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	3020	*2025*	*ARC-3020*	*1/2025*	*00*	*Architecture*

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المكتب الهندسي لخدمات التكنولوجيا و البرمجيات

Engineering office for Technology and Software Services

📐 **Advanced Structural Design**

Course Code: 3020-ARC

Title: Advanced Structural Design – Analysis and Simulation of Complex Architectural Structures

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📘 Course Introduction

This advanced-level course provides a comprehensive understanding of modern structural design techniques for complex architectural forms. It integrates theoretical foundations with practical applications, preparing professionals to tackle real-world challenges using cutting-edge analysis tools and sustainable practices.

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📘 Course Description

This advanced course explores the principles and practices of designing complex structural systems in modern architecture. It covers advanced load analysis (including wind, seismic, and dynamic forces), high-performance materials, and structural simulation using state-of-the-art tools. Engineers, architects, and advanced students will engage in real-world scenarios that bridge theory with practical design, with a strong focus on safety, innovation, and sustainability.

Participants will utilize software like **SAP2000**, **ANSYS**, and **ETABS** to simulate, analyze, and verify structural performance, culminating in a **capstone project** where learners develop a fully engineered solution for a sophisticated building structure.

📚 Detailed Course Outlines

Module 1: Introduction to Advanced Structural Design

- Overview of traditional vs. advanced structural approaches
- Key challenges in complex architectural structures
- Role of structural engineers in multidisciplinary teams

Module 2: Structural Load Analysis

- Load types: dead, live, wind, seismic, thermal, snow
- Dynamic and transient loading
- Load combinations and factors of safety
- National and international codes: ACI, Eurocode, ASCE

Module 3: Design with High-Performance Materials

- Properties and applications of:
    - High-strength concrete (HSC)
    - Fiber-reinforced concrete (FRC)

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- o High-tensile steel (HTS)

- Behavior under extreme loads

- Material selection for architectural needs

Module 4: Simulation and Modeling Tools

- Introduction to SAP2000, ETABS, ANSYS Workbench

- Finite Element Modeling (FEM) techniques

- Modal and frequency analysis

- Load path visualization and stress mapping

Module 5: Safety, Codes & Sustainability

- Design for resilience (earthquake-resistant design)

- Performance-based engineering

- Energy efficiency and structural sustainability

- Green building considerations and LEED relevance

Module 6: Structural Optimization & Innovation

- Structural systems for high-rise and irregular buildings

- Lightweight structures and long-span systems

- Parametric and generative structural design

- Value engineering and cost-efficiency strategies

Module 7: Practical Applications

- Industry case studies (bridges, towers, stadiums)

- Peer review of project progress

- Troubleshooting complex design issues

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- Team collaboration techniques

Module 8: Capstone Project

- Design and simulate a complete structural system

- Submit full calculation sheets, CAD drawings, and simulation reports

- Present final project to jury panel or instructor for feedback

🎓 Target Audience

- Structural and civil engineers seeking advanced design skills

- Architects collaborating with structural teams

- Graduate students in architecture or engineering fields

- BIM and simulation specialists looking to expand into structural analysis

- Professionals preparing for real-world multidisciplinary projects

🕐 Time Frame

- **Duration:** 8 weeks

- **Effort:** 5–6 hours per week

- **Structure:**

  o 6 weeks: core modules

  o 1 week: simulation workshops

  o 1 week: final project submission and presentation

❇ Instruction Format

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- **Delivery:** Online / Hybrid / In-person (flexible)

- **Includes:**

   o Pre-recorded expert video sessions

   o Hands-on simulation labs

   o Weekly assignments and quizzes

   o Live Q&A and design critique sessions

   o Downloadable references and guides

   o Capstone mentorship and feedback

🎯 What You Will Learn

- Perform advanced structural analysis under dynamic and environmental loads.

- Design using high-performance materials like fiber-reinforced concrete and high-strength steel.

- Utilize simulation software such as SAP2000 and ANSYS for structural modeling.

- Apply safety and sustainability standards in modern structural systems.

- Execute a capstone project: structural design of a complex architectural form.

📅 Time Frame

- **Duration:** 8 weeks

- **Study Time:** Approx. 5–6 hours/week

- **Final Project:** Week 8 – Structural design submission and presentation

🖥 Course Format

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- Online or hybrid (depending on the institution)

- Weekly video lectures and readings

- Practical exercises using engineering software

- Interactive discussion forums

- Final project with feedback and evaluation

📦 Materials Included

1. **Course Manual (PDF)** – theory, design procedures, codes

2. **Video Lectures** – HD recordings with real-case walkthroughs

3. **Software Tutorials** – SAP2000, ANSYS (simulation exercises)

4. **Design Templates** – structural drawings, load calculations

5. **Case Studies** – analysis of real complex structures

6. **Quizzes & Assignments** – reinforce learning after each unit

7. **Capstone Project Brief** – Design a structure with performance criteria

8. **Reference Codes & Standards** – ACI, Eurocode, ASCE excerpts

9. **Certificate of Completion** – Issued after final project approval

✅ Outcomes

By the end of the course, participants will:

- Master structural analysis techniques for irregular and high-performance buildings.

- Design safe and sustainable structural systems for architectural innovation.

- Build confidence in using engineering software for professional practice.

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المكتب الهندسي لخدمات التكنولوجيا و البرمجيات

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- Present structural design proposals with clarity and technical accuracy.