University: Cairo **Faculty: Engineering** **Department: Aerospace Engineering**

Course Specifications

Programme on which the course is given: B.Sc. in Aerospace Engineering

Major or minor element of programme: Major

Department offering the programme: Aerospace Department

Department offering the course: Aerospace Department

Academic year / Level: 3rd year

Date of specification approval: March 2015.

A- Basic Information

Title:	Propulsion of Jet Engines	**Code:**	AER 306		
Credit Hours:	3	**Lectures:**	4		
Tutorials:	2	**Practical:**	Included	**Total:**	**6**

B- Professional Information

1- Overall Aims of Course

- To distinguish between the capabilities of different types of Turbomachines.
- To provide the capability of conducting design analysis of axial flow compressors and turbines.
- To predict existing compressor or turbine off design characteristics.
- To know the types of intakes for different operating regimes and applications.
- To appreciate the internal and external aspects of intake performance, and to be able to use suitable analysis techniques for its evaluation for subsonic airplanes.
- To know the types of nozzles for different operating regimes and applications, and to appreciate the associated scientific problems.

2- Intended Learning Outcomes of Course

a- Knowledge and Understanding

a1- Basic knowledge of compressor and turbine cascade characteristics.

a2- Stage analysis and effects of its parameters on compressor and turbine design point overall performance.

a3- Estimating off design performance of compressors and turbines.

b- Intellectual Skills

b1- Hypothesizing and synthesizing the modeling process.

b2- The ability to analyze results and draw conclusions.

c-Professional and Practical Skills

c1- Construct and use software codes.

d- General and Transferable Skills

d1- The capability to split complicated systems into model-able modules.

d2- The capability to choose a convenient model rigorous to employ.

d3- To have an over view of the design process.

3- Contents

Topic	Total hrs	Lectures	Tutorial
Introduction			
Classification of turbomachines	3	3	
Torque-power-velocity triangle - blade passage	2	2	
Axial flow compressors			
Temperature rise across stage – aerodynamic loading coefficients	4	2	2
Cascade geometry-incidence-deviation-deflection-NACA65 series	2	2	
Deviation prediction	2	2	
Types of losses -diffusion factor- profile loss correlation	4	4	
Optimum incidence	2	2	
Stage efficiency evaluation	2	2	
Degree of reaction – nondimensional velocity triangle	2	2	
Blockage-work done factor	2	2	
Design of multistage compressor based on mean line analysis	8	2	6
Basic concepts in off design analysis	2	2	
Off design evaluation of compressor stage	7	2	5
Stall and compressor surge	2	2	
Axial flow turbines			
Introduction-temperature drop across stage	2	2	
Flow outlet angle	2	2	
Losses: Soderberge - Ainely's correlation	2	2	
Degree of reaction implications on velocity triangle	2	2	
Design of turbine based on mean line analysis	7	2	5
Turbine stage off design performance	3	3	
Multistage turbine performance characteristics	7	2	4
Turbine cooling techniques	3	2	
3D flow in turbomachines			
Simple radial equilibrium equations- indirect problem	3	3	
Direct problem	5	2	3
Intakes			
Intake pressure recovery	2	2	
Intake drag, approximate theory of frictional losses	4	4	
Nozzles			
Characteristics of convergent nozzles	2	2	
Types and performance of convergent divergent nozzles	2	2	
Σ	90	63	27

4- Teaching and learning Methods

4.1 Lecturing in a dynamic way and using teaching aids (slides and overhead projector).

4.2 Assignments including closed and open ended problems.

5- Student Assessment Methods

5.1	Quizzes	to asses	design tools
5.2	Reports	to asses	small preliminary design problems
5.3	Exams	to asses	the ability to cast inputs and use engine analysis techniques to produce specific outputs

Assessment Schedule

Assessment 1	Quiz 1	Week	3
Assessment 2	Report 1	Week	4
Assessment 3	Quiz 2	Week	5
Assessment 4	Report 2	Week	7
Assessment 5	Midterm exam	Week	8
Assessment 6	Report 3	Week	9
Assessment 7	Quiz 3	Week	10
Assessment 8	Report 4	Week	12
Assessment 9	Quiz 4	Week	13
Assessment 10	Report 5	Week	15
Assessment 11	Final Exam	Week	16

Weighting of Assessments

Mid-term Examination	10 %
Final-term Examination	68 %
Semester work	22 %

6- List of References

6-1 Course Notes

Not available

6-2 Essential Books (Text Books)

- N.Cumpsty, “Compressor Aerodynamics”, 1989
- R.I.Lewis, Turbomachinery Performance Analysis", 1996
- S.Dixon, “Fluid Mechanics and Thermodynamics of Turbomachines”, 1998

6-3 Recommended books

- J.L.Kerrbrock, “Aircraft Gas Turbines and Engines”, 1992
- P.G.Hill, G.R.Peterson, “Mechanics and Thermodynamics of Propulsion”, 1992
- H.Cohen, G.F.C.Rogers, H.Saravanamuttoo, “Gas Turbine Theory”, 1996
- Seddon, E.L.Goldsmith, "Intake Aerodynamics", 1999

6-4 Periodicals, Web sites, …. etc

7- Facilities Required for Teaching and Learning

- Lecture rooms
- Projector and overhead projectors
- PC computer and internet connection

Course Coordinator: Prof. A.A Hashem

Head of Department: Prof. Ayman H. Kassem

Date: March, 2015.