

M.Sc. STUDY PROGRAM

DEPARTMENT OF CIVIL ENGINEERING

PROGRAM : GENERAL COURSES

Course Code	Course Title	Credit Hrs	Pre- requisite
CE501	Numerical Methods	3	
CE502	Finite Element Methods	3	CE501
CE503	Modeling and Experimental Techniques	3	
CE504	Probability and statistics for engineers	3	

1. CE501 Numerical Methods :

Digital computers, roots of algebraic equations, solution of simultaneous, algebraic equations, curve fitting, numerical integration and differentiation, boundary value problems, partial differential equations, polynomial approximation to numerical integration and differentiation.

2. CE502 Finite Element Methods :

Development of finite element methods, formulation of the problems, direct approach, variational approach, elements and interpolation functions, elasticity problems, plane stress and axisymmetric cases, applications to problems in civil engineering.

3. CE503 Modeling and Experimental Techniques :

Modeling and model analysis. loading application and loading measurements, strain and displacement measurements, data recording and analysis, calibration techniques, introduction to photoelasticity.

4. CE504 Probability and statistics for engineers:

Significance of statistics in engineering, data collection, classification, and presentation parameters of random variables, elements of probability theory, frequency analysis and parameters estimation, frequency distributions, statistical hypothesis testing, simple and multiple linear regression, applications to problems in civil engineering.

PROGRAM : STRUCTURAL ENGINEERING COURSES

Course Code	Course Title	Credit Hrs	Pre- requisite
CE521	Structural Loads and Systems	3	
CE522	Matrix Structural Analysis	3	CE501
CE523	Structural Dynamics	3	CE501
CE524	Structural Stability	3	
CE525	Theory of Plates and Shells	3	
CE526	Theory of Elasticity	3	
CE527	Fatigue and Fracture Mechanics	3	
CE528	Earthquake Engineering	3	CE501 CE523
CE529	Theory of Plasticity	3	
CE541	Concrete Technology	3	
CE542	Advanced Concrete Technology	3	CE541
CE581	Design of Reinforced Concrete Elements	3	
CE582	Prestressed Concrete	3	
CE583	Design of Bridges	3	
CE584	Advanced Steel Structures	3	
CE585	Design of Plates and Shells	3	CE525
CE586	Repair and Strengthening of Reinforced Concrete Structures	3	CE541
CE587	Cold Formed Steel Structures	3	
CE588	Design of Reinforced Concrete Structures	3	CE581

1- CE521 Structural Loads and Systems:

Loads, dead, live, wind and earthquake loading, load factors, load combinations and concept of safety factor, choice and analysis of lateral loads, resistant systems, frames, shear walls, box systems, combined systems, eccentricity and torsional effects, approximate methods of analysis for indeterminate structures.

2- CE522 Matrix Structural Analysis:

Flexibility and stiffness methods for plan and space framed structures, computer - oriented direct stiffness method, symmetry, temperature changes and prestrain, support displacement, nonprismatic members, and introduction to finite element techniques.

3- CE523 Structural Dynamics:

Analysis of single and multiple degree of freedom structure systems under steady state and transient loads, discrete and continuous systems equations of motion, energy methods, eigen values and mode shapes earthquake response.

4 - CE524 Structural Stability:

Stability criteria, buckling of elastic and inelastic columns and frames. torsional and lateral buckling. buckling of frames, plates and shells under static loads, stability of stiffened structures, effects of imperfection and boundary conditions.

5 - CE525 Theory of Plates and Shells:

Introduction to plates and shells, thin elastic plates under loading with various conditions, rectangular and circular plates, application using cartesian and polar coordinate systems, finite difference analysis methods for plates, shell- membrane and bending theory for shells of translation and revolution, domes and cylindrical shells, folded plates.

6 - CE526 Theory of Elasticity :

Analysis of stress and strain in two and three dimensions, equations of elasticity and general theorems, two dimensional problems in cartesian and polar coordinate systems, problems in flexure, torsion, stress concentration, residual stresses.

7 - CE527 Fatigue and Fracture Mechanics :

Concepts of cracking, mechanism of fracture and crack growth, elastic crack – tip stress field. the crack – tip in a plastic zone, fatigue and crack propagation, stress intensity factor, practical problems.

