# Coastal Engineering: A Briefing on Key Themes and Course Structure

## Executive Summary

This document synthesizes the core themes and structural components of the Coastal Engineering course (16:180:590) offered by the Department of Civil and Environmental Engineering at Rutgers University. The material establishes the vast scale and critical importance of U.S. coastlines, which span nearly 100,000 miles and are home to over 40% of the nation's population. The course curriculum is comprehensive, addressing fundamental natural phenomena such as tides, waves, and estuarine processes, as well as engineered interventions ranging from traditional hard structures to modern nature-based solutions. A distinct regional focus on the New Jersey coastline is evident, utilizing major weather events like Superstorm Sandy (2012) and Hurricane Ida (2021) as case studies to illustrate severe coastal hazards, including storm surge, erosion, and inland flash flooding. The course is grounded in a robust academic framework, referencing key industry texts like the U.S. Army Corps of Engineers' Coastal Engineering Manual.

## Course Overview and Logistics

The provided materials outline a graduate-level engineering course scheduled for the Fall 2025 semester.

| Detail | Information |
|---|---|
| **Course Title** | 16:180:590 Coastal Engineering |
| **Institution** | Rutgers University-New Brunswick |
| **School / Department** | School of Engineering, Department of Civil and Environmental Engineering |
| **Instructor** | Qizhong (George) Guo, Ph.D., P.E., BC.WRE, Professor |
| **Instructor Contact** | qguo@rutgers.edu, (848) 445-2983, Weeks Suite 328 |
| **Term** | Fall 2025 |
| **Schedule** | Monday 6:00 PM - 9:00 PM |
| **Location** | Busch Campus, Weeks Hall 402 |
| **Office Hours** | By appointment |

## Curriculum and Academic Foundation

The course is structured to provide a thorough understanding of both natural coastal systems and human engineering approaches to managing them.

### Core Topics

The course outline is divided into eight major topics:

1. Introduction
2. Tides
3. Estuarine Processes
4. Waves
5. Coastal Processes
6. Grey/Hard Coastal Structures
7. Green/Soft Coastal Structures (Nature-Based Solutions)
8. Contemporary Coastal Management

### Assessment Structure

Student performance is evaluated through a combination of theoretical and practical assignments. The final course grade is based on the following components:

- **Homework:** 30%
- **Mini-design projects:** 20%
- **One presentation:** 20%
- **One in-class exam:** 30%

### Key Academic Resources

The curriculum is supported by a comprehensive list of eight text and reference books, indicating a blend of foundational theory and modern practice. Notable resources include:

- *Coastal Engineering: Processes, Theory and Design Practice, Third Edition* by D. Reeve et al. (2018)
- *Introduction to Coastal Engineering and Management, Third Edition* by J. W. Kamphuis (2020)
- *Living Shorelines: The Science and Management of Nature-Based Coastal Protection* by D. M. Bilkovic et al. (2017)
- The U.S. Army Corps of Engineers (USACE) Coastal and Hydraulics Laboratory's *Coastal Engineering Manual* (CEM) (2002)

# Thematic Focus: The Scale and Significance of Coastal Zones

The introductory materials emphasize the immense geographic and demographic importance of coastlines.

### National Perspective: U.S. Coastlines

According to the U.S. Geological Survey (U.S.G.S.), the scale of the nation's coastal areas is substantial.

“Our Nation’s coastlines are almost 100,000 miles long... Altogether, our coasts are home to more than 40 percent of the population and supports critical habitat for wildlife.”

The geographic scope is extensive, encompassing:

- **Atlantic Shores:** From Maine southward.
- **Gulf of America:** Southern coastlines.
- **Caribbean:** Insular areas.
- **Pacific Shores:** California, Oregon, Washington, Alaska, and Hawai'i.
- **Pacific Islands:** Insular areas.
- **The Great Lakes:** Characterized as one of the world's largest freshwater ecosystems.

### International Proximity Example

A "Fun Fact" is presented to illustrate a unique geopolitical coastal feature: the close proximity of the United States and Russia in the Bering Sea.

- **Shortest Distance:** The distance between the two nations is only 2.4 miles (3.8 km).
- **Location:** This occurs between the islands of Little Diomede (U.S.A.) and Big Diomede (Russia).
- **Geopolitical Context:** The map highlights that the International Border and Date Line runs between these two islands.

## Regional Case Study: New Jersey's Coastal Vulnerability

The course materials use New Jersey as a specific case study to examine coastal dynamics and hazards, supported by detailed maps of the state and its shoreline communities.

### Geographic Context

Maps of the "New Jersey Shore Coastline & Beaches" detail the extensive and densely populated coastal zone, listing numerous communities from Sandy Hook in the north to Cape May in the south. This geography makes the region highly susceptible to coastal storm events.

### Historical Storm Impacts

Two major storms are highlighted as examples of the severe threats facing the region.

#### Superstorm Sandy (October 2012)

A path map illustrates the storm's trajectory, noting its unusual westward turn.

- **Primary Impact:** The storm "abruptly veered toward the Greater New York City area, causing severe coastal flooding and erosion driven primarily by storm surge."

**Hurricane Ida (August-September 2021)**

A path map shows the hurricane's track from the Gulf of Mexico northeastward.

- **Primary Impact:** The remnants of the storm had a catastrophic effect on the region. The event "severely impacted New Jersey and New York, delivering torrential rainfall that triggered widespread and severe flash flooding."