systems development in last years (From Dupler system to GPS) – The main elements of the Earth coordinate system – Satellites - Tracks - The periodic time - The laws of Keller - Ground monitoring stations - Types of waves used - Wave receiving systems – Calculation of ground coordinates in cases of movement and rest - Application of GPS in geodesy.

Module Aims:

Knowledge of the modern methods to determine the ground coordinates.
Follow Up the developments to set the coordinates from the space.
To study and understand the key elements of the global positioning system.
Student to learn the role of satellites and tracks in the process of determination of co-ordinates.
Study the specifications and characteristics of ground monitoring stations.
The student would have the ability to distinguish different types of waves that are used and understand how they are received.
The student will be able to calculate the ground coordinates in cases of rest and movement with fully understanding and awareness of the differences between the two cases.
The student will be able to calculate the ground coordinates in cases of rest and movement with fully understanding and awareness of the differences between the two cases.

Outcomes:

The student is expected to be able to:

- understanding of GPS operation, types of GPS, and the use of GPS for spatial location of data.
- describe components of a GPS; appropriate applications and limitations of spatial data and analyse.
- understand of the functioning of the global positioning systems.
- be knowledgeable about the developments and applications of GPS.
- widen his skills of new frame of mind by increasing his ability to track the progress in set the coordinates and the new apparatus.
- use the GPS equipment to deal efficiently with recording the coordinates of the targets (rest or mobile).

Textbooks and References:

- **Gregory T. French, "Understanding the GPS: An Introduction to the Global Positioning System", ISBN: 1566902258 Baylin/Gale, (Latest edition).**
- Conrad Dixon, "Using GPS", Sheridan House; ISBN: 1574090593, (Latest edition).

Geographic Information System	
Code:	CE 478
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Introduction to the application of geographic information systems (GIS) to civil engineering problems. GIS as a tool for analysis, modeling, and evaluation of civil engineering problems. The design of spatial databases, assembly of requisite data, and the development of analysis tools within GIS. Definition of spatial data, data types, spatial relationships, computer operation on spatial data, topology in spatial data, representation of features in a GIS, data models, data dictionaries, data capture techniques; database types, composition of spatial queries, analysis of engineering data using a GIS, complex analysis of polygon and linear features, presentation of results, use of a GIS as an engineering model test bed. Software applications using Arc/GIS 9.1.

Module Aims:

Student learning of GIS techniques.
Training students to modern software packages used in GIS.
Preparing the civil engineer to use one of modern systems that are help to support good planning and decision-making.

Outcomes:

The student is expected to be able to:

- understand of the functioning of the global positioning systems.
- be knowledgeable about the developments and applications of GPS.
- widen his skills of new frame of mind by increasing his ability to track the progress in set the coordinates and the new apparatus.
- use the GPS equipment to deal efficiently with recording the coordinates of the targets (rest or mobile).

Textbooks and References:

- **C.P. Lo and Albert K.W. Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice –Hall of India, New Delhi, 2005.**
- Kang-tsung Chang, "Introduction to Geographic Information Systems", Tata McGraw-Hill Publishing Company Limited, New Delhi, 3rd edition, 2006.

High Resolution Satellite Images	
Code:	CE 479
Credits:	3 (3-1-0)

Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Introduction to Remote Sensing, Digital Image Processing, Digital Image Corrections, Image Enhancement and Filtering, Image Restoration and Transformation, Discrete Wavelet transform, Image Classification Techniques, Stereo Image Analysis Techniques, Image application using Fuzzy Logic, Texture Analysis, SAR Image Processing and applications, Hyperspectral Image Analysis.

Module Aims:

This course aims to giving the student an idea about the high resolution satellite images, processing it and getting the information from it. Monitoring map changes, and get information about topography of the earth, land use, and infrastructure.

Outcomes:

The student is expected to be able to:

- understanding the fundamentals of satellite imagery.
- correct the distortion in the High resolution satellite images using suitable digital image processing technique.
- extract information from digital image

Textbooks and References:

- **Robert, R, Schowengerdn, " Remote Sensing: Models and Methods for Image Processing", Academic press, (Latest edition).**
- Jams B. Campbell, "Introduction to Remote Sensing", The Guilford Press, 2002.

Remote Sensing	
Code:	CE 475
Credits:	3 (3-1-0)
Pre-requisite:	CE 474
Co-requisite:	NA

Module Description:

Fundamentals of remote sensing and its development, The effect of the atmosphere, The camera systems in remote sensing, Information processing and circulation of digital images of the American Landsat and French SPOT satellite, Other satellite remote sensing, Radar imaging, Digital image processing, Some remote sensing applications in engineering (soil classification, explore the site and planning, water resources and their uses, and transportation), Remote sensing applications in the areas of urban planning and agriculture, A practical application using one of the software for the analysis and study of satellite images using a computer.

Module Aims:

Introduce students to the basics of remote sensing.
Identify the different types of modern satellite and how they work.
Be aware of the difference between the aerial photographs and satellite images.
Study of varies factors affecting the imaging in remote sensing.
Learn how to get information from satellite images.
Familiarity with the process of radar imaging.
Understand and learn how to digital image processing.
Study of some remote sensing applications in the fields of engineering such as the exploration sites and planning.
Training using one of modern remote sensing software's.
To follow developments in the field of remote sensing through reports and seminars.

