Course Syllabus

- ENCE 355 – Introduction to Structural Design (3 credit)

- MWF 9:00 am – 9:50 am, EGR 2112
Course Syllabus

INSTRUCTOR:
Name: Dr. Ibrahim A. Assakkaf
Office Hours: MWF 10:00 am - 12:00 am and by appointment
Room: 0305, Engineering Classroom Building (EGR) Center for Technology and Systems Management (CTSM)
Telephone: (W) 301-405-3279
Email: assakkaf@eng.umd.edu
URL: http://ctsm.umd.edu/assakkaf http://www.cse.umd.edu/assakkaf

Course Syllabus

TEACHING ASSISTANT:
Name: Dr. Maged Sidki Morcos
Office Hours: MWF 12:00 pm – 1:00 pm
Room: TBA
Telephone: (301) 276-1000, Rm. 253
Email: m_sidki@hotmail.com
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TEXTBOOKS:
3. “Building Code Requirements for Structural Concrete (318-02) and Commentary (318-02),” American Concrete Institute (ACI).

REFERENCES:
INTRODUCTION a. SYLLABUS, MAJOR TOPICS, & COMPUTERS

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GRADING:
Homework 20%
Exam I 25%
Exam II 25%
Final Exam 30%
Quizzes & Attendance (±) 100%

PREREQUISITES:
• ENCE 300
• Permission of the Department

GENERAL COURSE DESCRIPTION (UM SCHEDULE OF CLASSES, FALL 2002):
Course Syllabus

HOMEWORK ASSIGNMENTS:

Professional presentation of homework assignments is required. Professional presentation consists of neat and organized solution of problems on **one side of 8.5"x11" papers**. Any homework not complying with professional standards will not be graded and will be assigned zero credit. The homework assignments are due one week after they are assigned. Homework will be assigned as the material is covered and will be collected every Monday at the beginning of the lecture period, starting on Monday 9/9. Assignments turned in late will be docked 10% for each day it is late past the original due date.

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HOMEWORK ASSIGNMENTS (cont’d):

Solutions will be available from the TA and on the class website after the problems are returned. No assignment will be accepted after the answers have been posted. Students are encouraged to discuss and formulate solutions to the problems by working in teams. However, assignments must be completed and submitted individually. Simply copying the answers from another student or from a solutions manual is not acceptable and will not be tolerated.
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HOMEWORK ASSIGNMENTS (cont’d):

Guidelines for homework are given below:

1. Use good quality paper, such as engineering graph paper or college-ruled paper, any color, with no spiral edges
2. Write on only one side of the paper
3. Either pen or pencil is acceptable
4. Include your name, section, and page number (e.g. 1/3 means 1 of 3) on each sheet
5. Staple all pages together in the upper left corner
6. Neatly box all answers, and include appropriate units for numerical answers
7. Show all work (e.g. no work means no credit will be given)

If the above guidelines are not followed, the TA will either reject the assignment outright, for extreme cases, or deduct points for items that do not conform to the specifications.
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EXAMS AND QUIZZES:
All students must take all exams and quizzes including the final exam. Only extenuating circumstances will be accepted as an excuse for missing an exam. The student must notify the instructor of the reason for absence as soon as possible. Health related excuses require medical reports and the signature of a physician that provided treatment. You are encouraged to go over Chapter 4 of the Undergraduate Catalogue for the University policies, or visit http://www.inform.umd.edu/ugradcat/chapter4/attendance.html.

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COURSE WEBSITE: Students are encouraged to access course web site at http://www.ajconline.umd.edu to download course materials such as homework sets and solutions. Timely information will also be posted on the web site. At initial login, use your wam account name as the username, and your SID as the password. You are advised to change your password after your first login. Report any problem with the course web site to the instructor. For technical problems of the web site, contact the Instructional Technologies staffs at 0123 Martin Hall.
### Course Syllabus

#### Schedule for Lectures

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<thead>
<tr>
<th>Week</th>
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<th>Section</th>
<th>Topic</th>
<th>Homework</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>W, 9/4</td>
<td>Handout</td>
<td>Introduction to the Course</td>
<td>Handout</td>
</tr>
<tr>
<td>1</td>
<td>F, 9/6</td>
<td>Handout</td>
<td>Structural Design and Analysis, Code Specifications</td>
<td>Handout</td>
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<tr>
<td>2</td>
<td>M, 9/9</td>
<td>1.1 – 1.4</td>
<td>Concrete, ACI Building Code, Cement and Water, Aggregates</td>
<td>SL*</td>
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<tr>
<td>2</td>
<td>W, 9/11</td>
<td>1.5</td>
<td>Concrete in Compression</td>
<td>Chapter 1</td>
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<tr>
<td>2</td>
<td>M, 9/16</td>
<td>1.6 – 1.8</td>
<td>Concrete in Tension, Reinforcing Steel, and Beams</td>
<td>1-1</td>
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<tr>
<td>2</td>
<td>F, 9/20</td>
<td>2.1 – 2.2</td>
<td>Reinforcement Ratio Limitations and Guidelines</td>
<td>1-2</td>
</tr>
<tr>
<td>3</td>
<td>M, 9/23</td>
<td>3.1 – 3.2</td>
<td>Flexural Strength of Rectangular Beams, Equivalent Stress</td>
<td>2-1a</td>
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<tr>
<td>3</td>
<td>W, 9/25</td>
<td>3.3, 3.5, 3.6</td>
<td>Development of T-Beams Analysis</td>
<td>2-2</td>
</tr>
<tr>
<td>3</td>
<td>F, 9/27</td>
<td>3.6 – 3.7</td>
<td>Summary of T-Beams Analysis and Design</td>
<td>2-3</td>
</tr>
<tr>
<td>4</td>
<td>M, 9/30</td>
<td>3.8 – 3.11</td>
<td>Doubly Reinforced Beams, Doubly RF Analysis</td>
<td>3-1</td>
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<tr>
<td>4</td>
<td>F, 9/20</td>
<td>4.1 – 4.2</td>
<td>Shear Analysis Procedure, Stirrups Design Procedure</td>
<td>4-1</td>
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### Schedule for Lecture (cont’d)

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Section</th>
<th>Topic</th>
<th>Homework</th>
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<tbody>
<tr>
<td>5</td>
<td>M, 9/23</td>
<td>3.1 – 3.2</td>
<td>Introduction, T-Beams Analysis</td>
<td>SL*</td>
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<tr>
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<td>3.3, 3.5, 3.6</td>
<td>Development of T-Beams Analysis</td>
<td>Chapter 3</td>
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<td>3.6 – 3.7</td>
<td>Summary of T-Beams Analysis and Design</td>
<td>3-3</td>
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<tr>
<td>6</td>
<td>M, 9/30</td>
<td>3.8 – 3.11</td>
<td>Doubly Reinforced Beams, Doubly RF Analysis</td>
<td>3-3</td>
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<tr>
<td>6</td>
<td>W, 9/10</td>
<td>3.12 – 3.14</td>
<td>Doubly Reinforced Beam Design for Moment</td>
<td>3-4</td>
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<tr>
<td>6</td>
<td>F, 9/20</td>
<td>4.1 – 4.2</td>
<td>Shear Analysis Procedure, Stirrups Design Procedure</td>
<td>4-1</td>
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<td>M, 9/23</td>
<td>3.1 – 3.2</td>
<td>Introduction, T-Beams Analysis</td>
<td>SL*</td>
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<tr>
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<td>W, 9/25</td>
<td>3.3, 3.5, 3.6</td>
<td>Development of T-Beams Analysis</td>
<td>Chapter 4</td>
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<td>7</td>
<td>F, 9/27</td>
<td>3.6 – 3.7</td>
<td>Summary of T-Beams Analysis and Design</td>
<td>3-3</td>
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<tr>
<td>8</td>
<td>M, 9/30</td>
<td>3.8 – 3.11</td>
<td>Doubly Reinforced Beams, Doubly RF Analysis</td>
<td>3-3</td>
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<tr>
<td>8</td>
<td>W, 9/10</td>
<td>3.12 – 3.14</td>
<td>Doubly Reinforced Beam Design for Moment</td>
<td>3-4</td>
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<tr>
<td>8</td>
<td>F, 9/20</td>
<td>4.1 – 4.2</td>
<td>Shear Analysis Procedure, Stirrups Design Procedure</td>
<td>4-1</td>
</tr>
</tbody>
</table>

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### Analysis and Design

- **SL* Chapter 1 – Materials & Mechanics of Bending**
  - Concrete, ACI Building Code, Cement and Water, Aggregates
  - Concrete in Compression
  - Concrete in Tension, Reinforcing Steel, and Beams

- **SL* Chapter 2 – Rectangular Reinforced Concrete Beams and Slabs: Tension Steel Only**
  - Reinforcement Ratio Limitations and Guidelines
  - Behavior Under Load, Strength Design Methods Assumption

- **SL* Chapter 3 – Reinforced Concrete Beams: T-Beams and Doubly Reinforced Beams**
  - Introduction, T-Beams Analysis
  - Doubly Reinforced Beams, Doubly RF Analysis
  - Doubly Reinforced Beam Design for Moment

