Course Name:
Design of Concrete Structures I

<table>
<thead>
<tr>
<th>Course Number: 20-231</th>
<th>Credit: 3</th>
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<tr>
<td>Program: Undergraduate</td>
<td>Course Type: Technical required</td>
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<tr>
<td>Prerequisite: Structural Analysis I</td>
<td>Corequisite: Construction Materials and Concrete Technology</td>
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Course Description (Objectives):
In this course, students become familiar with the basic analysis and design methods of various reinforced concrete structural elements based on the international code ACI318M-14. In addition to design of individual elements like beams and columns, students become familiar with the design philosophy, different building structural systems, modelling techniques, and design of a real structures by utilizing available computer programs like SAP2000.

Course Content (outline):

- **Mechanical Properties of Concrete**
  Compressive strength; Effects of age, strain rate, multi-axial loading on compressive strength; strain-stress diagram; modulus of elasticity; Poisson’s ratio; shrinkage; creep; tensile strength

- **Mechanical Properties of Steel Reinforcement**
  Plain and deformed bars; strain-stress diagram; standard rebar sizes; straight, coil rod, and WWF rebar reinforcement

- **Design Philosophy**
  Design objectives; structural design phases; limit states; ultimate limit states; serviceability limit states; special limit states; design approaches; margin of safety; loading and strength uncertainties; load types; load combinations and load factors; required design strength; design strength; strength reduction factors

- **Flexure**
  Flexural behavior of elastic beams; cracking moment; behavior of a reinforced concrete beam under different stages of loading; analysis assumptions of beams based on strain compatibility; brittle and ductile failures of beams; moment-curvature diagram; design requirements of beams; doubly reinforced beams, flanged beams

- **Shear**
Shear behavior of elastic beams; tensile stress trajectories in beams; types of cracks in beams; types of shear failures in beams; shear capacity of concrete section; design requirements for shear

- **Bond Stress, Development Length, and Cut-off**
  Bond stress; bond strength; Types of bond failure; development length of bars in tension; development length of bars in compression; standard hooks; splice; cut-off of flexural reinforcement

- **Torsion**
  Torsion of elastic beams with circular, rectangular, and thin-walled sections; cracking torsion; threshold torsion; equilibrium and compatibility torsions; truss analogy; design requirements of longitudinal and transverse reinforcement; shear and torsion combination; flexure and torsion combination; reinforcement detailing

- **Serviceability**
  Serviceability limit states; types of cracks in concrete structures; design requirements for controlling crack width; effective moment of inertia; instantaneous deflection; long-term deflection; maximum permissible deflection

- **Axial Force**
  Types of columns; nominal strength of columns under axial compression and tension; plastic centroid; design requirements of columns under axial compression

References: