FEA Professional

Degrees Offered

- Graduate Certificate – FEA Professional

Program Description

The Graduate Certificate – FEA Professional is a fully online graduate-level certificate program that teaches advanced skills in finite-element analysis for structural applications. The program has been designed to train recent graduates or midcareer professionals with at least a BS in engineering, computer science, or applied engineering physics who are interested in careers and/or opportunities in design, product development, or applied research. The program leverages industry-leading software to empower students with the skills and experience to drive innovation in their chosen field. Our courses help students build a foundation of practical knowledge focused on key fundamentals of applied computational mechanics complemented by the perfect balance of theoretical background. The fundamentals learned here may be applicable across a broad range of industries. Upon completion of the program, graduates will have the skills to: a) earn software-specific endorsements/certifications for industry-leading products such as Abaqus, SolidWorks Simulation, ANSYS, b) drive innovation through the effective application of simulation tools for ideation and design verification, c) leverage simulation to reduce physical testing in new product development (NPD) and reduce time to market, d) exploit parametric simulation, DOE, and optimization to reveal more and better R&D solutions, e) identify CTQ's in your development or applied research projects and quantify impact on all relevant outcome metrics, f) execute, review, and manage simulation strategies for your NPD or applied research pipeline, and g) spec software tools and training for your team.

Primary Contact

FEA Professional Program
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Associate Professor and Program Director

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Professor of Practice

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Program Requirements

The Graduate Certificate – FEA Professional requires a set of three core courses (Table 1) and one elective chosen from selected relevant online courses (Table 2). Elective options will continue to expand as the program matures.

The student must complete the following three core courses.

FEGN525	ADVANCED FEA THEORY & PRACTICE	3.0
FEGN526	STATIC AND DYNAMIC APPLICATIONS IN FEA	3.0
FEGN527	NONLINEAR APPLICATIONS IN FEA	3.0

The student must complete one of the following elective courses (3 semester hrs).

FEGN528	FEA FOR ADVANCED DESIGN APPLICATIONS	3.0
AMFG521	DESIGN FOR ADDITIVE MANUFACTURING	3.0

Transfer Credits

Transfer credits are not currently accepted to satisfy requirements for the Graduate Certificate – FEA Professional.

Prerequesites

A baccalaureate degree in engineering, computer science, a physical science, or mathematics is required.

Courses

FEGN525. ADVANCED FEA THEORY + PRACTICE. 3.0 Semester Hrs.
This course examines the theory and practice of finite element analysis. Direct methods of deriving the FEA governing equations are addressed as well as more advanced techniques based on virtual work and variational methods. Common 1D, 2D, and 3D element formulations are derived, and key limitations examined. Matlab is used extensively to build intuition for FEA solution methods and students will create their own 2D FEA code by the end of the course. The commercial FEA software Abaqus is introduced with hands-on examples and Matlab solutions are compared to Abaqus for model validation.
Course Learning Outcomes

- Define DOF.
- Recall three different approaches for developing governing equations in FEA and list typical applications for each.
- Apply FEA governing equations to solve2D structural analysis by hand using symbolic math in Matlab.
- Explain and execute a mesh convergence study.
- Define the isoparametric element formulation and use shape functions to derive isoparametric elements for 2D and 3D applications.
- Recall numbers and locations of integration points for different element types.
- List and explain limitations of common 2D and 3D elements.

FEGN526. STATIC AND DYNAMIC APPLICATIONS IN FEA. 3.0 Semester Hrs.
This course emphasizes proficiency with commercial FEA software for solution of practical static, quasistatic, and dynamic structural problems. Common 1D, 2D, and 3D elements are examined in the context of linear solution techniques. Students will explore efficient methods for model construction and solution with commercial tools (the Abaqus FEA software). Emphasis will also be placed on verification, validation, and reporting standards for effective application of FEA software tools. Online course. Prerequisite: FEGN525.
Course Learning Outcomes

- Explain the difference between implicit and explicit solvers for static, quasi-static, and dynamic analyses.
- Compare the pros and cons of solutions obtained using implicit and explicit solvers for static, quasi-static, and dynamic analyses.
- Perform a 1D, 2D, or 3D structural analysis with or without symmetry (axi, cyclic).

- Request desired outputs from commercial FEA software and recall the difference between field and history output data types.
- Setup an FEA analysis to request desired output variables defined spatially and temporally.
- Use commercial FEA software pre-processor to visualize results from an FEA solution.

FEGN527. NONLINEAR APPLICATIONS IN FEA. 3.0 Semester Hrs.
This course explores common nonlinearities frequently encountered in structural applications of FEA. Students will gain proficiency in modeling geometric nonlinearity (large strains), boundary nonlinearity due to contact, and material nonlinearity (creep, rate dependence, plasticity, temperature effects, residual stress). The commercial FEA software Abaqus is used for hands-on experience. Online course. Prerequisite: FEGN526.
Course Learning Outcomes

- Recall and explain the three most common sources of nonlinearity in an FEA simulation.
- Perform an FEA simulation including large strains and finite rotations.
- Execute an FEA simulation including contact and compare several strategies for modeling contact interactions.
- Develop and apply nonlinear models for hyperelastic, viscoelastic, and elastic-plastic materials.
- Use an FEA simulation to compute residual stresses in a part following plastic deformation.
- Construct a clear report to communicate work performed for an FEA simulation.

FEGN528. FEA FOR ADVANCED DESIGN APPLICATIONS. 3.0 Semester Hrs.
In this course students will learn the automation tools and methods necessary for effective application of FEA on advanced design problems. Strategies for parametric analysis, performance optimization, and consideration of statistical uncertainty will be examined using Python scripting and commercial automation software. Online course. Prerequisite: FEGN526.
Course Learning Outcomes

- Apply Python scripting to automate parametric analysis of a part or assembly using commercial FEA software.
- Apply Abaqus Isight to automate parametric analysis of a part or assembly using commercial FEA software.
- Use Python scripting or other software tools to automate extraction and post-processing of results from commercial FEA software.
- Apply automation tools to perform optimization and probabilistic analysis using commercial FEA software.
- Construct a clear report to communicate work performed for an FEA simulation.

FEGN599. INDEPENDENT STUDY. 0.5-6 Semester Hr.