- **SL* Chapter 4 – Shear in Beams**
  - Introduction, Shear Reinforcement Design Requirements
  - Shear Analysis Procedure, Stirrups Design Procedure

- **SL* Chapter 5 – Development, Splices, and Simple-Span Bar Cutoffs**
  - Development Length, Tension Bars
  - Development Length, Compression Bars, Standard Hooks

- **SL* Chapter 9 – Columns**
  - Introduction, Strength (small eccentricity), Code Requirements
  - Analysis of Short Columns, Design of Small Columns
# Course Syllabus

## Schedule for Lecture (cont’d)

<table>
<thead>
<tr>
<th>Week</th>
<th>Lec. Date</th>
<th>Section</th>
<th>Topic</th>
<th>Homework</th>
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<tbody>
<tr>
<td>8</td>
<td>M, 10/21</td>
<td>9.7 – 9.11</td>
<td>The Load-Moment Relationship, Analysis (large eccentricity)</td>
<td>9-11</td>
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<td>W, 10/23</td>
<td>1.1 – 1.7</td>
<td>Advantages and Disadvantages, Early uses, Steel Sections</td>
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<td></td>
<td>1.8 – 1.21</td>
<td>Modern Structural Steels, Uses, Failure, and Computers</td>
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<td>F, 10/25</td>
<td>2.1 – 2.4</td>
<td>Specifications and Building Codes, Loads, Dead &amp; Live Loads</td>
<td>2-1</td>
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<td>2.5 – 2.6</td>
<td>Environmental Loads, Load &amp; Resistance Factor Design</td>
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<td>M, 10/28</td>
<td>*** EXAM I ***</td>
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<td>W, 10/30</td>
<td>2.7 – 2.10</td>
<td>Load and Resistance Factors, Reliability and LRFD</td>
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<td>2.11 – 2.12</td>
<td>Advantages of LRFD, Computer Example</td>
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<td>F, 10/31</td>
<td>3.1 – 3.3</td>
<td>Effect of Staggered Holes, Effective Net Areas</td>
<td>3-1</td>
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<td>9</td>
<td>M, 10/28</td>
<td>3.4 – 3.5</td>
<td>Connecting Elements for Tension Members, Block Shear</td>
<td>3-10</td>
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<td>W, 11/6</td>
<td>3.6 – 3.7</td>
<td>Introduction, Design Strength, Net Areas</td>
<td>3-14</td>
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<td>F, 11/8</td>
<td>4.1 – 4.3</td>
<td>Selection of Sections, Built-up Tension Members Rods and</td>
<td>3-20</td>
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<td>4.4 – 4.5</td>
<td>Built-up, Pin-connected Members, Design for Fatigue Loads</td>
<td>3-24</td>
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<td>M, 11/14</td>
<td>5.1 – 5.3</td>
<td>General, Residual Stress, Sections Used for Columns</td>
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<td>W, 11/13</td>
<td>5.4 – 5.5</td>
<td>Development of Column Formulas, Euler Formula</td>
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<td>F, 11/15</td>
<td>5.6</td>
<td>End Restraints and Effective Lengths of Columns</td>
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<td>5.7</td>
<td>Stiffened and Unstiffened Elements</td>
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<tr>
<td>10</td>
<td>M, 11/14</td>
<td>5.8 – 5.9</td>
<td>Long, Short, and Intermediate Columns, Column Formulas</td>
<td>5-15</td>
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<td>W, 11/20</td>
<td>5.10 – 5.11</td>
<td>Maximum Slenderness Ratios, Example Problems</td>
<td>5-17</td>
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<td>F, 11/22</td>
<td>6.1 – 6.4</td>
<td>Introduction, LRFD Design Tables, Built-up Columns</td>
<td>6-2</td>
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<td>6.5</td>
<td>Built-up Columns w/ components in contact with each other</td>
<td>6-8</td>
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<tr>
<td></td>
<td>6.7</td>
<td>Built-up Columns w/ components not in contact with each other</td>
<td>6-22</td>
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<tr>
<td>11</td>
<td>M, 11/18</td>
<td>8.1 – 8.4</td>
<td>Types of Beams, Sections, Stresses, Plastic Hinges</td>
<td>8-2</td>
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<td></td>
<td>F, 11/29</td>
<td>******** NO CLASS, Thanksgiving Recess ********</td>
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Schedule for Lecture (cont’d)

