الجامعـــة الإسلاميـــة للتكنولوجيا

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

COURSE STRUCTURE
AND
COURSE CONTENTS

ACADEMIC CALENDAR 2013-2014

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING (CEE)

2013

Contents

GENERAL INFORMATION

Civil Engineering is a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including works such as bridges, roads, canals, dams and buildings. Civil Engineering is the oldest engineering discipline. The earliest practices of Civil Engineering may have commenced between 4000 and 2000 BC in Ancient Egypt and Mesopotamia (Ancient Iraq) when humans started to abandon a nomadic existence, thus causing a need for the construction of shelter. In fact, it is traditionally broken into several sub-disciplines-environmental engineering, geotechnical engineering, structural engineering, transportation engineering, municipal or urban engineering, earthquake engineering, water resources engineering, materials engineering, coastal engineering, surveying and construction engineering.

The Department of Civil and Environmental Engineering started at IUT from academic session 2008-2009 with an enrolment of 41 students. At present, there are 10 well-qualified full-time teachers along with 9 part-time teachers. The mission of the department is to:

- Educate students in fundamental concepts and principles, develop critical thinking, technical skills, as applied to engineering analysis and sustainable design and through appropriate curriculum and courses,

- Provide continuing educational opportunities, technical assistance, and intellectual resources to the local, national, and international arena,

- Serve the engineering profession and society through innovative research and

- To strengthen educational cooperation and expertise within the OIC member states in the field of Civil and Environmental Engineering.

Programmes offered by CEE Department:

- **Master of Science in Civil Engineering (CE)**
- **Bachelor of Science in Civil Engineering (CE)**

The 4-year B.Sc. Engg. CE Programme consists of a number of courses which are distributed in 8 semesters. Total number of credit hours is 181.5. There is also an Industrial Training of 4 week duration offered to students to familiarise with construction and design works.

The department is well equipped with laboratories in the areas of concrete and structures geo-technics hydraulics and environmental engineering. The laboratory facilities are constantly developed and augmented to cater for increased teaching and research needs. The laboratories are well supported and managed by laboratory technicians and auxiliary staffs.

The four year B.Sc. Engg. CE Programme consists of a number of courses which are distributed in eight semesters. To achieve a B.Sc. Engg. CE, degree a student has to complete a total of 181.5 credit hours. Undergraduate students have to participate in an Industrial Training for 4 weeks, to familiarize with various civil engineering construction and design works, at prominent government bodies and industries.

Master of Science (M.Sc.) in Civil Engineering and Master of Engineering (M. Engg.) in Civil Engineering with specialization in Structural, Geotechnical, Environmental, Water Resource, and Transportation is hosted by the Department of Civil and Environmental Engineering. The programme accepts both full time and part time students. To qualify for the M.Sc. Engg. degree with specialization, a candidate must successfully complete a programme of study consisting of at least 36 credit hours, including a thesis for which a total of 18 credit hours shall be assigned. For the degree of M. Engg. a student must earn a minimum total of 36 credit hours including a project of 6 credit hours. Students for Masters programme can register on a full-time or part-time basis.

To support these programmes the Department has a team of highly qualified and professionally experienced academic

members. They regularly conduct specialized short courses and provide consultancy and advisory services. Interacting closely with industry and government bodies, they are actively engaged in research and development activities. The department is well equipped with laboratory facilities, including Concrete Laboratory, Materials and Structural Laboratory, Geotechnical Laboratory, Environmental Laboratory, Hydraulic Laboratory and Transportation Laboratory. The laboratory facilities are constantly developed and augmented to cater for increased teaching and research needs. The laboratories are well supported and managed by skilled laboratory technicians and auxiliary staffs.

CEE FACULTY

Head of the Department

Prof. Dr. A.K.M. Sadrul Islam
Ph.D. (London), M.Sc. (BUET), B.Sc. Engg. (BUET)

Professor

Prof. Dr. Md. Rezaul Karim
Ph.D. (Japan), M.Sc. (BUET), B.Sc. Engg. (BUET)

Assistant Professors

Dr. Shakil Mohammad Rifaat
Ph.D. (Calgary), M.Sc. (NUS), B.Sc. Engg. (BUET)

Dr. Md. Aslam Hossain
Ph.D. (NUS), B.Sc. Engg. (BUET)

Dr. Md. Jahidul Islam
Ph.D. (NUS), B.Sc. Engg. (BUET)

Lecturers

Shakil Ahmed
B.Sc. Engg. (BUET)

Md. Mosabbir Pasha
B.Sc. Engg. (IUT)

Tanvir Ahmed
B.Sc. Engg. (IUT)

Aziz Hasan Mahmood
B.Sc. Engg. (IUT)

Ijaj Mahmud Chowdhury
B.Sc. Engg. (IUT)

COURSE STRUCTURE for B.Sc. in Civil Engineering Programme

L = Lecture, P = Practical

First Semester

Course Number	Course Title	Contact Hours	Credit Hours
		L - P	
Math 4103	Mathematics I	3	3
Phy 4103	Physics I	3	3
Chem 4103	Chemistry	3	3
CEE 4191	Computer Programming and Applications	2	2
CEE 4101	Surveying	4	4
TVE 0107	Islamiat	2	2
TVE 0102	Spoken Arabic I	2	1
	Or		
TVE 0104	Spoken English I		
	Or		
TVE 0106	Spoken French I		
Phy 4104	Physics I Lab	1.5	0.75
Chem 4104	Chemistry Lab	1.5	0.75
CEE 4108	Civil Engineering Drawing I	3	1.5
CEE 4192	Computer Programming and Applications lab	3	1.5
	Total L- P	**17 11**	**22.5**
	Total Hours	**30**	

Second Semester

Course Number	Course Title	Contact Hours	Credit Hours
		L - P	
Math 4203	Mathematics II	3	3
Phy 4203	Physics II	3	3
Chem 4203	Chemistry of Engineering Materials	3	3
CEE 4201	Analytic Mechanics	3	3
TVE 0207	Islamic History & Culture	3	3
TVE 4249	Technology, Environment and Society	3	3
Phy 4204	Physics II Lab	1.5	0.75
Chem 4204	Chemistry of Engineering Materials Lab	1.5	0.75
TVE 0202	Spoken Arabic II	2	1
	or		
TVE 0204	Spoken English II		
	or		
TVE 0206	Spoken French		
CEE 4200	Civil Engineering Drawing II	3	1.5
CEE 4210	Workshop Practice	3	1.5
CEE 4202	Practical Surveying*		1.5
	Total L – P	**18 11**	**25.0**
	Total Hours	**29**	

*2 weeks of field works

Third Semester

Course Number	Course Title	Contact Hours		Credit Hours
		L - P		
Math 4303	Mathematics III	4		4
CEE 4303	Engineering Geology & Geomorphology	3		3
CEE 4311	Mechanics of Solids I	3		3
CEE 4321	Fluid Mechanics	3		3
EEE 4325	Electrical & Electronic Tech.	3		3
CEE 4331	Ecology and Environment	2		2
CEE 4302	Mechanics of Solids Lab		3	1.5
CEE 4312	Quantity Surveying		3	1.5
CEE 4322	Fluid Mechanics Lab		3	1.5
EEE 4326	Electrical & Electronic Tech. Lab		1.5	0.75
	Total L – P	**18**	**10.5**	**23.25**
	Total Hours	**28.5**		

Fourth Semester

Course Number	Course Title	Contact Hours		Credit Hours
		L - P		
Math 4403	Mathematics IV	3		3
CEE 4413	Mechanics of Solids II	3		3
CEE 4401	Construction Materials	3		3
CEE 4423	Hydrology	3		3
CEE 4431	Water Supply Engineering	3		3
CEE 4441	Soil Mechanics	4		4
CEE 4402	Materials Lab		3	1.5
CEE 4400	Details of Construction		3	1.5
Math 4404	Mathematics Practice IV		1.5	0.75
CEE 4442	Geotechnical Engineering Lab		3	1.5
	Total L – P	**19**	**10.5**	**24.25**
	Total Hours	**29.5**		

Fifth Semester

Course Number	Course Title	Contact Hours		Credit Hours
		L - P		
CEE 4511	Design of Concrete Structures I	3		3
CEE 4513	Structural Analysis and Design I	4		4
CEE 4521	Open Channel Flow	3		3
CEE 4531	Wastewater Engineering and Environmental Sanitation	3		3
CEE 4523	Irrigation and Drainage Engineering	3		3
CEE 45xx	Elective/Specialization Subject	3		3
CEE 4522	Open Channel Flow Lab		3	1.5
CEE 4532	Environmental Engineering Lab		3	1.5
TVE 4572	Technical Report Presentation		2	1
	Total L – P	**19**	**8**	**23**
	Total Hours	**27**		

Elective courses:

1. CEE 4515: Design of Steel Structures
2. CEE 4525: Ground Water Engineering
3. CEE 4533: Solid and Hazardous waste management
4. CEE 4541: Subsurface soil investigation and in-situ testing.

Sixth Semester

Course Number	Course Title	Contact Hours		Credit Hours
		L	**P**	
CEE 4613	Design of Pre-stressed Concrete Structures	3		3
CEE 4641	Foundation Engineering	3		3
CEE 4651	Transportation Engineering and Traffic Design	3		3
CEE 4611	Design of Concrete Structures II	3		3
TVE 4649	Social Studies and Accountancy	3		3
CEE 46xx	Elective/Specialization Subject	3		3
CEE 4612	Structural Analysis and Design Sessional I		3	1.5
CEE 4614	Design of Concrete Structures Sessional		3	1.5
CEE 4652	Transportation Engineering Sessional I		3	1.5
	Total L – P	**18**	**9**	**22.5**
	Total Hours	**27**		

Elective courses:

1. CEE 4615: Construction Technology
2. CEE 4623: Hydraulic Structures
3. CEE 4643: Soil Improvement
4. CEE 4655: Transportation data analysis.

Seventh Semester

Course Number	Course Title	Contact Hours	Credit Hours
		L - P	
CEE 4700	Project and Thesis I	6	3
CEE 4701	Professional Practices and Communication	2	2
CEE 4711	Structural Analysis & Design II	3	3
CEE 4731	Environmental Pollution and its Control	3	3
MCE 4717	Engineering Economy	2	2
TVE 4749	Science, Technology & Islam	2	2
CEE 47xx	Elective Subject	3	3
CEE 4712	Structural Analysis & Design Sessional II	3	1.5
CEE 4790	Industrial Training		1
	Total L – P	**15 9**	**20.5**
	Total Hours	**24**	

Elective courses:

1) CEE 4713: Finite Element
2) CEE 4723: River Engineering and flood mitigation
3) CEE 4731: Industrial wastewater engineering
4) CEE 4733: Energy and Environment
5) CEE 4741: Earth retaining Structures
6) CEE 4753: Highway Drainage and Airports

Eighth Semester

Course Number	Course Title	Contact Hours	Credit Hours
		L - P	
CEE 4800	Project & Thesis II	6	3
CEE 4803	Socio Economic Aspects of Development Projects	2	2
CEE 4821	Integrated Water Resources Management	3	3
CEE 4831	Environmental Impact Assessment	2	2
CEE 4851	Highway Design and Railways	3	3
CEE 4801	Project Planning & Management	3	3
CEE 48xx	Elective Subject	3	3
CEE 48xx	Elective Sessional	3	1.5
	Total L – P	**16 9**	**20.5**
	Total Hours	**25**	

- **Elective Courses (Subject):**

1) CEE 4813: Dynamics of Structures
2) CEE 4823: Coastal Engineering and Management
3) CEE 4833: Environmental Economics
4) CEE 4835: Environmental Modeling
5) CEE 4837: GIS application in Environmental Engineering
6) CEE 4843: Slope Stability
7) CEE 4853: Transportation Projects and operations

- **Elective Courses (Sessional):**

1) CEE 4832: Environmental Engineering Design Sessional
2) CEE 4842: Geotechnical Engineering Design Sessional
3) CEE 4852: Transportation Engineering Design Sessional
4) CEE 4822: Water resource Engineering Design Sessional

COURSE CONTENTS FOR UNDERGRADUATE PROGRAMME

CEE 4101: Surveying 4-0 Credit 4.00

Reconnaissance survey; linear measurements; traverse survey; leveling and contouring; calculation of areas and volumes; problems on heights and distances; curves and curve ranging, transition curve, vertical curves. Tachometry: introduction, principles and problems on tachometry. Astronomical surveying: definition, instruments, astronomical corrections, systems of time. Photogrametry: introduction of terrestrial photography, aerial photography, reading of photo mossaic, scale; project surveying; errors in surveying; remote sensing; introduction to global positioning system (GPS).

Math 4103 Mathematics I 3-0 Credit 3.00

Matrices: Definition of different kinds of matrices. Algebra of matrices. Inverse of matrix. Rank and elementary transformation of matrices. Solution of system of linear equations. Eigen values and eigen vectors. Cayley-Hamilton theorem.
Vector Algebra: Scalar, vector and their representation to physical quantities. Dot and cross products and their application. Triple and multiple product
Differential calculus: Definition and concept of limit, continuity and differentiability of function. Differentiation of different functions. Successive differentiation. Expansion of function by different theorems, Tangent and normal. Maxima and minima, Determination of curvature and their properties. Curve tracing. Partial differentiation.

CEE 4108: Civil Engineering Drawing I 0-3 Credit 1.50

Lines and lettering; plane geometry; drawing of linear and curve geometric figures, e.g. pentagon, hexagon, octagon, ellipse, parabola, hyperbola; solid geometry; concept of isometric view and oblique, theory of projections; drawing of isometric view of 3D objects such as cube, prism, pyramid, cone and cylinder; projection of cube, pyramid, cone, cylinder; developments of cubes, pyramid, cone, cylinder; plan, elevations and section of one storied and duplex building.

CEE 4191: Computer Programming and Applications **2-0** **Credit 2.00**

Introduction to Computers and Programming Languages, Introduction to C and C++ Programming Language, Programming Exercises, Calculations Using MATLAB.

