

## **EE4351 Aircraft Electrical and Actuation System**

### **The syllabus:**

***Electrical Systems*** - Aircraft electrical and distribution system, Aircraft power generation, Ground Power Supply, Power distribution, Power Converter.

***Aircraft Power Electronics and Drives*** – Transformer rectifier unit, inverter, Variable speed constant frequency, brushless motors.

***Electrical Energy Storage*** – Batteries technology, Battery charger, super-capacitors, battery management system.

***Emergency Systems*** - Emergency power sources, Interruptible power supply, Warning and Protection.

***Environmental Electrical Systems*** – Aircraft lighting, air conditioning, windscreen anti-ice systems, Anti-Skid systems.

***Electric Actuation*** – Power electronic actuators, Landing gear and Electrical flap systems, Key helicopter systems

***More Electric Aircraft*** – Fault tolerant power distribution, energy optimized aircraft, intelligent and effective energy, management.

**Schedule 2017 Wednesday 2:30 – 5:20 Rm: QR402**

Week	Date	Description	Lecturer
1	18-Jan	Introduction, Electrical Systems I – Electric circuit and components, power generation (+Assignment announcement )	E. Cheng
2	25-Jan	Electric Systems II - Power supply, power converter	E. Cheng
	1-Feb	New Year Holiday	
3	8-Feb	Aircraft Power Electronics and Drives - Distribution, power generation and supply, converter (Presentation)	E. Cheng
4	15-Feb	Aircraft Power Electronics and Drives – Rectifier, AC-DC, motor drives (Presentation)	E. Cheng
5	22-Feb	Energy Storage Systems – battery technologies, charger, super-capacitor, BMS (Presentation)	E. Cheng
6	1-Mar	More electric aircraft – Future power system +Test (Presentation)	E. Cheng
7	8-Mar	Electric Actuation I – introduction to actuation	Norbert Cheung
8	15-Mar	Electric Actuation II - landing gear, helicopter systems	Norbert Cheung
9	22-Mar	Electric Actuation III - Electrical flap, system (presentation)	Norbert Cheung
10	29-Mar	Emergency power - warning and protection (Presentation)	Norbert Cheung
11	5-Apr	Environmental Electrical Systems – lighting, windscreen anti-ice, Anti-skid systems (Presentation)	Norbert Cheung
12	12-Apr	More electric Aircraft - Intelligent management, optimization + Test (Presentation)	Norbert Cheung
13	19-Apr	Revision	Norbert Cheung, E.Cheng

**Project presentation list: (1 person in a group)**

Week	Date	Group 1	Group 2	Group 3
1	18-Jan	N/A		
2	25-Jan	N/A		
	1-Feb	Chinese New Year		
3	8-Feb			
4	15-Feb			
5	22-Feb			
6	1-Mar			N/A
7	8-Mar	N/A		
8	15-Mar	N/A		
9	22-Mar			
10	29-Mar			
11	5-Apr			
12	12-Apr			N/A
13	19-Apr	N/A		

## The Course work and Exam:

- Course work: 50%
  - Test x 2, each 25 %
  - Mini-project 25 %
- Exam 60%
- Miniproject:
  - 2 persons in a group
  - Project report, 2 weeks after presentation
  - Report, around 15 pages
  - Report submitted electronically.

## Submission of mini-project

- [ftp://eeserver.ee.polyu.edu.hk/Upload/eric/EE4351\\_or\\_blackboard](ftp://eeserver.ee.polyu.edu.hk/Upload/eric/EE4351_or_blackboard)
- **Format of file name:**
- **For homework:** studentname\_student no.pdf or studentname\_student no.doc or studentname\_student no.ppt
- Once submitted, you cannot alter, but you may submit a better version lately on using:
  - Studentname\_student no\_V2.pdf
- All submissions must be done in group submission.
- Use only one person in the file name not two persons, otherwise the name is too long.

## **Mini-Project: EE4351**

- 1. Compare the difference between Airbus A380 and Boeing 777 in terms of the power system, power conversion and actuation.**

You should include the system specification of each component and explain the difference between two air-crafts in terms of the above electrical equipment for the power electronics and actuation.

- 2. Computer simulation a power electronics system of an airbus A380**

You can use Saber/Pspice or other package to describe the power system of the airbus A380. You will draw the schematic diagram of the aircraft and do a steady-state simulation.

- 3. Study the EMI on the military system**

The EMI is now the important consideration for all the power electronics system. Discuss the international system used in the military system. Concentration is put on the electromagnetic interference.

- 4. Discuss the Military aircraft in the areas of power electronics**

Discuss the military aircrafts and their general specification. What manufacturers are available? What are the typical cost and the equipment used? What does the installation differ from the civil aircraft?

- 5. Study the EMI on the aircraft system**

The EMI is now the important consideration for all aircrafts. Discuss the international system used in the aircraft system. Concentration is put on the electromagnetic interference for the primary and secondary fight control system.

- 6. Examination of the fuel pump**

The fuel used in Boeing 747 is tens of kW and the power inverter for the fuel pump is using electro hydraulic system. Write a report on the fuel pump and explain the power electronics used.

- 7. Discussion of the photovoltaic system for aircraft application**

The solar power is now being used in aircraft. There have been news in using the solar power for aircraft and the travelling around the world. Discuss the technology and the possible design. You can design a 2-seater aircraft for this application.

- 8. Examination of the primary and secondary fight control system**

The fight control is mainly divided into primary and secondary fight controls. Discuss the two control methods and the associated power electronics installation. Compare the use of hydraulic, electro-hydraulic or all electric system.

- 9. Review study of the recent development of aircraft power electronics**

Write an article to discuss the recent technology of power electronics including the power converter, actuator, robotic and energy management for the aircraft power electronics. Diagram and text of at least 1500 words are needed.

- 10. Discussion of the VFCE**

VFCE is referred to variable frequency to constant frequency converter. Discuss the availability of this product and the renowned manufacturer and supplier. What are the specification, power rating and frequency of operation.

- 11. Application of electrical motor to aircraft system**

What is the best motor to be used in aircraft actuation. Discuss the issue and the new technology. Conduct a comparison for the new motors to the application of actuator for aircraft.

- 12. Design a battery system for a power level similar to A380 aircraft**

Design the battery system for the power level similar to A380. The design will cover the battery type, battery rating, associated control and battery management system.

- 13. Simulation of an aircraft power distribution system**

Use a simulator such as Pspice/Saber/Matlab to conduct a simulation of a power distribution of an aircraft. You can use your own choice of aircraft and specify the rating, power level and operation.

- 14. Design of an aircraft lighting system**

Design a lighting system that includes all the possible lightings being used for the aircraft. You can specify which aircraft you use. The design should cover the rating and specification of the lighting units and the associated ballast if needed.