1. Introduction to CAE and FEA

- **Introduction to CAE (Computer-Aided Engineering):** Overview of CAE, its benefits, and its role in product development.
- **Introduction to FEA (Finite Element Analysis):**
  - Fundamental concepts of FEA: Nodes, elements, degrees of freedom, stiffness matrix.
  - General procedure for conducting FEA.
  - Key assumptions in FEA (geometry, material properties, boundary conditions).
  - Types of engineering analysis (structural, thermal, fluid flow, electromagnetic, coupled field).
  - Important terms and definitions (stress, strain, load, elastic limit, factor of safety, etc.).
  - Advantages and limitations of FEA software.

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2. Introduction to ANSYS Workbench

- **ANSYS Workbench Interface:** Understanding the graphical user interface (GUI), project schematic, and toolbox.
- **System Requirements and Installation.**
- **Working on a Project:** Project management, saving files, database, and file formats.
- **Units in ANSYS Workbench:** Setting and changing unit systems.
- **Components of the System.**

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3. Geometry Modeling

- **DesignModeler:**
  - Introduction to DesignModeler.
  - Sketching tools and techniques (lines, circles, arcs, rectangles, polygons, constraints, dimensions).
  - Solid modeling fundamentals: Extrusion, revolution, sweep, loft.
  - Placed features: Holes, rounds, chamfers, patterns.

    - Boolean operations: Intersect, add, subtract, overlap, glue, divide.
    - Surface and line models.
- **Importing CAD Models:** Importing geometry from other CAD software.
- **Geometry Clean-up and Repair:** Identifying and fixing common geometry issues.
- **Parameters:** Introduction to parameterization for design exploration.

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4. Material Properties

- **Engineering Data:** Introduction to the Engineering Data workspace.
- **Creating and Adding Materials:** Defining linear elastic, plastic, and other material models.
- **Assigning Materials:** Applying defined materials to different parts of the geometry.

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5. Meshing

- **Introduction to Meshing:** Understanding the purpose of meshing in FEA.
- **Types of Elements:** 1D, 2D, and 3D elements (quadrilateral, triangular, brick, tetrahedral, shell).
- **Meshing Techniques:**
    - Mapped vs. Free meshing.
    - Global mesh settings and local mesh refinement.
    - Mesh controls (sizing, inflation, face meshing).
    - Mesh quality assessment and visualization.
    - Assembly meshing.
- **Body of Influence:** Using specialized tools for meshing.

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6. Structural Analysis

- **Static Structural Analysis:**
    - Introduction to static structural analysis theory.
    - Preprocessing: Applying loads (forces, pressure, moment) and supports (fixed, displacement, remote).
    - Contact regions: Types of contact (bonded, no separation, frictional, frictionless) and contact settings.
    - Analysis settings.

    - Solution and post-processing: Interpreting results (stress, strain, deformation, factor of safety, reaction forces).
    - Case studies (cantilever beam, plate with holes, pressure vessel, assembly).
- **Modal Analysis (Natural Frequencies):**
    - Introduction to vibration and modal analysis.
    - Performing modal analysis to determine natural frequencies and mode shapes.
    - Specifying analysis settings for modal analysis.
    - Case studies (beams, plates, assemblies).
- **Buckling Analysis:**
    - Introduction to buckling phenomena.
    - Performing buckling analysis to determine critical buckling loads.
    - Case studies (columns, built-up structures).
- **Harmonic Response Analysis:** Analyzing structural response to oscillatory loads.
- **Explicit Dynamics:** Introduction to explicit dynamics for high-speed, short-duration events (impact, drop tests).
- **Nonlinearities:** Geometry nonlinearities (large deformation), material nonlinearities (plasticity), and contact nonlinearities.
- **Fatigue Analysis:** Predicting the fatigue life of components.

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7. Thermal Analysis

- **Introduction to Thermal Analysis:** Important terms (heat transfer modes, thermal gradient, thermal flux).
- **Types of Thermal Analysis:** Steady-state and transient thermal analysis.
- **Thermal Boundary Conditions:** Conduction, convection, radiation.
- **Thermal Stress Analysis:** Coupling thermal and structural analyses to predict stresses due to temperature changes.
- Case studies (heat sinks, engine components, electronic devices).

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8. Fluid Dynamics (CFD)

- **Introduction to CFD:** Fundamentals of fluid flow.
- **ANSYS Fluent/CFX:**
    - Preprocessing: Meshing for fluid domains.
    - Defining flow boundary conditions (inlet, outlet, wall).
    - Solver settings and options.
    - Performing laminar and turbulent flow simulations.

    - Post-processing: Visualizing flow velocity, pressure, temperature contours, streamlines.
- **Conjugate Heat Transfer (CHT):** Coupled fluid and solid thermal analysis.
- **Fluid-Structure Interaction (FSI):** Simulating the interaction between fluid flow and structural deformation.

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9. Multiphysics and Optimization

- **Multiphysics Simulations:** Combining different physics phenomena (e.g., thermal-structural, FSI).
- **DesignXplorer and Optimization:**
    - Introduction to design optimization and exploration.
    - Parameterization for design of experiments (DOE).
    - Response surface creation, correlation, and goal-driven optimization.

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10. Post-processing and Reporting

- **Interpreting and Visualizing Results:** Contour plots, vector plots, animations, path plots.
- **Generating Reports:** Creating professional reports of analysis results.
- **Validation:** Techniques for validating simulation results (e.g., comparison with analytical solutions or experimental data).

Advanced Topics (May be covered in specialized courses):

- **Acoustics Analysis**
- **Electromagnetics (Maxwell, HFSS)**
- **Additive Manufacturing Simulation**
- **Rigid Body Dynamics (ANSYS Motion)**
- **Materials Characterization**
- **Submodeling:** Detailed analysis of a localized region of interest.
- **Scripting and Automation (Python in ANSYS)**

The specific depth and breadth of topics can vary based on the course duration, target audience (e.g., beginner, intermediate, advanced), and the specific ANSYS modules being emphasized. Certification exams usually cover both theoretical knowledge of FEA/CFD and practical application skills within the ANSYS software.