CEE 4192: Computer Programming and Applications Practice Lab **0-3** **Credit 1.50**

Solving of Problems through Computer Praogrammimg Using Microcomputers and Workstations.

CEE 4201: Analytic Mechanics **3-0** **Credit 3.00**

Coplanar and non-coplanar force systems, moments; analysis of two dimensional frames and trusses; friction; flexible chord, centroids of lines, areas, and volumes; moments of inertia of areas and masses; plane motion; principles of work and energy; impulse and momentum; virtual work principle for rigid bodies.

CEE 4200: Civil Engineering **0-3** **Credit 1.50**

Introduction to computer usage; introduction to CAD packages and computer aided drafting; drawing editing and dimension of simple objects; plan, elevations and sections of multi storied buildings; reinforcement details of beam, slabs, stairs etc., plan and section of septic tank; detailed drawings of roof trusses; plans, elevations and sections of culverts, bridges and other hydraulic structures; drawings of building services.

CEE 4202: Practical Surveying

Credit 1.50

Two weeks of field work based on CEE 4201

Math 4203: Mathematics II 3-0 Credit 3.00

Integral Calculus: Integration by parts. Standard integrals. Integration by the method of successive reduction. Definite integrals. Beta function. Gamma function, Multiple integrals.
Ordinary differential equation: Formation of differential equations. Solution of first order differential equations by various methods. Solution of differential equation of first order but higher degrees. Solutions of general linear differential equations of second and higher order with constant co-efficients. Solution of Euler's homogeneous linear differential equations.

Phy 4203: Physics II 3-0 Credit 3.00

Electricity and Magnetism: Electric charge, Coulomb's law, electric field and electric field strength, Electric dipole, Gauss' law, Electric potential, Capacitance, Dielectrics and Gauss' law, Current electricity, Magnetic effect of current, Magnetic induction, Magnetic force on moving charges, Torque on a current carrying loop, Biot and Savart's law, Ampere's law, Faraday's laws of electro-magnetic induction, Lenz's law, Magnetic properties of matter.
Modern Physics : Special theory of relativity, Michelson-Morley experiment, Lorentz transformations, Consequence of special theory of relativity, Mass-energy relation, Photo-electric effect, Compton effect, Dual aspect of matter, de-Broglie waves, Schrodinger equation, Radioactivity, Atomic nucleus, Alpha, beta and gamma rays.
Structure of Matter: State of Matter, Classification of solids, Different types of bonds in Solids, X-rays, X-ray diffraction-Bragg's law, Metal, insulator and semi-conductor, Statistical mechanics.

Chem 4203: Chemistry of Engineering Materials **3-0** **Credit 3.00**

Chemical treatments of boiler feed water and water for other industrial applications, Corrosion and its control; definition, classification, importance, various forms, theories of corrosion, bimetallic corrosion, stray current corrosion, corrosion control; by design, material selection, inhibitors, Cathodic protection, applying various coatings; Classification of engineering materials; their different properties, composite materials, structure of solids; types of solids, crystal structure, different crystal systems, packing of atoms, solid state defects; Insulator, semiconductor. Cement: types, portland cement, raw materials, methods of manufacture, setting and hardening, Glass: properties of glass, raw materials, methods of manufacture, chemical reactions in furnace, some special glasses. Ceramics: classification, properties, raw materials, manufacturing process; Refractories: definition, classifications, characteristics, raw materials, fire clay bricks, its manufacture and uses; Lubricants: functions, classification, Polymer: classification, different polymerization processes, important plastics and their uses; Natural and synthetic rubber; compounding of rubber, vulcanization.

Phy 4204: Physics II Lab **0-1.5** **Credit 0.75**

Laboratory Experiments, studies based on Phy 4203.

Chem 4204: Chemistry of Engineering Materials Lab **0-1.5** **Credit 0.75**

Laboratory Experiments, studies and visits to industrial units based on Chem 4203.

CEE 4210: Workshop Practice **0-3** **Credit 1.50**

Carpentry shop, Machine shop and Welding shop sessional

Carpentry shop (3/2 hrs/week)
Wood working tools; Wood working machine: Band saw, scroll saw, circular saw, jointer, thickness planer, disc sander, wood lathe; Types of sawing; Common cuts in wood works; Types of joint; Defects of timber: Natural defects and artificial defects; Seasoning; Preservation; Substitute of timber; Commercial forms of timber. Characteristics of good timber; Use of fastening; Shop practice: Practical job, planning and estimating of a given job.

Machine shop (3/4 hrs/week)
Kinds of tools; Common bench and hand tools; Marking and layout tools, measuring tools, cutting tools, machine tools, bench work with job. Drilling, Shapar, Lathe and Milling Machines: Introduction, type, size and capacity, uses and applications.

Welding shop (3/4 hrs/week)
Methods of metal joints: Riveting, grooving soldering, welding; Types of welding joints and welding practice; Position of arc welding and polarty: Flat, vertical, horizontal, overhead; Electric Arc welding and its machineries; Welding of different types of materials: Low carbon steel, cast iron, brass, copper, stainless steel, aluminium; Types of electrode, fluxes and their composition; Arc welding defects; Test of Arc welding: Visual, destructive and non-destructive tests. Types of gas welding system and gas welding equipment; Gases and types of flame; welding of different types of materials; Gas welding defects; test of gas welding.

CEE 4302: Mechanics of Solids Lab **0-3** **Credit 1.50**

Tension, direct shear and impact tests of mild steel specimen, compression test of timber specimen, slender column test; static bending test; hardness test of metals; helical spring tests; determination of shear centre; load-deflection behavior of simple beam.

CEE 4303: Engineering Geology & Geomorphology **3-0** **Credit 3.00**

Minerals; identification of minerals, common rock forming minerals; physical properties of minerals; mineraloids rocks; types of rocks, cycle of rock change; earthquake and seismic map of Bangladesh.

Structural geology; faults; types of faults; fold and fold type; domes; basins; erosional process; quantitative analysis of erosional land forms. Channel development; channel widening; valley shape; stream terraces; alluvial flood plains; deltas and alluvial fans; channel morphology; channel patterns and the river basin; geology and geomorphology of Bangladesh.

Math 4303: Mathematics III 4-0 Credit 4.00

Vector Calculus: Formal definition of differentiation and integration and their elementary application to geometry and mechanics. Scaler point function and vector point function. Definition and physical interpretation of gradient of scalar function, divergence and curl of a vector function. Vector formula. Theorems of Gauss. Green and stokes.

Partial differential equations: Introduction, Equation of the linear and non-linear first order. Standard forms. Linear equations of higher order. Equations of the second order with variable coefficients.