Outcomes:

The student is expected to be able to:

- knowledge of the differences between the different types of aerial photographs and satellite images.
- analyze and derive useful information from satellite images after processing.
- deal with software for Remote Sensing.
- increase the capacity and awareness of the student to follow up on the latest developments in this area of engineering constructions.

Textbooks and References:

- Robert, R, Schowengerdn, " Remote Sensing: Models and Methods for Image Processing", Academic press, (Latest edition).
- Jams B. Campbell, "Introduction to Remote Sensing", The Guilford Press, 2002.

Pavement Maintenance

Code:	CE 483
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Essential terminologies and concepts of preserving existing highway pavements; characterizing of flexible and rigid pavements distresses and identifying possible cause of distresses; relating pavement distress types and distress severity to cost-effective repair alternatives; simple procedure to inventory pavement conditions and select maintenance methods. Example applications will be provided on various topic areas.

Module Aims:

Introduce students to the basics of pavements distresses and possible causes and how to repair it.

Outcomes:

The student is expected to be able to:

- evaluate pavement distresses.
- undersand causes of pavement distress.
- Use and apply methods of pavement maintenance.

Textbooks and References:

- Y. H. Huang, "Pavement Analysis and Design", Prentice Hall, (Latest edition).
- Bent Thagesen, "Highway and Traffic Engineering in Developing Countries", Chapman & Hall, (Latest edition).
- Martin Rogers, "Highway Engineering", Blackwell Science, (Latest edition).

Soil Improvement	
Code:	CE 484
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Purposes of soil stabilization, principles of soil stabilization, mechanical stabilization, cement stabilization, asphalt stabilization, lime stabilization, chemical stabilization, preloading and vertical sand drains, reinforced earth, reinforced retaining walls, stabilization by heating, grouting, compaction of granular soils, using blasting, heavy tamping and vibroflotation.

Module Aims:

This course will expose the students techniques of ground improvement for cohesion less and cohesive soils along with the merits and demerits of each method and its suitability.

Outcomes:

The student is expected to be able to:

- first choose two or three methods of ground improvement on the basis of type of soil.
- narrow down to the most optimum method of ground improvement and also decide the parameters involved for assessing the effectiveness of the method.
- set the broad specifications for the field implementation of Soil Improvement.

Textbooks and References:

- Manfred Hausman, "Principles of Ground Modification", (Latest edition).
- Hunt, “Ground Engineering Hand Book", (Latest edition).

Transportation Engineering	
Code:	CE 485
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

The transportation systems and its characteristics, Transportation and society, Transportation technology: components of transportation systems, Vehicle motion, flow, and performance. Continuous flow, Terminals, Introduction to transportation demand.

Module Aims:

Clarify basic information about Transport systems, Components, Objectives.
Acquire knowledge and techniques for Travel Demand Forecasting.
Explain how to analyze Transport systems.
Acquire knowledge to conduct an economical evaluation of the Transport systems.

Outcomes:

The student is expected to be able to:

- analysis transport systems.
- predict travel demand.
- evaluate transport systems.
- safe operation of transport systems.

Textbooks and References:

- Bent Thagesen, "Highway and Traffic Engineering in Developing Countries", Chapman & Hall, (Latest edition).
- Martin Rogers, "Highway Engineering", Blackwell Science, (Latest edition).

Urban Transportation Planning	
Code:	CE 486
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Characteristics of urban transportation systems, the methods through which they are planned and analyzed. Urban transportation planning process, Environmental impacts on urban travel, the application of systems approach to transport planning, survey design and data management, calibration of urban transport demand and supply models.

Module Aims:

To familiarize students with the characteristics of urban travel and the process of urban transport system planning, and to provide them with the necessary engineering

tools to formulate and calibrate transport models.

Outcomes:

The student is expected to be able to: – acquire knowledge of investigation and sampling techniques in urban transport travel demand analysis. – describe the concept of regression statistics, chaise theory and assignment techniques to forecast ridership/trips for the private and the public urban transport modes.

Textbooks and References:

- Meyer & Miller, " Urban Transport Planning", McGraw-Hill, (Latest edition)
- J. D. Ortuzar & L. G. Willumsen, "Modeling Transport", Wiley, (Latest edition).

Airport Planning and Design	
Code:	CE 487
Credits:	3 (3-1-0)
Pre-requisite:	NA
Co-requisite:	NA

Module Description:

Introduction to airport planning and design parameters, site selection, configuration, development and design of terminal areas, demand forecasting, access, traffic control.

Module Aims:

This course will provide students with the experience and understanding of the procedures involved in airport planning and designs.

Outcomes:

The student is expected to be able to:

- plan and design airports.
- select appropriate airport site.
- develop and design of airport terminals.

Textbooks and References:

- Horonjeff, R. and Mckelvey, F. X., "Planning and Design of Airports", McGraw-Hill, (Latest edition).
- Wells, A., “Airport Planning and Management", McGraw-Hill, (Latest edition).