Course Specifications

Program(s) on which this course is given:	Aerospace Engineering
Department offering the program:	Aerospace Engineering Department
Department offering the course:	Aerospace Engineering Department
Academic Level:	Doctor of Philosophy
Date	
Semester (based on final exam timing)	☐ Fall ☐ Spring

A- Basic Information

1. Title:	Modal Analysis of Structures			**Code:**	AER 730			
2. Units/Credit hours per week:	Lectures	2	Tutorial	0	Practical	0	Total	2

B- Professional Information

1. Course description:	This course is the first of a series of two courses aiming to setup the theoretical and technical background behind experimental modal analysis. The course begins with reviewing single degree of freedom (SDOF) and multi degree of freedom (MDOF) models with hysteretic, proportional viscous and general viscous damping. The modal parameters (natural frequencies, mode shapes and modal damping) are calculated. The frequency response function (FRF) is introduced and calculated. The free/forced responses and FRF's are calculated both directly and in terms of the modal parameters. These concepts are applied to finite element (FE) models. Finally, modal parameter extraction methods are used for calculating the modal parameters from experimentally measured FRF's.
2. Intended Learning Outcomes of Course (ILOs):	**a) Knowledge and Understanding**
	1) Know the advanced structures of Aerospace vehicles
	2) Know modal parameters and modal analysis
	3) Know resonance and damped response
	4) Know what the FRF is
	5) Know that all modal parameters are contained in the FRF
	6) Know about modal testing for experimental modal analysis
	7) Understand the influence of modal parameters on the response and the FRF
	8) Understand the response and FRF modal superposition
	b) Intellectual Skills
	9) Modeling physical process mathematically and numerically
	10) Calculate SDOF modal parameters
	11) Calculate SDOF free and Forced response
	12) Calculate and present SDOF FRF
	13) Calculate the free/forced response and FRF's of MDOF model using the direct method
	14) Calculate the modal parameters of MDOF models with hysteretic, proportional viscous and general viscous damping
	15) Calculate the free/forced response and FRF's of MDOF model using the modal parameters
	16) Check the quality of experimentally measured FRF's
	17) Calculate modal parameters from experimentally measured FRF's
	c) Professional and Practical Skills

	18) Structural synthesize and/or design of a complete aerospace vehicle
	19) Practice several experimental modal analysis techniques and skills
	20) Gain serious programming and visualization skills using Matlab
	d) General and Transferable Skills
	21) Solve problems
	22) Analyze results and reach conclusion
	23) Understand the frequency spectrum and extract useful information from it
	24) Ability to design structures under dynamic load

3. Contents

Topic	**Total hours**	**Lectures hours**	**Tutorial/ Practical hours**
Introduction to Modal Analysis	1	1	
Tour on Experimental Modal Analysis	1	1	
SDOF Modal Analysis	6	4	2
MDOF Spatial Analysis	4	2	2
MDOF Modal Analysis	8	6	2
Experimental Modal Analysis	4	2	2

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; Report Assignment	2
-Assessment 2; Report Assignment	3
-Assessment 3; Report Assignment	4
-Assessment 4; Report Assignment	5
-Assessment 5; Midterm Exam	7
-Assessment 6; Report Assignment	8
-Assessment 7; Report Assignment	10
-Assessment 8; Report Assignment	12
-Assessment 9; Final Exam	15
• **Weighting of Assessments**	
-Mid-Term Examination	6
-Final-term Examination	70
-Reports	18
-Class Attendance	6
-Total	100

6. List of References

1) A. Brandt, Noise And Vibration Analysis, Wiley, 2011.

2) D. J. Ewins, Modal Testing: Theory and Practice, Wiley, 2nd ed., 2001.

3) Mircea Rades, Mechanical Vibrations I, 2006.
7. Facilities Required for Teaching and Learning
Projector, white board, Modal analysis laboratory (Signal analyzer, multichannel dynamic data acquisition, vibration sensors (accelerometers), force transducers, programmable function generators, shakers, impact hummer, test structure, data acquisition/analysis software, experimental modal analysis software)

Course Coordinator:	**Dr. Ahmed Mohamed Rashed Desoki**
Head of Department:	**Prof. Ayman Hamdy Kassem**