Numerical Analysis: Concept of Simple difference and divided difference and their relation. Newtons forward and backward interpolation formula. General interpolation formula of Newtons and Langrange. Langrange's inverse interpolation formula. Inverse interpolation by successive approximation. Numerical differentiation. Numerical integration. General quadrature formula for equidistant ordinates. Simpson's rule, Weddles rule, Trapezoidal rule and their comparative study. Gauss quadrature formula. Study of least square principle and its application in curve fitting. Solution of algebraic and transcendental equation by graphical method and Newton-Raphson method. Newton-Raphson method for the solution of simultaneous equations. Numerical solution of simple first order differential equation by Euler's method, Picards method and Runge-kutta method

CEE 4311: Mechanics of Solids I 3-0 Credit 3.00

Concepts of stress and strain, constitutive relationships; deformations due to tension, compression and temperature change; beam statics: reactions, axial force, shear force and bending moments; axial force, shear force and bending moment diagrams using method of section and summation approach; elastic analysis of circular shafts, solid non-circular and thin walled tubular members subjected to torsion; flexural and shear stresses in beams; shear centre; stress transformation.

CEE 4312: Quantity Surveying 0-3 Credit 1.50

Analysis of rates; detailed estimate of all items of work of a building, bridge, truss, highway. Specifications of materials for the above constructions.

CEE 4321: Fluid Mechanics 3-0 Credit 3.00

Development and scope of fluid mechanics; fluid properties; fluid statics; kinematics of fluid flow; fluid flow concepts and basic equations- continuity equation, Bernoulli's equation, energy equation, momentum equation and forces in fluid flow. Similitude and dimensional analysis. Steady incompressible flow in pressure conduits; laminar and turbulent flow; general equation for fluid friction. Empirical equations for pipe flow. Minor losses in pipe flow. Fluid measurement: pitot tube, orifice, mouthpiece, nozzle, venturimeter, weir. Pipe flow problems- pipes in series and parallel, branching pipes, pipe networks.

CEE 4322: Fluid Mechanics Lab 0-3 Credit 1.50

Center of pressure; proof of Bernoulli's theorem; flow through venturimeter; flow through orifice; coefficient of velocity by co ordinate method; flow through mouthpiece; flow over V- notch; flow over sharp crested weir; fluid friction in pipe.

CEE 4331: Ecology and Environment 2-0 Credit 2.00

Ecology: Concept, definition, and components of ecology. Ecosystem: Concept, principles, structure and functioning of ecosystem; Types of ecosystem; Energy and Materials flow in ecosystem; Food chain, biodiversity and stability in ecosystems. Biochemical cycles: Carbon cycle, nitrogen cycle, sulfur cycle and phosphorous cycle, cycle of trace elements. Population dynamics and carrying capacity. Environment: Introduction to environment; components of the environment; environmental resources; environment-human interaction and environmental degradation; Environmental pollution; Environmental conservation. Global environmental concerns: Climate change, ozone layer depletion, global warming and green house effects, sea level rise, El nino, La nino.

CEE 4400: Details of Constructions 0-3 Credit 1.50

Foundations; different types of foundations; brick masonry; framed structures and bearing walls; arches and lintels; details of floors and roofs; pointing; plastering and interior finishing; scaffolding, staging; shoring and underpinning; thermal insulation and acoustics; House plumbing.

CEE 4401: Construction Materials 3-0 Credit 3.00

Properties and uses of bricks, efflorescence; cement, cement chemistry, aggregates, cement and lime mortars, concrete, standard tests of bricks, Cement and concrete, salinity problem in concrete, corrosion and its prevention, paints, varnishes, metallic coating. Design of concrete mixes; atomic structure and bonding; crystal structures, mechanical properties, yielding, fracture, elasticity, plasticity, properties and uses of rubber, timber and plastics. Concrete for special purposes. Ferrocement.

CEE 4402: Materials Lab 0-3 Credit 1.50

Test for specific gravity. Unit weight and voids in aggregates; moisture content and absorption of coarse and fine aggregates; normal consistency and initial setting time of cement; direct tensile and compressive strengths of cement mortar; gradation of coarse and fine aggregates; design and testing of a concrete mix.

Math 4403 Mathematics IV 3-0 Credit 3.00

Statistics: Measures of central tendency and standard deviation. Moments, Skewness and Kurtosis. Elementary probability theory and discontinuous probability distribution. Continuous probability distributions, e.g. normal and exponential. Hypothesis testing and regression analysis.
Laplace transform: Laplace transformation and application. Use of laplace transformation in solution of ordinary and partial differential equation.
Series solution, Bessel function, Legendre function, Fourier series, even and odd functions. Fourier integral, Fourier transform and their uses in solving boundary value problems.

CEE 4413: Mechanics of Solids II 3-0 Credit 3.00

Symmetric and un-symmetric bending of beams; failure criteria; thin walled pressure vessels; beam deflection by direct integration and moment area method; buckling of columns; elastic strain energy and external work; cable and cable supported structures; bolted and welded joints.

CEE 4423: Hydrology 3-0 Credit 3.00

Hydrologic cycle; weather and hydrology; precipitation, evaporation and transpiration; infiltration; stream flow; rainfall-runoff relations; hydrographs, unit hydrographs; hydrologic routing; application of telemetry and remote sensing in hydrologic data acquisition; statistical methods in hydrology.

CEE 4431: Water Supply Engineering 3-0 Credit 3.00
Water Supply Engineering: introduction; water demands; water sources; ground water exploration: aquifer properties and ground water flow, well hydraulics, water well design, drilling, construction and maintenance; water demand for rural communities; shallow hand tube wells and deep set Tara pumps for problem areas. Rainwater harvesting. Surface water collection and transportation. Pumps and pumping machinery.

Water quality: Impurities in water; important water quality parameters; Guidelines and Standards for drinking water. Water treatment: plain sedimentation, flocculation and settlement, filtration, disinfecting; miscellaneous treatment methods; Low cost treatment methods for rural communities. Water distribution system: analysis and design of distribution network; Fire hydrants; Water meters; Leak detection; Unaccounted-for water. Water Safety Plan.

CEE 4441: Soil Mechanics 4-0 Credit 4.00

Introduction to geotechnical engineering; formation, type and identification of soils; soil composition; soil structure and fabric; index properties of soils; engineering classification of soils; soil compaction; principles of total and effective stresses; permeability and seepage; stress-strain-strength characteristics of soils; compressibility and settlement behaviour of soils; lateral earth pressure; stress distribution.

CEE 4442: Geotechnical Engineering Lab 0-3 Credit 1.50

Field identification tests; grain size analysis by sieve and hydrometer; specific gravity test; Atterberg limits test; permeability tests; unconfined compression test; compaction test; relative density test; direct shear tests; consolidation tests.

CEE 4511: Design of Concrete Structures I 3-0 Credit 3.00

Fundamental behaviour of plain & reinforced concrete; Introduction to WSD and USD methods; Analysis and design of singly reinforced, doubly reinforced and T- beams according to strength design method; Shear, diagonal tension and torsion of beams; Bond & anchorage; Design of one-way slabs.

CEE 4513: Structural Analysis and Design I 4-00 Credit 4.00

Stability and determinacy of structures: analysis of statically determinate trusses and arches; influence lines; moving loads on beams and trusses; analysis of suspension bridge.

Wind and earthquake loads; approximate analysis of statically indeterminate structures, e.g. braced trusses and multi storied building frames (portal and cantilever menthod for lateral load analysis and approximate method for vertical load analysis); deflection of beams, trusses and frames by virtual work method.

