ABET Course Syllabus

ENAE 481 Principles of Aircraft Design (0101)

Credits & Contact Hours: 3 credits (3 hours of lecture)

Course Status: Required

Schedule: Offered every Fall semester

Course Description: Aircraft design principles blending both synthesis and analysis. The iterative nature of the design process. Applied aerodynamics. Elements of aircraft performance calculation and optimization. Design of aircraft including payload, crew and avionics provisions, propulsion selection and sizing, aerodynamic configuration optimization, mass properties, stability and control characteristics, and vehicle subsystems. Individual student projects in aircraft design.

Pre-Requisites: ENAE 324, ENAE 362, ENAE 432

Co-Requisites: ENAE 414

Textbooks: None

Other Required Material: Course lecture notes and handouts

Course Oversight: Design/Lab Committee

Syllabus Prepared By/Date: Dr. Palumbo

Course Objectives/Student Learning Outcomes:

1. Calculate jet and propeller driven airplane performance (takeoff/landing distance, range, endurance, climb, maneuver)
2. Perform conceptual airplane and propulsion sizing estimates to meet specified operational and performance requirements

Topics Covered:

- Phases of the design process
  - Conceptual Design
  - Preliminary Design
  - Detailed Design
  - Typical program organization and personnel responsibilities.
  - Role of the aircraft designer - you are a key member of the design team
  - Major differences between manned and unmanned air vehicle design
- Basic aircraft terminology and conventions
  - Coordinate systems, forces and moments, aerodynamic coefficients
  - Aircraft weight breakdown and definitions
  - Basic aircraft performance terminology (flight in the horizontal and vertical planes)
- Aircraft sizing
  - Factors influencing aircraft configuration, size and weight
  - Weight breakdown
  - Historical weight data

  - Sizing with a “rubber” engine
  - The lift curve and parabolic drag polar
- Aircraft Performance and Fuel Fraction Estimates
  - Range
  - Endurance
  - Maneuvering Flight in the vertical and horizontal planes
  - Climbing Flight
  - Descent/Glide
  - Field Performance – Takeoff and Landing
  - Special performance requirements
- Propulsion System Selection
  - Flight regimes
  - Refined performance estimating methods
  - Installation factors
- Configuration trade studies
  - Configuration type (tailless, canard, conventional)
  - Wing location
  - Empennage configurations (cruciform, T, H, V, cathedral)
  - Engine placement (single and multi engine)
  - Landing gear type and placement (tail dragger, tricycle, tandem)
  - Airfoil selection
  - Packaging for storage/transport

Relationship of Course Objectives to Program Outcomes
This course addresses program outcomes: 1, 3, 4, 5, 7, 8, 9, 10, 12, 13, 16