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

La asignatura tiene 14 sesiones que se distribuyen a lo largo de 14 semanas.

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	HOMEWORK HOURS (Max. 7h week)
1	1	**Advanced Aeroelasticity. Getting Started**. → 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.	X				Reading corresponding notes chapters Study and personal work about the lecture. Perform Homework RCA.	1,6	2
2	2	**Environmental Vibration** → RCA failed equipment analysis brainstorming. → Causes of the environmental vibration in an aircraft. Differential Diagnosis. → Measuring environmental vibration. ▪ Revisiting DSP. ▪ Aliasing, leakage,…	X				Reading corresponding notes chapters Study and personal work about the lecture. Perform Homework RCA.	1,6	3

		→ 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								
3	3	**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	**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	**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	**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	Partial Exam 1	**X**				Study Partial Exam 1	1,6	7
8	8	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	**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	**X**				Reading corresponding notes chapters Study and personal work about the lecture.	1,6	3

		▪ 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					Perform Homework: determination of elevator effectiveness.		
10	10	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	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	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.	**X**				Reading corresponding notes chapters Study and personal work about the lecture. Perform homework: determine wing root 2D	1,6	3

		→ 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					envelopes of DTG and compare with Dynamic landing		
14	13	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	Partial Exam 2	**X**				Study Partial Exam 2.	1,6	7
17		Final Exam						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		Assessment						**0,5**	**0,5**
17									
18									
							Subtotal 2	**1**	**1**
							Total 2 *(Hours of class plus student homework hours between weeks 15-18)*	**2**	

TOTAL *(Total 1 + Total 2. <u>Maximum 90 hours</u>)*	**75**