CEE 4521: Open Channel Flow 3-0 Credit 3.00

Open channel flow and its classification. Velocity and pressure distributions. Energy equation, specific energy and transition problems. Critical flow and control. Principles of flow measurement and devices . Concept of uniform flow, Chezy and Manning equations, estimation of resistance coefficients and computation of uniform flow. Momentum equation and specific momentum. Hydraulic jump. Theory and analysis of gradually varied flow. Computation of flow profiles. Design of channels.

CEE 4522: Open Channel Flow Lab 0-3 Credit 1.50

Broad crested weir. Sluice gate. Venturi flume. Parshall flume. Cut throat flume. Hydraulic jump. Velocity distribution profile. Manning's roughness coefficient. Specific force and specific energy.

CEE 4523: Irrigation and Drainage Engineering 3-0 Credit 3.00

Importance of irrigation; sources and quality of irrigation water; soil-water relationship; consumptive use and estimation of water requirements; methods of irrigation; design of irrigation canal systems; irrigation structures; irrigation pumps; problems of irrigated land; irrigation water management; importance of land drainage; drainage systems and design.

CEE 4531: Wastewater Engineering and Environmental Sanitation 3-0 Credit 3.00

Sewage Sanitation: Estimation of sewage; Collection and transportation of sewage; Characteristics of sewage; Preparatory, primary and secondary treatment of sewage; Sewage disposal; Treatment of industrial wastewater, treatment and disposal of sludge.

Sanitation of low-income communities: on-site sanitation systems; septic tank and soakwell/subsurface drainage systems, small-bore sewer system.
Refuse (Solid Wastes) sanitation: sources, type and characteristics of refuse; generation of wastes; collection and transportation; resource recovery and recycling; incineration; composting; disposal in landfills.
Air pollution and control, indoor sanitation, food sanitation and sanitation of public places.

CEE 4532 Environmental Engineering Lab **0-3** **Credit 1.50**

Physical, chemical and bacteriological analysis of water and wastewaters.

CEE 4611: Design of Concrete Structures II **3-0** **Credit 3.00**

Design of two-way edge supported slabs using strip and alternate methods; Reinforced concrete floor & roof systems; yield line methods; Design of column supported slabs; Introduction to slender columns; design of columns under uni-axial and bi-axial loading; Design of footings, pile cap, and retaining walls; Seismic detailing; Shear wall.

CEE 4612: Structural Analysis and Design Sessional I **0-3** **Credit 1.50**

Analysis and design problems; design of members and connection of steel structures; e.g. trusses and plate girders; use of software in analysis and design problems.

CEE 4613: Design of Pre-stressed Concrete Structures **3-0** **Credit 3.00**

Prestressed concretes: materials; prestressing systems; loss of prestress; analysis of sections for flexure, shear, bond and bearing; beam deflections and cable layout; partial prestress. Design of prestressed sections for flexure, shear, bond and bearing.

CEE 4614: Design of Concrete Structures Sessional **0-3** **Credit 1.50**

Use of structural analysis and design software; analysis and design problems based on CEE4511 and CEE 4611; design of a slab bridge, simple girder bridge and a low-rise building.

CEE 4641: Foundation Engineering **3-0** **Credit 3.00**

Soil investigation techniques; settlement computation; types of foundations; bearing capacity of shallow and deep foundations; settlement and distortion of foundations; design and construction of footings, rafts and piles; slope stability analyses.

CEE 4651: Introduction to Transportation Engineering & Traffic Design **3-0** **Credit 3.00**

Introduction to transportation engineering; development of transportation systems; elements of transportation system; transportation in Bangladesh; modal share; transportation planning concepts: collection, study and analysis of basic data; highway location and surveys; geometric design of highways: elements of design, cross-section elements, curves and sight distances; road intersections; traffic engineering: the road/traffic system, vehicle and traffic characteristics, traffic control devices, traffic studies, parking and roadway lighting; waterways and terminals.

CEE 4652: Transportation Engineering Sessional I **0-3** **Credit 1.50**

Tests on bituminous materials, tests on subgrade, subbase and base materials; mix design; roadway capacity studies.

CEE 4700: Project and Thesis I 0-6 Credit 3.00

Experimental and theoretical investigation of various topics in structural engineering, concrete technology, environmental engineering, transportation engineering and geotechnical engineering. Individual or group study of one or more topics from any of the above fields. The students will be required to submit thesis/project report at the end of the work.

CEE 4701: Professional Practices and Communication 2-0 Credit 2.00

The project cycle; project proposal; contractual provisions; techniques of specification writing; evaluation of bids; project evaluation.
Interpretation of literature, documents etc.; communicating; preparation of report; industrial and labour relations; professional ethics in Civil Engineering.

CEE 4711: Structural Analysis and Design II 3.00 Credit 3.00

Analysis of statically indeterminate beams and frames by moment distribution, consistent deformation/flexibility and stiffness methods; Algorithms for implementing direct stiffness method in a computer; influence lines of statically inderminate beams and frames.

CEE 4731: Environmental Pollution & Its Control 3-0 Credit 3.00

Water pollution: Sources and types of pollutants; Dissolved oxygen models and waste assimilation capacity of water bodies/streams; Industrial pollution; Groundwater pollution; Marine pollution; Pollution control measures; Water quality monitoring and management. Air pollution: Sources and types of pollutants; Effects on health, properties and plants;
Air pollution monitoring and control measures. Sources, effects and control of noise pollution; Sources, effects, control of thermal pollution; Soil pollution, control and remediation.

CEE 4712: Structural Analysis **3-0** **Credit 1.50**

Use of structural analysis and design software; design of various reinforced concrete structures, e.g. buildings, water towers, folded plate roof.

CEE 4790: Industrial Training **Credit 1.00**

CEE 4800: Project and Thesis II **0-6** **Credit 3.00**

Continuation of the Project

CEE 4801: Project Planning and Management **3-0** **Credit 3.00**

Principles of management; principles of construction management; construction contracts and specifications; inspection and quality control; construction safety; construction planning and scheduling: PERT, CPM, case studies, resource scheduling; PERT: a cost accounting system, linear programming. Psychology in administration; materials management; demand forecasting; inventory control; stores management; procurement. Project planning and evaluation; feasibility reports, cash flow, pay back period, internal rate of return. Benefit-cost ratio, construction equipments and plants. Replacement studies.

CEE 4803: Socioeconomic Aspects of Development Projects **2-0** **Credit 2.00**

Economic and social structure; development and economic growth; socio-economic indicators; population, prosperity and poverty; employment of workforce; population displacement; rehabilitation strategy; productivity, landloss, landuse and land ownership patterns; fisheries and aquaculture; deforestation and afforestation; communication, commerce, industries and other economic benefits; water supply, sanitation, health and nutrition; inequalities in distribution of benefits and losses; socio-economic survey; case studies.

CEE 4821: Integrated Water Resources Management **3-0** **Credit 3.00**

Introduction to IWRM and Climate Change, Drivers and Impacts of Climate Change, Impacts of Climate Change on water uses, Strategy development and planning for adaptation in the context of IWRM, IWRM and Conflicts Resolution, Water Agreements, Implication for IWRM.

