Course Specifications

Program(s) on which this course is given:	Masters Program
Department offering the program:	**Department of Aerospace**
Department offering the course:	**Department of Aerospace**
Academic Level:	Masters
Date	
Semester (based on final exam timing)	■ Fall ■ Spring

A- Basic Information

1. Title:	**Boundary layer control and turbulence**			**Code:**	**AER612**			
2. Units/Credit hours per week:	Lectures	3	Tutorial	NA	Practical	**NA**	Total	3

B- Professional Information

1. Course description:

This course introduces Turbulent flows, with emphasis on engineering methods. Governing equations for momentum, energy, and species transfer. Turbulence: its production, dissipation, and scaling laws. Reynolds averaged equations for momentum, energy, and species transfer. Simple closure approaches for free and bounded turbulent shear flows. Applications to jets, pipe and channel flows, boundary layers, buoyant plumes and thermals, and Taylor dispersion, etc., including heat and species transport as well as flow fields.

2. Intended Learning Outcomes of Course (ILOs):

a) Knowledge and Understanding

- Derive the governing equations for laminar and turbulent boundary layers
- Understand the different length and time scales for turbulent flows and concept of eddy viscosity

b) Intellectual Skills

- To solve laminar boundary layer flows
- To apply momentum techniques and circulation to enhance flow over laminar airfoils
- To solve and model turbulent flows for free shear flows, jets, wall bounded flows and flow in pipes

c) Professional and Practical Skills

- Apply course material to examine a relevant research project, such as turbulent flow over airfoils, heat exchangers and ducts

d) General and Transferable Skills

- Solving complex unsteady aerodynamics problems

3. Contents

Topic	Total hours	Lectures hours	Tutorial/ Practical hours
Introduction	3	3	
Derivation of Boundary Layer Equations	6	6	
Laminar Boundary Layer, Separation and Control	6	6	
Turbulent Transport of Momentum and Heat	6	6	
The Dynamics of Turbulence	6	6	

Free Shear Flows	3	3	
Wall Bounded Flows	3	3	
Turbulent Flows in Channels	3	3	
Statistical Nature of Turbulent Flows	3		
Modeling of Turbulent Flows	6		
4. Teaching and Learning Methods	Lectures ■	Practical Training/ Laboratory ( )	Seminar/Workshop ( )
	Class Activity ( )	Case Study ( )	Projects ■
	E-learning ( )	Assignments /Homework ( )	Other:

5. Student Assessment Methods	
• **Assessment Schedule**	**Week**
-Assessment 1; Class test	NA
-Assessment 2; Project Assignment	During the last week of the course
-Assessment 3; Presentations	NA
-Assessment 3; Midterm Exam	NA
-Assessment 4; Final Exam	15
• **Weighting of Assessments**	
-Mid-Term Examination	NA
-Final-term Examination	70%
-Project	30%
-Class Test	NA
-Presentation	NA
-Total	100%

6. List of References

- A First Course in Turbulence , Henk Tennekes and John L. Lumley

7. Facilities Required for Teaching and Learning

.White board, projector, computer

Course Coordinator:	**Dr. Basman Elhadidi**
Head of Department:	**Dr. Ayman Kassem**