8- CE528 Earthquake Engineering :

Earthquake motions and structural response, seismicity, probability distributions of response spectral ordinates, response of linear and nonlinear systems, earthquake effects on reservoirs, behavior of materials and structural components, flexural members; joints, framed and continuous beams, diaphragms.

9 - CE529 Theory of Plasticity :

Stress and strain tensors, elastic stress – strain relation, criteria for yielding, plastic stress strain relations, elastoplastic problems of sphere and cylinders, plane elastoplastic problem, torsion problem, slip –line field limit analysis, creep.

10 - CE541 Concrete Technology:

Concrete constituent materials, types of cement, aggregate coarse and fine, water and admixtures, fresh concrete, workability control methods, problems of bleeding, creep, shrinkage and plastic settlement, curing methods, placing method, sampling and testing. hardening concrete, properties, destructive and non- destructive testing laboratory and in site.

11 - CE542 Advanced Concrete Technology :

Temperature problems in concreting, concreting under extreme environmental conditions, development of strength, permeability and durability, compliance with specifications (quality control), admixtures special types of concretes and concreting techniques , current concrete mix design methods.

12 - CE581 Design of Reinforced Concrete Elements :

General review of R/C elements, design of reinforced concrete frames, design for torsion, interaction between axial and shear, shear and torsion, axial and bending moment, design for deep beams, reinforced concrete columns under uniaxial and biaxial bending, slender columns under biaxial bending, design of long columns, principle of precast concrete.

13 - CE582 Prestressed Concrete :

General principles, structural behavior and failure modes, stress losses, design of members under flexure, shear, torsion, deflections and blocks, simple and continuous beams and slabs.

14 - CE583 Design of Bridges :

Historical background, choice location and bridge layout, types of bridges, loading on bridge foundations, piers, abutment and wing – walls, applications of reinforced concrete and prestressed concrete bridges.

15 - CE584 Advanced Steel Structures :

Limit state principles, elastic and inelastic behavior, plastic analysis and design of beams, frames and high - rise buildings, space frames and space trusses, design of connections, analysis and design of plate girder.

16 - CE585 Design of Plates and Shells :

Design of folded plates and shells of revolution and translation, domes, cylindrical shells, hyperboloid etc.

17- CE586 Repair and Strengthening of Reinforced Concrete Structures :

Introduction and literature review of repair and/or strengthening of reinforced concrete structures, terminology and definitions, materials for repair and strengthening, causes and classification of cracks and damages, deterioration of concrete, construction defects, diagnosis and assessment to identify the extent of damage to the structures, methods of repair and/or strengthening of reinforced concrete elements.

18- CE587 Cold Formed Steel Structures :

Introduction to cold formed steel as a construction material, including manufacturing processes, current design codes using international standards to design cold formed steel sections, the course emphasize a balance between theory, analysis, design to satisfy the needs of industry.

19- CE588 Design of Reinforced Concrete Structures :

Concrete models, comparative between codes for interaction and moment – curvature diagrams, theory and applications of yield line theory to reinforced concrete slabs, strip method, design for corbels, design of water tanks and shear walls.

PROGRAM :GEOTECHNICAL ENGINEERING COURSES

Course Code	Course Title	Credit Hrs	Pre- requisite
CE531	Advanced Soil Mechanics	3	
CE532	Foundation Analysis and Design	3	
CE533	Earth Structures	3	CE531
CE534	Embankment Dams	3	CE535 CE531
CE535	Rock Mechanics	3	
CE536	Field and Laboratory Measurements	3	
CE537	Ground Water and Seepage	3	
CE538	Soil dynamics	3	CE523

1. CE 531 Advanced Soil Mechanics:

Soil structure and fabric stress distribution, stress – strain and strength behavior, time dependent behavior, (seepage and consolidation), residual strength, stress paths failure criteria, difficult soils.

2. CE 532 Foundation Analysis and Design :

Types of foundation systems, design criteria for shallow and deep foundation. geotechnical considerations, structural considerations, soil – structure interaction, special foundations.

3. CE 533 Earth Structures :

Theory of earth pressures, retaining structures, design and stability, flexible and rigid support systems diaphragm walls. soil anchors, reinforced earth, buried structures.

