University: Cairo Faculty: Engineering Department: Aerospace Engineering

Course Specifications

Programme(s) on which the course is given: **Aerospace Engineering**

Major or Minor element of programmes: **Aerodynamics**

Department offering the programme: **Aerospace Engineering**

Department offering the course: **Aerospace Engineering**

Academic year / Level: **2nd year Aero. Eng.Students**

Date of specification approval

A- Basic Information

Title:Fluid and Gas Dynamics Code: **AER 201 B**

Credit Hours: Lecture: **3**

Tutorial: **2** Practicals: Total: **5**

B- Professional Information

1 – Overall Aims of Course

The aim of teaching AER201B (Gas Dynamics) is to introduce the student to high speed flows. The entry behavior to this class will be a student who has attended AER201A (Fluid Dynamics). Gas dynamics can be described as an introductory class on inviscid compressible flow. This course consists of six chapters and includes a mixture of classical analysis along with some computational techniques.

2 – Intended Learning Outcomes of Course (ILOs)

a- Knowledge and Understanding:

a1.Students are conversant with the pressure, velocity and temperature relations for one-dimensional compressible flows in ducts with shocks, heat addition (Rayleigh flows) and friction (Fanno flows)

a2.Students can solve problems on above flows using the appropriate charts and tables for normal shocks, Rayleigh and Fanno flows.

a3.Students understand and are able to calculate oblique shocks and expansion waves using appropriate charts.

a4. Students can solve problems on shock reflection and intersection and are familiar with pressure-deflection diagrams

a5. Students understand and are able to calculate isentropic flows in varying-area ducts such as convergent, divergent and convergent-divergent nozzles

a6. Students understand the wave equation and the concept of moving normal shock waves in ducts and their reflection at the end walls.

a7. Students understand and are able to calculate pressure, temperature and velocity variations in shock tubes

b- Intellectual Skills

b1- Analysis.

b2- Problem solving.

b3- Creative thinking.

c- Professional and Practical Skills

c1- Managing.

c2- Perform basic Gas Dynamics measurements and data analysis.

c3- Communicate important results of Gas Dynamics experiments in written reports of various styles.

d- General and Transferable Skills

d1- Computing skills

d2- Working in a group

d3- Use of technological tool

3- Contents

Subject Area	No. of Hours	Lectures (hr)	Exercise / Laboratory (hr)
Introduction and brief review of thermodynamics: Thermodynamics laws and relation, perfect gas, compressible flow, flow regimes	**8**	**4**	**3**
Governing equations for inviscid flows: Philosophy, approach, integral forms of the continuity, momentum, and Energy equation.	**4**	**2**	**2**

One-dimensional flows: Introduction, equations, speed of sound and Mach number, some conventional defined flow parameters, alternate forms of the one dimensional flow equations, normal Shock wave relations, one dimensional flow with heat addition, one dimensional flow with friction.	**12**	**6**	**6**
Oblique shock waves and expansion waves (Prandtl Meyer flow) Introduction, oblique shock wave relations, supersonic flow over wedges and cones, shock polar, pressure deflection diagram, Prandtl Meyer expansion waves, shock expansion theory.	**12**	**6**	**4**
Quasi-one-dimensional governing equations, Aera velocity relation, flow through variable area ducts, diffusers.	**8**	**4**	**1**
Unsteady one dimensional flow: Introduction, moving normal shock wave, reflected shock wave, shock tube relations.	**2**	**1**	**1**

4– Teaching and Learning Methods

4.1- Lecture
4.2- Information collection
4.3- Class activities
4.4- Discussions
4.5- Practical training

5- Student Assessment Methods

5.1 **Class test (1)** to assess **Understanding.**
5.2 **Reports.** to assess **Problem Solving**
5.3 **Mid-term topics.** to assess **Gains of completed**

Assessment Schedule

Assessment 1……. Week ……**3**…….
Assessment 2 ……. week …….**5**…….
Assessment 3……. Week ……**6,7**…..

Assessment 4…….	Week ……**8,9**…..
Assessment 5…….	Week ……**10,11**….
Assessment 6…….	Week ……**12,13**.

Weighting of Assessments	
Mid-Term Examination	12%
Final-term Examination	68%
Oral Examination.	0%
Practical Examination	0%
Semester Work	16%
Other types of assessment	4%
Total	100%

Any formative only assessments

6- List of References

6.1- Course Notes

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6.2- Essential Books (Text Books)

Anderson, J.D., "Modern Compressible Flow with Historical Perspective" McGraw-Hill. 1990.

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6.4- Periodicals, Web Sites, … etc

http://www.eng.cu.edu.eg/users/mkhalil/AER201B

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7- Facilities Required for Teaching and Learning

Aerodynamic Laboratory at the Aerospace Engineering Department

Course Coordinator:

Dr. Eng. Mohammed Khalil Ibrahim, Aerospace Engineering Department 2F, Phone: 567-8653 (Office)

Head of Department: Prof. Ayman H. Kassem

Date: **March. 2015**