CEE 4831: Environmental Impact Assessment **2 -0** **Credit 2.00**

Definition, aims and objectives of Environmental Impact Assessment (EIA); Environmental issues in development projects; EIA in the project cycle; Project screening; Initial Environmental Examination (IEE); EIA Methodologies; Impact identification, prediction, analysis and evaluation; Scooping and people's participation in EIA; Environmental Impact Statement (EIS); Environmental Management Plan(EMP); Environmental monitoring and post development audit; EIA Guidelines of developing countries and donor agencies; Organization of EIA. Case studies.

CEE 4851: Highway Design & Railways **3-0** **Credit 3.00**

Highway materials; subgrade, subbase and base courses; soil stabilization and soil aggregates in road constructions; low-cost roads; production, properties and uses of bituminous materials and mix design methods; design, construction and maintenance of flexible and rigid road pavements; equipments; railways: general requirements, alignment, permanent way, station and yards, signalling, points and crossings, maintenance.

Specilalization/ Elective Courses 5th & 6th Semester

CEE 4515: Design of Steel structures 3-0 Credit 3.00

Behaviour of structural steel members and steel frames; code requirements; design of tension and compression members by WSD and LFD methods; design of beam, beam-columns; Joint design.

CEE 4525: Groundwater Engineering 3-0 Credit 3.00

Groundwater in hydrologic cycle and its occurrence; Physical properties and principles of groundwater movement; groundwater and well hydraulics; hand, shallow, deep set shallow and deep tube wells; their design, drilling, construction and maintenance; groundwater resource evaluation; groundwater levels and environmental influences; water mining and land subsidence; groundwater pollution and contaminant transport; recharge of groundwater; saline water intrusion in aquifers; groundwater management; groundwater exploration.

CEE 4533: Solid and Hazardous Waste Management 3-0 Credit3.00

Solid wastes: Sources and types of solid wastes; Physical and chemical properties of solid wastes; Solid wastes generation; Collection of solid wastes; Community participation in solid waste collection; Transfer and transport; On-site handling and shorting; Volume reduction and recycling; Recovery of resources, conversion products and energy; Final disposal of solid wastes and residual products.

Hazardous wastes: Identification and classification of hazardous wastes; Generation, on-site storage, collection and transport of hazardous wastes; Physical, chemical and biological processes of treatment; Disposal of hazardous wastes. Generation, storage, collection, treatment and disposal of hospital wastes.

CEE 4541: Sub-surface Soil Investigation and In-situ Testing **3-0** **Credit 3.00**

Soil investigation techniques: Pit sampling; Wash boring; Borehole stability; borehole logging; sample quality, preservation, transportation, preparation for testing; stress release effects; Standard Penetration tests; Cone penetration tests; Pressure meter tests; Vane shear tests; Plate load tests; field permeability tests; installation of settlement plates, slope indicators etc. Subsoil exploration program; interpretation of topographic, geological and agricultural soil maps; Soil investigation report writing.

CEE 4615: Construction Technology 3-0 Credit 3.00

Construction contracts; value engineering in construction; project network analysis (CPM); selection of construction equipment; fundamentals of earth moving; soil stabilization and compaction; tractor and related equipment; scrapers; excavating equipment; trucks and wagons; operation analyses; belt-conveyor systems; compressed air; drilling rock and earth; blasting rocks; tunneling; foundation grouting; pile and pile driving equipment; pumping equipment; production of crushed-stone aggregates; concrete technology; scaffolding and form works.

CEE 4623: Hydraulic Structures 3-0 Credit 3.00

Types of hydraulic structures; principles of design; design of different types of hydraulic structures: regulators; dams; barrages; cross- drainage works; pump house, etc.

CEE 4643: Soil Improvement 3-0 Credit 3.00

Field and laboratory compaction; compaction equipment and methods; methods of stability analysis; stability analysis for static and dynamic forces; seepage in composite sections; piping; pinhole test; core design; measurement of performance; construction control of embankments; ground improvement methods; field instrumentations: installation of piezometers, settlement plates, inclinometers; maintenance of dams and embankments.

CEE 4655: Transportation Data Analysis **3-0** **Credit 3.00**

Descriptive Statistics, Presenting Data, Discrete Probability Distributions, Continuous Probability Distributions, Interval Estimation, Hypothesis Testing, Population Comparison, Testing Goodness of Fit, Linear Regression, Count Data Models, Discrete Outcome Models, Non Parametric Statistics

Specialization/ Elective courses **7th & 8th Semester**

CEE 4713: Introduction to Finite Element Method **3-0** **Credit 3.00**

Introduction to finite element method as applied to Civil Engineering problems. One dimensional stress deformation and time dependent flow problem. Two dimensional plane stress and plane strain analysis of stress deformation problems.

CEE 4723: River Engineering and Flood Mitigation **3-0** **Credit 3.00**

Behavior of alluvial rivers; river pattern and morphological processes; river training and bank protection works; navigation and dredging; sediment movement in river channels, bed forms and flow regimes; flood and its causes; methods of flood management; structural and non structural measures such as reservoirs, levees and flood walls, channel improvement, interior drainage, flood ways, land management, flood proofmg, flood zoning, flood hazard mapping, flood forecasting and warning; flood damage in urban and rural areas.

CEE 4731: Industrial Wastewater Engineering 3-0 Credit 3.00

Characteristics and volume of industrial wastewater; Estimation of pollution load; Environmental chemistry and microbiology; Physical, chemical and biological treatment of industrial wastewater; Problems associated with treatment of wastewaters from different industries; toxicity and biodegradability; Treatment and disposal of sludges; Advanced treatment process: Electrochemical processes, membrane bio-reactors, sequential batch reactor etc.; Tertiary treatment; Resources recovery, reuse and recycling of industrial wastewater; Zero-discharge technologies.

CEE 4733: Energy and Environment 3-0 Credit 3.00

Introduction: Definition, classification and sources of energy, importance and use of energy, renewable and non-renewable energy, transformation of energy; Fossil fuel: Sources, exploration, abstraction and related environmental problems, burning of fossil fuel and emission of pollutants, acid rain and transboundary effects; Nuclear energy- environmental problems and safety associated nuclear power plants; Environmental issues related to Solar and geothermal energy, hydro, tidal and wind power energy; Energy consumption, emission of green-house gases, climate change and international initiatives to combat climate change; Energy policies.

CEE 4741: Earth Retaining Structures 3-0 Credit 3.00

Fundamentals of earth pressure and classical methods of analysis; Braced excavations; retaining walls; design of sheet piling systems; cofferdam design; reinforced earth walls; bearing capacity theories and their implication in design.

CEE 4753: Highway Drainage and Airports **3-0** **Credit 3.00**

Highways drainage and drainage structures. Evaluation and strengthening of pavements; importance, advantages and trends in air transportation; planning and design of airports; aircraft characteristics related to airport design; types and elements of airport planning studies; airport configuration; geometric design of the landing area; Terminal area; heliports; design of airport pavements; lighting, marking and signing; Airport drainage.