4. CE 534 Embankment Dams:

Principles of design and stability analysis, choice of dam type, stress distributions and deformation. prediction of pore pressures during construction, steady seepage and rapid draw down, properties of earth and rockfills, the control of cracking and the design of filters.

5. CE535 Rock Mechanics :

The behavior of rock material in uniaxial and multiaxial compression tests, the influence of test conditions and testing system stiffness, tensile behavior of rock, fracture and yield criteria, shear strength and deformability of discontinuities in rock, failure mechanisms and strength of jointed rock masses, stability of rock masses, openings in rock.

6. CE536 Field and Laboratory Measurements:

Principles of the laboratory measurement of load, displacement and pore water pressure, laboratory determinations of soil strength and deformation characteristics, interpretation of test results, drilling, sampling and logging, in-situ testing for evaluation shear strength compressibility and permeability, field monitoring of stress determination and pore pressure.

7. CE537 Ground Water and Seepage:

Fundamental of ground water flow, velocity, permeability, Darcy law, general hydrodynamic equations, velocity potential. two dimensional flow, stream function. streamlines and equipotential lines, Laplace equation, flow-net, confined flow problems, solutions by analysis graphical and analogue or numerical relaxation techniques, Dupuit theory for unconfined flow problems . conformal mapping techniques, velocity hydrograph solutions, seepage from canal and ditches, seepage toward walls, fully- penetrating and partially – penetrating, filters, types and design of filter.

8. - CE538 Soil dynamics

Foundation vibration; design of foundation for machinery , stress strain behavior of soil during transient and repeated loading; relation of soil properties to wave velocity , effects of earthquakes upon structures; amplification by a layer of soil , effect of foundation upon building response, problem of slope stability and liquefaction as related to earthquakes, dynamic of lumped system as applied to problem in soil dynamics.

PROGRAM :WATER RESOURCES ENGINEERING COURSES

Course Code	Course Title	Credit Hrs	Pre- requisite
CE561	Applied Hydrology	3	CE471
CE562	Applied Hydraulics	3	CE471
CE563	Advanced Mechanics Of Fluids	3	
CE564	Sedimentation Engineering	3	CE562
CE565	Irrigation And Drainage Engineering	3	CE471
CE566	Ground Water Engineering	3	
CE567	Costal Hydromechanics	3	CE465
CE568	Flow In Porous Media	3	
CE569	Stochastic Hydrology	3	CE471
CE570	Advanced Water and Wastewater Treatment	3	
CE571	Water Quality and Pollution Control	3	CE467
CE572	Ground Water Contaminant Transport	3	

1-CE561 Applied Hydrology :

Rain fall - runoff relation, unit hydrograph and S-curve hydrograph analysis, instantaneous unit hydrographs- linear and non- linear models, frequency analysis - normal, gumbel. person distributions, applications to hydrograph extremes-floods and draughts, flood control measures, food forecasting techniques, flood routing- river routing and reservoir routing methods, storage, pondage and flow duration curves.

2- CE562 Applied Hydraulics:

Theory, design of hydraulic structures - different types of dams, gates, sluices, culverts, spillways and energy dissipation methods, case studies, reservoir regulation and control reservoir sedimentation and Its control, water resources planning.

3- CE563 Advanced Mechanics Of Fluids :

Continuity equation, velocity potential and stream function, flow - nets, source, sink, circulations and vorticity. euler equation of motion, bernoulli's equation for real fluid. momentum equation, moment of momentum equation, applications. Navier - Stokes equations and Its applications. boundary layer equations. water hammer and its effects, surge tanks. open channel flow, basic concepts of flow, critical flow conditions, hydraulic jump analysis, gradually varied Flow.

4- CE564 Sedimentation Engineering :

Nature of sedimentation problems - erosion, sediment transport and deposition, mechanics of sediment transportation- hydraulics , sediment discharge, sediment in rivers and pipes, sediment measurements techniques - valley deposits, air borne sediment laboratory procedures, sediment yield - erosion rate, sediment sources, sediment control - water shed areas and reservoir.

