GRADUATE STUDY: AERONAUTICS

SEMESTER (I)

Syllabus

Academic year 2021/2022

Course:	**Avionics and IFR Flying**				
Head of course: Prof. **Tino Bucak**, Ph.D., Assist. Prof. **Jurica Ivošević**, Ph.D.					
Co-lecturers: Prof. **Doris Novak**, Ph.D.					
Semester: **I**	Course code: **47866**	Lectures: **30**	Auditory exercises: **10**	Laboratory exercises: **2**	ECTS credits: **5**
Group for lectures: **15 students**			Group for auditory and laboratory exercises: **15 students**		

Objective of the course:

- To acquire the knowledge required to understand the working principles of the avionics systems and its components and to learn about modern navigational concepts and methods in instrument flying

Learning outcomes:

After completing the course, the student will be able to:

1. Recognize the basic terms and physical parameters of analog and digital electronics in aviation,
2. Calculate parameters of antennas, filters and electroacoustic transducers of aircraft radiocommunication and radionavigation equipment,
3. Distinguish the avionics components and their specific function,
4. Compare display technologies and data standards in civil and military aviation,
5. Operate the Flight Director and Autopilot system on a synthetic flight training device,
6. Apply modern concepts of navigation in IFR,
7. Integrate the presentation, workshop, discussion and knowledge assessment through seminar work on specific avionics and/or IFR topic.

LECTURES and EXERCISES

Week	Syllabus	Form of classes	Performed by	Lessons	Remark
1.	▪ Analog electronics. Semiconductors. Basic transistor circuits. Operational amplifiers. EMI and EMC. ESD components.	L	Jurica Ivošević	2	
	▪ Exercises	AE	Jurica Ivošević	1	
2.	▪ Digital electronics. A/D and D/A conversion, Number systems. Logic circuits. Computer systems, hardware and software.	L	Jurica Ivošević	2	
	▪ Exercises	AE	Jurica Ivošević	1	
3.	▪ Colloquium I ▪ Radiocommunications, history, parameters, capacity, ranges. Contemporary aircraft communication, navigation and surveillance systems.	L	Tino Bucak	3	
4.	▪ Radio transmitters and receivers, construction and circuitry, antennas: antenna coupling, RF preamplifier, mixer, local oscillator, IF stage, detector, AF stage, AGC, squelch, carrier generator, modulation signal source (microphone/ ID generator), AF amplifier, modulator, power stage, duplexer. Basic types of antennas. Integrated transceiver with common antenna.	L	Tino Bucak	3	
5.	▪ Electroacoustic transducers. Loudspeakers and microphones. 1st, 2nd and 3rd order filters.	L	Tino Bucak	2	

	• Exercises	AE	Jurica Ivošević	1	
6.	▪ Colloquium II ▪ Avionics data buses, technology, organization, architecture and topology. Standards and protocols. Fiber optics. Aircraft software, navigation databases. ATE and BITE aircraft equipment.	L	Tino Bucak/ Jurica Ivošević	2	
	▪ Exercises	AE	Tino Bucak/ Jurica Ivošević	1	
7.	▪ Display technologies. Large aircraft avionics. Glass Cockpit. Integrated Modular Avionics (IMA).	L	Tino Bucak/ Jurica Ivošević	2	
	▪ Exercises	AE	Tino Bucak/ Jurica Ivošević	1	
8.	▪ Colloquium III ▪ Aircraft safety, warning and recording systems. Airborne radars	L	Tino Bucak/ Jurica Ivošević	3	
9.	▪ Contemporary avionics in G/A aircraft.	L	Tino Bucak/ Jurica Ivošević	1	
	▪ FNPT exercises	LE	Tino Bucak/ Jurica Ivošević	2	
10.	▪ Colloquium IV ▪ Area navigation – concept and definition.	L	Doris Novak	2	
	• Exercises	AE	Doris Novak	1	

11.	▪ ICAO PBN concept and navigation specifications.	L	Doris Novak	2	
	▪ Exercises	AE	Doris Novak	1	
12.	▪ Colloquium V ▪ 4D business trajectories. Approaches with vertical guidance (APV).	L	Doris Novak	2	
	• Exercises	AE	Doris Novak	1	
13.	▪ RNP APCH (APV Baro VNAV), RNP AR APCH and LPV (APV SBAS) specifications	L	Doris Novak	2	
	• Exercises	AE	Doris Novak	1	
14.	▪ B-RNAV and P-RNAV area navigation specification and applications	L	Doris Novak	2	
	• Colloquium VI	AE	Doris Novak	1	
15.	▪ Student essay presentations	S	Jurica Ivošević	3	

L = Lectures; **AE** = Auditory Exercises; **LE** = Laboratory Exercises; S = Seminars

STUDENT OBLIGATIONS AND EXAMS

Conditions for obtaining signatures:

The attendance of the lectures, laboratory exercises and the seminar work.