CEE 4813: Dynamics of Structures **3-0** **Credit 3.00**

Formulation of equation of motion; free vibration response; SDOF and MDOF systems; response to harmonic and impulse loading and vibration analysis by Rayleigh's method.

CEE 4823: Coastal Engineering and Management **3-0** **Credit 3.00**

Coast and coastal features; tides and currents; tidal flow measurement; waves and storm surges; docks and harbours; forces of waves and tides in the design of coastal and harbour structures; coastal sedimentation processes; deltas and estuaries; shore protection works; dredging and dredgers.

CEE 4833: Environmental Economics **3-0** **Credit 3.00**

Concept and systems of environmental economics; Environment, economic growth and sustainability; The economy and environment: Natural resources economics, the fundamental balance, environment as an economic and social asset; Analytical tools: Benefits and costs, supply and demand, economic efficiency and markets; Economics of environmental quality: pollution control-a general model, environmental damages, efficient level of emission, abatement cost, enforcement cost; Environmental analysis: Impact analysis, cost-effectiveness analysis, benefit-cost analysis, risk analysis; Economics of enforcement: Environmental taxes, Incentive-based strategies, emission and effluent charges, abatement subsidies; Institutional strengthening and capacity building.

CEE 4835: Environmental Modeling 3-0 Credit 3.00

Introduction, objectives and applications of environmental models; Physical, mathematical and conceptual models; Modeling parameters, model formulation, solution, calibration, verification and sensitivity analysis; Modeling of surface and ground water quality: sources and sinks of contaminants, dispersion and hydraulic transport processes, mathematical formulation, and solution techniques. Biochemical system, nutrient cycle, and ecosystem models; Air pollution models; Software based studies of environmental problems; Case studies.

CEE 4837: GIS application in Environmental Engineering 3-0 Credit 3.00

Definition of GIS, data, database and information; Techniques of data input and digitizing geographical features; Database management in GIS environment; Data manipulation techniques, sub-model formation, weighting and multi-criteria evaluation for selecting sites for establishment safeguarding environment. Mapping concepts: Definition of map and map features, characteristics of map, concept of layers, topographical maps, thematic maps, attribute information and display information. Image enhancement and image classification; Application of GIS for resources identification and environmental planning and management.

CEE 4843: Slope Stability 3-0 Credit 3.00

Methods of stability analysis: Taylor's method, Felleneous method, Bishop's methods, Morgenstern and Price's method; Stability for dynamic forces; Seepage in composite sections; Measurement of performance; construction control of embankments; field instrumentations.

CEE 4853: Transport projects and Operations **3-0** **Credit 3.00**

Highway needs study; highway planning, economics and financing; evaluation and analysis of transportation projects. management, monitoring; organization and implementation of transportation projects; selected case studies; traffic engineering administration and legislation; urban public transportation and freight movement.

CEE 4822: Water-resource Engineering Design Sessional **0-3** **Credit 3.00**

Design of hydraulic structures, river training works; groundwater resources assessment and water well design.

CEE 4832: Environmental Engineering Design Sessional **0-3** **Credit 3.00**

Design of water supply and sewerage system: estimation of industrial, domestic and fire demands, designing deep tubewell and water distribution network; estimation of industrial, domestic and commercial wastewater generation, wastewater network design; household plumbing system design; design of water and wastewater treatment plant; computer application in environmental engineering; field visit and reporting.

CEE 4842: Geotechnical Engineering Design Sessional **0-3** **Credit 3.00**

Computer aided design of foundation: footing, pile and pile cap, pier, raft/mat foundations and caisson; retaining structures: shore pile, abutment, retaining walls; reinforced soils.

CEE 4852: Transportation Engineering Design Sessional **0-3** **Credit 3.00**

Design of rigid and flexible pavement and air field pavements; geometric design: Roadway intersections design and interchanges; traffic studies.

COURSE CONTENTS FOR POSTGRADUATE PROGRAMMES

Note on Course Numbering

Each course is designated by CEE followed by four digits. The second digit of the course identifies the major field of Civil Engineering namely

1 for Courses from Structural Engineering and Construction Management
2 for Courses from Geotechnical Engineering
3 for Courses from Environmental Engineering
4 for Courses from Water Resources Engineering
5 for Courses from Transportation Engineering

The name of the degree will be as follows:

Master of Science in Civil Engineering (Structural) abbreviated as M.Sc. Engg. (Civil & Structural)
Master of Science in Civil Engineering (Geotechnical) abbreviated as M.Sc. Engg.(Civil & Geotechnical)
Master of Science in Civil Engineering (Environmental) abbreviated as M.Sc. Engg. (Civil & Environmental)
Master of Science in Civil Engineering (Water Resource) abbreviated as M.Sc. Engg. (Civil & Water Resource)
Master of Science in Civil Engineering (Transportation) abbreviated as M.Sc. Engg. (Civil & Transportation)

Master of Engineering in Civil Engineering (Structural) abbreviated as M. Engg. (Civil & Structural)
Master of Engineering in Civil Engineering (Geotechnical) abbreviated as M. Engg. (Civil & Geotechnical)
Master of Engineering in Civil Engineering (Environmental) abbreviated as M.Engg. (Civil & Environmental)
Master of Engineering in Civil Engineering (Water Resource) abbreviated as M.Engg. (Civil & Water Resource)
Master of Engineering in Civil Engineering (Transportation) abbreviated as M.Engg. (Civil & Transportation)

CEE 6101 Structural Stability and Dynamics 3-0 3 Credits

Buckling behavior of beam-column, equilibrium method; effects of imperfection; effects of end moments, shear deformation and large deformation. Slope deflection equations, energy method, approximate method. Fundamentals of structural dynamics. SDOF systems, free vibration response, forced vibration response, MDOF systems and continuous systems; undamped free vibrations. Selected advance topics.

CEE 6103 Finite Element Method 3-0 3 Credits

Introduction to finite element concepts, basic techniques, shape functions. One-dimensional elements, two-dimensional elements, strain-displacement and compatibility equations, constitutive (stress-strain) relationships. Numerical integration and modeling considerations. Weighted residual methods, Galerkin finite element method, weak formulation; three-dimensional stress analysis. Convergence and accuracy of solutions, types of error and measures of error, patch test. Solution techniques: front and band solutions, element assembly and equation solving. Computer implementation of finite element method. Field problems.

CEE 6105 Advanced Theory and Design of Steel Structure 3-0 3 Credits

Tension members - Design criteria; Compression members - Buckling of Column; Residual Stress; Column Strength curves; AISC design formulas for working stress design; Buckling of plates; Design of column as affected by local buckling. Design of laterally supported beam; Shear on beams; Biaxial bending; Stresses due to torsions; Analogy between torsion and plane bending; Design for combined procedures for laterally unsupported beams. Beam column; AISC working stress design criteria for combined bending and axial-load; Connections.