5- CE565 Irrigation And Drainage Engineering :

Methods of irrigation, components and application, surface irrigation, hydraulics –zero inertia, kinematic wave, volume balance, evaluation of surface irrigation system, basin. Border and furrow system, case studies, sprinkler and drip irrigation system, case studies. Drainage of irrigated lands- different types of drainage and their design.

6-CE566 Ground Water Engineering :

Water extraction by wells and galleries, influence of partial and limited gallery length, steady and unsteady flow of ground water to single well in leaky and multilayered aquifers, influence of partial penetration and anisotropy on flow patterns. Ground water flow to a system of wells. Pumping near hydrologic boundaries, hydrologic system analysis, ground water modeling, analogue (and digital computer) models, finite difference and finite element models, ground water exploration and pumping test analysis.

7- CE567 Costal Hydromechanics :

Force, harbor planning and layout , design of breakwater, wharves, piers, jetties, dolphins works, dredging and dredgers, navigation locks, dry dock and spillways, container hipping terminals.

8- CE568 Flow In Porous Media :

Physical nature of porous media, introduction to flow dynamics, derivation of Darcy's Law, (4) subsurface fluid potential fields, equations governing saturated and unsaturated flow chemical mass transport in permeable media (hydrodynamic dispersion, dispersivity concept, theory of solute transport -advection-dispersion-reaction equation).

9- CE569 Stochastic Hydrology :

Properties of random variables, stochastic characteristics of hydrologic data,. type of hydrological data, statistical properties of hydrological data. probability concepts and distributions (discrete and continuous probability distributions). data generation. hydrologic discrete time series (univariate series), frequency analysis: analytical hydrologic frequency analysis stochastic modeling and simulation of hydrologic data.

10- CE 570 Advanced Water and Wastewater Treatment :

Surface and ground water characteristics, theory and application, miscellaneous water of treatment techniques, drinking water quality guideline, design project work for water treatment plant , disposal and treatment methods of water and wastewater sludge's , Wastewater reuse , design and calculation of secondary and advanced (tertiary) treatment units , unit of aerobic treatment as activated sludge systems , different design methods of nutrients removal (nitrogen & phosphors) from wastewater , operation control techniques ,design project work for wastewater treatment plant with a technical report .

11- CE 571 Water Quality and Pollution Control :

Introduction to water quality, water chemistry and microbiology, water pollution and sources, water pollution control, water pollution management, water quality assessment, water quality management, water quality guidelines and regulations.

12- CE572 Ground Water Contaminant Transport :

Review of groundwater principles: partial differential equations (PDE) for groundwater flow in aquifers. PDE for mass (contaminant) transport: advection-dispersion equation, numerical groundwater contaminant transport modeling: finite difference method (FDM)- stability analysis, implicit and explicit finite difference solutions, method of characteristics (MOC)- characteristic equations, analytical solutions: transformed advection/dispersion equation- fundamental solution, continuous point solution, instantaneous line solution, normal distribution of contaminants.

PROGRAM : SURVEYING COURSES

Course Code	Course Title	Credit Hrs	Pre- requisite
CE550	Physical Geodesy	3	
CE551	Photogrammetry (1)	3	CE475
CE552	Global Navigation Satellite Systems (1)	3	CE478
CE553	Analytical Methods and Adjustment Computations	3	
CE554	Map Projections	3	
CE555	Navigation Systems and Integration	3	CE552 CE553 CE557
CE556	Global Navigation Satellite Systems (2)	3	CE553 CE552
CE557	Photogrammetry (2)	3	CE553 CE551
CE558	Geographic Information System	3	
CE559	Remote Sensing	3	

1- CE550 Physical Geodesy

Fundamentals of potential theory, gravity field of the earth, gravity reduction, heights, the geometry of the earth, gravity field outside the earth, space methods modern views on the determination of the figure of the earth statistical methods in physical geodesy, least squares collocation, computational methods, processing and programming some physical geodesy examples, course project: study and analysis some physical geodesy software.

2- CE551 Photogrammetry (1)

Introduction to photogrammetry, importance, products, applications, types of photographs and images, data acquisition, camera calibration, coordinate systems, interior and exterior orientation, rotation matrix, relative orientation, coplanarity equations, absolute orientation, collinearity equations, Space Resection, space forward intersection, aerial triangulation, bundle block adjustment, least squares adjustment, self calibrating bundle adjustment, processing and programming some photogrammetric examples, course project: study and analysis some photogrammetric software.

