Universidad Carlos III de Madrid
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COURSE: Advanced Aeroelasticity		
MASTER: Aerospace Engineering	YEAR: 1st	TERM: 2nd

La asignatura tiene 28 sesiones que se distribuyen a lo largo de 14 semanas. Los laboratorios pueden situarse en cualquiera de ellas. Semanalmente el alumnos tendrá dos sesiones, excepto en un caso que serán tres

WEEKLY PLANNING

WEEK	SESSION	DESCRIPTION	GROUPS (mark X)		SPECIAL ROOM FOR SESSION (Computer class room, audio-visual class room)	Indicate YES/NO If the session needs 2 teachers	WEEKLY PROGRAMMING FOR STUDENT		
			LECTURES	SEMINARS			DESCRIPTION	CLASS HOURS	HOME WORK HOURS (Max. 7h week)
1	1 6F	**Advanced Aeroelasticity. Getting Started**. → Course presentation → Aeroelasticity as a multidisciplinary task → History of aeroelasticity ▪ Revisiting Wing Divergence ▪ Revisiting Control reversal ▪ Revisiting flutter ▪ Revisiting dynamic landing ▪ Revisiting gust and turbulence response ▪ Revisiting buffet → Root Cause Analysis (**RCA**): failed equipment. Prepare a table of possible	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform Homework RCA.	1,6	2

		causes and the way to verify if this is the right cause. Present to the student a RCA fish-bone diagram and disregard some of the options like manufacturing quality etc.							
2	2 13F	**Environmental Vibration** → RCA failed equipment analysis brainstorming. → Causes of the environmental vibration in an aircraft. Differential Diagnosis. → Measuring environmental vibration. ▪ Revisiting DSP. ▪ Aliasing, leakage,… → In lack of measurements: MIL-STD-810 & RTCA-DO-160 → Establishing Requirements for Environmental Vibration Qualification → Tracking equipment qualification test → 1 dof vibration equations… → Engineering with only 1 dof: isolators → Root Cause Analysis (RCA): EVIS failure	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform Homework RCA.	1,6	3
3	3 20F	**Powerplant Dynamics** → RCA EVIS failure brainstorming → Powerplant dynamics issues. Differential diagnosis. → Sudden engine stoppage → Windmilling → Propeller dynamics. Propeller massbalance → Propeller blade dynamics → Root Cause Analysis (RCA): Blade rupture in a C-295 Portuguese aircraft	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform Homework RCA.	1,6	3
4	4 27F	**Impacts** → RCA propeller rupture brainstorming → Causes of impacts in aircraft design. Differential diagnosis. → Impacts on aircraft caused by external impactor ▪ Bird strike ▪ Ice impacts ▪ Stones, runway debris… → Impacts of the aircraft ▪ Crashworthiness ▪ WUL ▪ Ditching → Ballistic limit. Some analytical formulas… → 1 dof vibration equation…sensitivity of a response to Δt… → Root Cause Analysis (RCA): DASS flare ignition sequence.	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform Homework RCA.	1,6	3

5	5 6M	**Getting started with MSC.NASTRAN** → RCA flare ignition sequence brainstorming → Introduction to FEM & MSC.NASTRAN → GRIDS. B.C. CELAS elements. → OUTPUT request → 2 dof system. Coupling between dofs → Root Cause Analysis (RCA)	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform Homework RCA	1,6	3
6	6 13M	**Normal Modes** → RCA brainstorming → Normal modes in an aircraft. Differential diagnosis. → The very “basic” normal modes ▪ Wing bending mode ⇒ 2D plunge mode ▪ Wing torsion mode ⇒ 2D pitch mode ▪ Aileron rotation ⇒ sensitivity to actuator stiffness → Mode shape identification. Brainstorming. ▪ Identification of bending modes (lifting surfaces; fuselages) ▪ Identification of torsion modes (lifting surfaces; fuselages) ▪ Identification of control surface rotation modes → Normal modes. What for? Brainstorming. → Introducing Generic Transport Aircraft model (NASTRAN format) → Model geometry: grid points → Model connectivity: BAR elements → Model properties: PBAR elements. MAT elements. → Mass model properties: CONM2 → GTA normal modes → Homework: starting from the complete aircraft dynamic model derive half symmetric and half antisymmetric model.	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform Homework: derive half (S) and half(A) model starting from a complete aircraft model.	1,6	3
7	7 20M	Partial Exam 1	**X**				Study Partial Exam 1	1,6	7