Special Requirements about Acquired Knowledge and Skills – Guidance Notes for Students

Students should have the knowledge acquired from the following topics:
- **Electricity Fundamentals,**
- **Electronics Fundamentals,**
- **Aircraft Instrumentation and**
- **General Navigation**

LITERATURE

a) Obligatory literature:

1. Moir, I., Seabridge, A., Jukes, M.: Civil Avionics Systems, Wiley, 2013.
2. Helfrick, A.: Principles of Avionics, Avionics Communications Inc., Leesburg, USA, 2000.
3. Collinson, R.P.G.: Introduction to avionics, Chapman & Hall, London, UK, 1996.
4. Tooley M.: Aircraft Digital Electronic and Computer Systems: Principles, Operation and Maintenance, Elsevier, 2009.
5. Tooley, M.: Aircraft Communications and Navigation Systems: Principles, Maintenance and Operation for Aircraft Engineers and Technicians, Elsevier, 2009.
6. Tooley, M.: Aircraft Electrical and Electronic Systems: Principles, Maintenance and Operation, Elsevier, 2009.
7. Buckwalter, L.: Avionics Training: Systems, Installation and Troubleshooting, Avionics Communications Inc., Leesburg, USA, 2010.
8. Buckwalter Len (ed): Avionics Databuses, Avionics Communications Inc., Leesburg, USA, 2001.
9. Jukes, M.: Aircraft Display Systems, American Institute of Aeronautics and Astronautics Inc., Reston, Virginia, USA, 2004.
10. Schmitt, V. R., Morris, J, W., Jenney Gavin D.: Fly-by-Wire: Ahistorical and Design Perspective, Society of Automotive Engineers Inc., Warrndale, PA, USA, 1998.

b) Recommended literature:

1. Nagabhushana S., Sudha L. K.: Aircraft Instrumentation and Systems, I. K. International Publishing House Pvt. Ltd., New Delhi, India, 2013.
2. Wyatt D.: Aircraft Flight Instruments and Guidance Systems, Routledge, GB, 2015.
3. Moir I., Seabridge A.: Military Avionics Systems, Wiley, 2006.
4. US Department of Transportation, FAA, Flight Standard Service: Advanced Avionics Handbook, Middletown, DE, USA, 2009.
5. MOT Staff of UA: Avionics Fundamentals, Jeppesen Sanderson, Englewood, USA, 1984.
6. Wasson, J. W.: Avionic Systems, Jeppesen Sanderson, Englewood, USA, 1994.
7. Hoy, D.: Instrument Flying, Airlife, England, 1995.
8. Popović B., Bucak T.: NDB-ADF, Fakultet prometnih znanosti, Zagreb, 1999.
9. Butcher, R.: Instrument pilot flight training manual, Skyroamers Publications, USA, 1994.
10. Spitzer, C. R.: Avionics: Development and Implementation (The Avionics Handbook), CRC, 2007.

11. Anon.: “Instrument Commercial Manual”, Jeppesen Sanderson, 1996.
12. Anon.: “Jeppesen Airway Manual”, Jeppesen & CO. GmbH Frankfurt.

METHODOLOGY OF THE IMPLEMENTATION OF THE COURSE PLAN

1. LECTURES AND EXERCISES

Attending laboratory exercise and seminar work (15th week) is mandatory. From the remaining course lessons, the student can be absent three terms, with two extra terms properly justified (medical reasons etc.). The attendance at each lesson is 1 point. By attending classes, the student can therefore collect 15 points, and the minimum number for signing points is 10, according to Table 1.
Laboratory exercises consist of preparation, execution and report phases. Preparation involves familiarization with devices, instruments and displays, as well as commands, operational procedures and navigation procedures of the synthetic flight trainer in which the exercise will take place. Preparation for laboratory exercises is carried out in a group before the individual exercise on the trainer and may include a part that needs to be done independently before the exercise. The exercise is carried out in a pilot / co-pilot crew arrangement supervised by a flight instructor. The report on the performed exercise is submitted by the student on the prescribed form no later than the 15th week of teaching. The form contains a written confirmation of the instructor that the student is capable to use the Flight Director and Autopilot system on a synthetic flight training device, that is, the student met the defined learning objective. Successfully passed laboratory practice gives the student 10 points, which is the minimum number of points required for signature, according to Table 1.

2. SEMINARS

Students select the topic of the seminar work from the specific area of avionics and/or instrument flying. Within the scope of the seminar, the student is required to send a written version via e-mail to the teacher within 13th week at the latest, and to hold in the 15th week public oral presentation, workshop and debriefing for other students in the group. If a student fails to undertake a seminar for a justified reason, an additional term will be set in agreement with the teacher and other students. The seminar work can score to a student a minimum of 10 and a maximum of 15 points according to Table 1. The student cannot compensate the minimum number of attendance points for the seminar points.

3. DOCUMENTATION

Attendance to lectures and exercises are registered and the records are kept.
Exam documentation is archived in accordance with the Regulations of the Department of Aeronautics.

4. SCORING SYSTEM

Table 1 The scoring system for the monitoring of students and explained credit values in ECTS credits

no	Segment:	Required credits to be achieved:		Remark:	ECTS credits
		Min.	Max.		
1.	Attendance to lectures	10	15		**1**
2.	Seminar	10	15		**1**
3.	Attendance to lab exercises	10	10		**1**
4.	Written exam (or six colloquia)	0	60		**1**
5.	Oral exam				**1**
Σ		**30**	**100**		**5**

Table 2 - Explanation of the credit values in evaluations

CREDITS:	Estimate based on attendance, seminar paper and six colloquia (or written exam) - [4 ECTS]:	The final score [5 ECTS]:
70 - 75	Sufficient (2)	Determined after oral exam, except for maximum credits achieved
76 - 85	Good (3)	
86 - 93	Very good (4)	
94 - 100	Excellent (5)	

Information for students (scoring system, implementation plan, learning outcomes, syllabus, literature, consulting teachers, announcement of results of examinations or colloquium, and all other information):

- **https://moodle.srce.hr/2021-2022/**
- **http://www.fpz.unizg.hr**