3- CE552 Global Navigation Satellite Systems (1)

Introduction to GNSS (GPS, GLONASS, Beidou, Galileo), global positioning system (GPS) signal structure, time systems, GPS pseudo-range measurements, GPS carrier phase measurements, GPS errors and biases, GPS observation equations, datum, coordinate systems and map projections, GPS positioning modes and techniques: static, kinematic, RTK, PPP, ambiguity resolution techniques, GPS data and correction services, GPS standard formats, GNSS integration, GPS/INS/laser scanner, GNSS applications, mobile mapping systems, processing and programming some GPS examples, course project: study and analysis some GNSS software.

4- CE553 Analytical Methods and Adjustment Computations

Error propagation, observation equation, condition equation, combined equation, least squares method- Kalman filtering, analytical methods, adjustment computation, statistical tests, observations filtering and outliers detection - data snooping, robust estimation, detection of multiple outliers, processing and programming some adjustment examples, course project: study and analysis some adjustment software.

5- CE554 Map Projections

Definitions and notations, the Figure of the earth, theory of distortion, mapping reference surfaces - general transformation formula, azimuth and distance projections, conformal projections, equivalent projections, coordinate reference systems, mathematics of map projections, the fundamental properties of map projection, classification of map projections, computation of projection coordinates, the choice of a suitable map projection, applications of map projection, surveying and map projection, processing and programming some map projection examples, course project: study and analysis some map projection software.

6- CE555 Navigation Systems and Integration

Navigation systems: GNSS, INS, vision based navigation, laser Scanning based navigation, Wi-Fi based navigation, GNSS/GIS integration, GNSS/ LRF (Laser range finder) integration, GNSS/dead reckoning integration, GNSS/INS (Inertial Navigation System) integration, GNSS/Pseudo, lite integration, GNSS/cellular integration, GNSS/ vision based navigation/laser scanning based navigation integration, INS/ vision based navigation/laser scanning based navigation integration, INS/Wi-Fi Integration, Wi-Fi/vision based navigation/laser scanning based navigation integration, GNSS/INS/ Wi-Fi/ vision based navigation/laser scanning based navigation integration, processing and programming some navigation systems and integration data, course project: study and analysis some integration systems software.

7- CE556 Global Navigation Satellite Systems (2)

GPS observable, code and carrier phase measurements - Kalman filtering Vs. least squares, processing and programming GPS code observable, processing and programming GPS carrier phase observable, modeling and programming some GPS errors and biases, programming differential GPS code positioning: static, kinematic, programming differential GPS carrier phase positioning: static, kinematic, programming GPS precise point positioning (PPP): static, kinematic, processing and programming Some ambiguity resolution techniques, processing and programming GPS/INS integration data, course Project: study and analysis some advanced GNSS software.

8- CE557 Photogrammetry (2)

Digital image, digital Image processing, digital edge detection, digital image matching, correlation matching, least squares matching, area based matching, feature based matching, relation based matching , image pyramid, digital photogrammetric systems, automatic image orientation, automatic aerial triangulation, automatic generation of digital elevation model, rectification of digital images, ortho, rectification and ortho, image ,simultaneous localization and mapping, mobile mapping systems, satellite photogrammetry, satellite interior and exterior orientation, satellite block triangulation, processing and programming advanced photogrammetric examples, course project: study and analysis some advanced photogrammetric software.

9- CE558 Geographic Information System

Introduction to GIS, data structure, digital elevation models, data input, verification, storage, output,method of data analysis and spatial modeling, data quality, errors, natural variation, data classification methods, method of spatial information choosing, engineering surveying and GIS, GIS applications, course project: study and analysis some GIS software.

10- CE559 Remote Sensing

Introduction to remote sensing, electromagnetic radiation, reflection, absorption, transmission, remote sensing systems, scanners and detectors, multispectral scanners, thermal scanners, side looking airborne radar, laser ranging scanning systems, digital image surveying processing and classification, applications of remote sensing, processing and programming some remote sensing data, course Project: study and analysis some remote sensing software.