8	8 27M	3D unsteady aerodynamics: DLM → RCA brainstorming → Revisiting 2D unsteady aerodynamics (Wagner, Küssner, Theodosen) → Revisiting 3D unsteady aerodynamics (B. Rodden and the Doublet Lattice Method DLM) → Model geometry: CAERO → Model properties: PAERO → Interpolation: SPLINES → GTA unsteady aerodynamic model	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Prepare Partial1 exam.	1,6	3
9	9 10A	**Static Aeroelasticity. Trim Solution. Control Surface Effectiveness.** → Relevance of the static aeroelastic problem. → Airworthiness regulations on static aeroelasticity → The very “basic” normal modes ▪ Wing bending mode ⇒ 2D plunge mode ▪ Wing torsion mode ⇒ 2D pitch mode ▪ Aileron rotation ⇒ sensitivity to actuator stiffness → Relevance of Divergence → Briefing on 2D divergence analytical solution → Relevance of Control surface effectiveness → Briefing on 2D control surface effectiveness → Brainstorming on what is needed to solve the static aeroelastic problem using the FE technique. → GTA Trim solution (NASTRAN SOL 144) → Spanwise evolution of vertical deformation and twist → GTA Divergence solution → GTA Aileron effectiveness → Homework: determine elevator effectiveness	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform Homework: determination of elevator effectiveness.	1,6	3
10	10 17A	Flutter → Relevance of flutter. → Airworthiness regulations on flutter → Briefing on flutter solver mathematics → Brainstorming on what is needed to solve the flutter problem using the FE technique. → GTA Flutter solution (NASTRAN SOL 145) → GTA V-g plot → Homework: determine aileron massbalance to prevent flutter	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform homework: determination of aileron massbalance to prevent flutter.	1,6	3

11	11 24A	Dynamic Landing → Relevance of dynamic landing → Airworthiness regulations on dynamic landing → Briefing on dynamic landing solver mathematics → Brainstorming on what is needed to solve the dynamic landing problem using the FE technique. → GTA dynamic landing solution (NASTRAN SOL 145) → 1D envelopes of bending, shear and torque due to dynamic landing → Homework: determine and plot wing root 2D envelopes	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform homework: determine and plot wing root 2D envelopes.	1,6	3
13	12 8M	Discrete Tuned Gust (DTG) → Relevance of DTG analysis → Airworthiness regulations on DTG → Briefing on DTG solver mathematics → Brainstorming on what is needed to solve the DTG problem using the FE technique. → GTA DTG solution (NASTRAN SOL 146) → 1D envelopes of bending, shear and torque due to DTG → Homework: determine wing root 2D envelopes of DTG and compare with Dynamic landing	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform homework: determine wing root 2D envelopes of DTG and compare with Dynamic landing	1,6	3
14	13 15M	Continuous Turbulence (CT) → Relevance of CT analysis → Airworthiness regulations on CT → Briefing on CT solver mathematics → Brainstorming on what is needed to solve the CT problem using the FE technique. → GTA CT solution (NASTRAN SOL 146) → 1D envelopes of bending, shear and torque due to DTG → Homework: determine wing root 2D envelopes of CT (equal probability ellipses) and compare with DTG & Dynamic Landing	**X**				Reading corresponding notes chapters Study and personal work about the lecture Perform homework: determine wing root 2D envelopes of CT (equal probability ellipses) and compare with DTG & Dynamic Landing	1,6	3
15	14 22M	Partial Exam 2	**X**				Study Partial Exam 2.	1,6	7
17		Final Exam: 1-Jun-2014 [16:00 – 20:00]						1,6	
							Subtotal 1	**24**	**49**
							Total 1 *(Hours of class plus student homework hours between weeks 1-14)*	**73**	

15		Tutorials, handing in, etc						**0,5**	**0,5**
16									
17		Assessment						**0,5**	**0,5**
18									
							Subtotal 2	**1**	**1**
							Total 2 *(Hours of class plus student homework hours between weeks 15-18)*	**2**	

TOTAL *(Total 1 + Total 2. Maximum 90 hours)*	**75**