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<th>Topic</th>
<th>Homework</th>
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<td>14</td>
<td>39</td>
<td>M, 12/2</td>
<td>8.8 – 8.9</td>
<td>The Collapse Mechanism, Virtual Work Method</td>
<td>8-22</td>
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<td>40</td>
<td>8.10</td>
<td>Location of Plastic Hinge for Uniform Loading</td>
<td>8-31</td>
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<td></td>
<td></td>
<td>W, 12/4</td>
<td>8.11 – 8.12</td>
<td>Continuous Beams, Building Frames</td>
<td>8-37</td>
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<td>MN Chapter 9 – Design of Beams for Moments</td>
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<td></td>
<td>Introduction, Yielding Behavior, Design of Beams (Zone 1)</td>
<td>9-1 9-4 9-10</td>
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<td>15</td>
<td>42</td>
<td>M, 12/9</td>
<td>9.4 – 9.5</td>
<td>Lateral Support of Beams, Inelastic Buckling (Zone 2)</td>
<td>9-12 9-16</td>
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<td>9.6</td>
<td>Moment Capacities</td>
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<td>W, 12/11</td>
<td>9.7 – 9.9</td>
<td>Elastic Buckling (Zone 3), Design Charts, Noncompact</td>
<td>9-24</td>
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<td>Sections</td>
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<td>Review</td>
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<td>16</td>
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<td>T, 12/19</td>
<td>All material</td>
<td>*** FINAL EXAM - 8-10 AM, EGR 2112 ***</td>
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</table>

Course Syllabus

Course Objective

- Introduce the concept of Design of structural members for building and bridges subjected to tensions, compression, shear and bending.
- Materials: structural **steel** and reinforced **concrete**.
PART I
Concrete Design and Analysis

- Concrete is a mixture of cement, fine and coarse aggregates, and water.
- Water is the key ingredient for chemical reaction for curing.

Add Water
\[
\text{Cement + Aggregates} = \text{Concrete}
\]
Major Topics

- Materials and Mechanics of Bending
  - Concrete Strength

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Reinforcing Steel
INTRODUCTION a. SYLLABUS, MAJOR TOPICS, & COMPUTERS

Slide No. 24

Major Topics

Mechanics of Bending

Pure Bending: Prismatic members subjected to equal and opposite couples acting in the same longitudinal plane

INTRODUCTION a. SYLLABUS, MAJOR TOPICS, & COMPUTERS

Slide No. 25

Major Topics

RECTANGULAR R/C CONCRETE BEAMS: TENSION STEEL ONLY

- 500 mm
- 24-mm diameter
- 225 mm
- 50 mm

Dead and Live Loads

M
**Major Topics**

- **Reinforced Concrete Beams: T-Beams and Doubly Reinforced Beams**

  ![T-Beam Diagram]

  - 24-mm diameter
  - 500 mm
  - 225 mm
  - 50 mm

- **Shear in Beams**
  - **Design Requirements**

  ![Shear Diagram]

  - $V$ (lb)
  - $M$ (ft-lb)
Major Topics

- Development Length, Splices, and Simple Span Bar Cutoffs

- Reinforced Concrete Columns
PART II
Steel Design and Analysis

Major Topics

- Introduction to Structural Steel Design
- Specifications, Loads, and Methods of Design

ASIC American Institute of Steel Construction
Major Topics

- Analysis and Design of Tension Members

- Introduction to the Design of Axially Loaded Compression Members
Major Topics

- Introduction to the Analysis and Design of Beams for Moments

Dead and Live Loads

$M$
Computers and Software

- Computers Evolution Era (Chapra & Canale 1988)
  - Zero Generation - Manual & Mechanical (pre 1951)
  - First Generation – Vacuum tubes (1951 – 1958)
  - Second Generation – Transistors (1958 – 1964)

- Fourth Generation – Very large scale integration (1971 – present)
  - Mainframes, Supercomputers
  - Personal Computers, Microcomputers, and Minicomputers
Computers and Software

- Computers Evolution Era (Chapra & Canale 1988)
  - Fifth Generation (1990?)
    - Parallel Processing
    - Artificial intelligence

Computers and Software

- High-level Languages
  - FORTRAN (introduced by IBM in 1957)
    - FORTRAN = FORmula TRANslation
    - Developed for the IBM 704 Computer
    - Developed by John Backus and a team of 13 other programmers
  - BASIC
  - Pascal
  - Others
Computers and Software

- Software Packages
  - MATLAB
  - MathCad
  - Spreadsheet
    - MS Excel
    - Quattro Pro
  - Specialized Structural Packages
    - GTSTRUDLE
    - ETABS
    - SAP & INSTEP32 Design Software
    - etc

Major Topics

Be Proud To Be An Engineer