CEE 6107 Advanced Design of Concrete Structures **3-0** **3 Credits**

Review of principles; beams, slabs and columns, Design of columns; long columns, two way slab systems, grids, waffle slabs, ribbed slab, deep beams, curved beams shear walls, building frames, Design for torsion. Bulk storage structures, creep and temperature effects. Details of reinforced concrete members, Advanced problems in foundations of structures, Codes and specifications and their influence in design. An individual or group project to design a complete structural system. Prestressed concrete structures.

CEE 6109 Advance Concrete Technology **3-0** **3 Credits**

Properties of plain concrete, physico-chemical aspects of behavior; Constituent materials; Cements, hydration of cements, mineral admixtures and blended cements, chemical admixtures; Mix design of concrete, response of concrete to stress; Durability, permeability and porosity; physical and chemical deterioration. Field control and acceptance. Destructive and non-destructive testing. Concrete for special purposes, high strength concrete, lightweight concrete, cement-polymer composites, fiber-reinforced concrete.

CEE 6111 Advance Finite Element Analysis **3-0** **3 Credits**

Weak formulation and finite element concepts, degenerated beam and plate elements, nonlinear finite element formulation. Newton-Raphson and Modified Newton Raphson solution procedures. Geometric Nonlinearity- Large displacement and structural instability, Lagrangian and Eulerian approaches; Material modelling. yield criteria, plasticity, creep, elasto-plasticity, viscoplasticity, elasto viscoplasticity, modeling of reinforced concrete. Modeling of dynamic problems and solution procedure. Finite element with size effect and mesh-free methods. Students will attend the hands-on sessions, complete a finite element project and present their work in the class.

CEE 6119 Construction Project and Site Control **3-0** **3 Credits**

Concepts, methodologies and tools for project control, organization, planning and scheduling a project for execution; In-place controls for schedule and cost; Methods for managing work interfaces and improving productivity, including advanced methodologies such as lean construction, considerations in equipment selection and fleet size determination, Work improvement and optimization methods related to allocation of resources, theory of constraints and critical chain; Issues of contract management, safety, health, environment, quality and document management for proper site control.

CEE 6121 Engineering Economics & Project Evaluation **3-0** **3 Credits**

Analytical methods and techniques to evaluate projects from an economic perspective; Cost concepts; Time value of money relationships; Methods for evaluating alternatives; Inflation and foreign exchange; Depreciation and income tax; Cost estimates and sensitivity study; Handling risk and uncertainty; Equipment replacement studies; Public projects.

CEE 6123 Construction Equipment and Methods **3-0** **3 Credits**

An overview of the construction methods available in civil engineering, industrial, offshore and building type projects; planning for earthwork construction; design of formwork, trench supports and cofferdams; evaluation and selection of equipment; estimating project cost; Work improvement and optimization methods related to resource allocation, transportation, process planning and inventory; and systems analysis and optimization.

CEE 6301 Water Treatment and Process Design **3-0** **3 Credits**

Water and its impurities. Water quality standard; Planning and design consideration. Intake facilities. Conventional Water Treatment processes. Advanced water treatment process: Ion exchange, Membrane processes, Activated carbon adsorption, Desalination, Demineralization. Control of taste and odor.

CEE 6303 Municipal Wastewater Treatment and Process Design **3-0** **3 Credits**

Composition, properties and analysis of municipal wastewater. Principles of physical, chemical and biological treatment processes. Tertiary treatment of effluents. Advanced processes in anaerobic treatment and nutrient removal. Wastewater disinfection; Wastewater reclamation and reuse. Sludge treatment and disposal.

CEE 6305 Surface Water Quality Modeling **3-0** **3 Credits**

Objectives of modeling, applications; Mass balance and transport; biochemical processes and particle phenomena in natural environment; Mass loading for point source, tributary and intermittent sources; Low flow estimates, travel time and velocity estimates; Steady state stream equations; Estuarine hydrology; Distribution of water quality in rivers and estuaries, dispersion coefficients, hydraulic transport processes, mathematical formulations, water quality parameters, solution techniques, multi-dimensional models; Physical and hydrologic characteristics of lakes, lake wide response to inputs, finite segment steady state lake models, model calibration and verification, sensitivity analysis parameter estimation.

Principal components of dissolved oxygen (DO) analysis, dissolved oxygen and algal dynamics; engineering control of DO; sediment-water-pollutant interactions; modeling application to rivers and estuaries. Case studies.

CEE 6307 Contaminated Site Assessment and Remediation **3-0** **3 Credits**

Site assessment and remediation issues. Hydro-geological and geochemical aspects of site characterization. Contaminant fate and transport in the subsurface environment. Site remediation techniques. Principles and application of remedial technology.

CEE 6309 Air Quality Management 3-0 3 Credits

Classification and legislation. Atmospheric properties. Meteorological conditions, pollutants distribution and interaction. Engineered systems for removal of particulate, biological and gaseous pollutants. Indoor air quality. Monitoring and models. Global warming.

CEE 6311 GIS and Remote Sensing in Environmental Modeling 3-0 3 Credits

Definition of GIS, Necessity of GIS, Required functions for GIS, Areas of GIS application, Data Model, Geometry and topology of vector data, Topological data structure, Topological relationships between spatial objects, Geometry and topology of Raster data, Topological features of raster data, Thematic data modeling. Basic principles of remote sensing (RS) and global positioning systems (GPS): definition, data acquisition, spectral characteristics of land cover, multi-spectral analysis, image interpretation, Digital Elevation Model, surface analysis, Flood mapping, wild fire modeling, soil erosion and non-point source modeling.

CEE 6501 Highway Engineering 3-0 3 Credits

Introduction to highway planning and engineering; human factors; road vehicle performance characteristics; highway capacity and level of service; highway classification; design consistency; alignment elements, cross section elements, intersections, interchanges, traffic barriers; road safety audits. Planning and design of pedestrian/bicycle facilities. Environmental impact of highways. Explicit evaluation of safety in road design.

CEE 6503 Traffic Engineering 3-0 3 Credits

Introduction to traffic engineering, traffic stream components, traffic stream characteristics, traffic studies, data collection, speed, travel time and delay studies, speed limits and advisory speeds, accident studies, parking studies, traffic barriers, traffic noise, capacity and level of service, warrants for traffic control devices, principles of intersection signalization, actuated and pretimed signals, signal control systems, progression, traffic systems management, local area traffic management studies, intelligent transportation systems, road safety issues.

CEE 6505 Transportation Planning 3-0 3 Credits

Techniques and processes used in solving transportation problems, relationship between trip generation and land use, collection and characteristics of base year data, formulation of mathematical models to simulate existing travel patterns, forecasting procedures and evaluation of transportation systems.

CEE 6511 Introduction to Traffic Safety 3-0 3 Credits

Theory and evidence in accident analysis and prevention. Topics include Haddon's matrix, crash data analysis, traffic enforcement, road safety advertising, fleet safety, road safety audits, vehicle safety and program evaluation.

CEE 6515 Applied Probability and Statistics in Engineering 3-0 3 Credits

Review of probability theory; extreme value distributions; engineering reliability; conditional distributions; applications of common probability models; parameter estimation and confidence intervals; significance testing; elementary Bayesian analysis; simple stochastic processes.