



**B.E DEGREE EXAMINATIONS: NOV/DEC 2023**

(Regulation 2018)

Seventh Semester

**AERONAUTICAL ENGINEERING**

U18AEI7203: Avionics

**COURSE OUTCOMES**

- CO1:** Brief the functional description of typical avionics systems in aircraft.  
**CO2:** Describe the components and architecture of avionics systems.  
**CO3:** Interpret the data communication word in avionic data buses.  
**CO4:** Explain the working principle of aircraft communication, surveillance and navigation systems.  
**CO5:** Explain the architecture of flight control systems in aircraft.  
**CO6:** Describe the components and working of aircraft landing systems.

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 2 = 20 Marks)**

**(Answer not more than 40 words)**

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|-----|--|-----|-------------------|
| 1.  | What are the functions performed by navigation management system in civil aircrafts?   | CO1 | [K <sub>2</sub> ] |
| 2.  | What is the need for analog-to-digital conversion in avionics systems?   | CO2 | [K <sub>2</sub> ] |
| 3.  | Draw the Manchester bi-phase and Bi-polar return-to-zero waveforms for a digital data '11001'.   | CO3 | [K <sub>3</sub> ] |
| 4.  | Write the bits 32 to 1 (from MSB to LSB) in the BNR word in the ARINC 429 data bus standard to represent a Total Air Temperature of '-20 deg C'. The scale value (range) for the Total Air Temperature is 512, the resolution is 0.25, and the octal label is 211. Show the pad zero bits clearly. | CO3 | [K <sub>3</sub> ] |
| 5.  | What is the need for modulation in communication systems?  | CO4 | [K <sub>2</sub> ] |
| 6.  | Mention the four conditions to be satisfied by an early TCAS for issuing a RA reversal.  | CO4 | [K <sub>2</sub> ] |
| 7.  | Find the total number of words and the total number of bits in a GPS navigation message. Also, find the elapsed time for the message.  | CO4 | [K <sub>2</sub> ] |
| 8.  | Name the motion sensors used in fly-by-wire flight control system.   | CO5 | [K <sub>1</sub> ] |
| 9.  | What is the main function of automatic flight control systems in aircraft?   | CO5 | [K <sub>2</sub> ] |
| 10. | Mention any four features of microwave landing system.   | CO6 | [K <sub>2</sub> ] |

**Answer any FIVE Questions:-**

**PART B (5 x 16 = 80 Marks)**

**(Answer not more than 400 words)**

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|-----|--|----|-----|-------------------|
| 11. | Describe the components of a typical avionics system and explain the architecture of a microcontroller-based avionics computer.  | 16 | CO2 | [K <sub>2</sub> ] |
| 12. | In a commercial aircraft, the flight information (octal label 360) entered by the pilot in MCDU is transmitted as a message to the FMS via the ARINC 429 data bus. The flight information consists of a total of 11 characters (without any spaces), of which the first five correspond to the flight number 'AI538', the next three correspond to the origin 'MAA', and the last three correspond to the destination 'DEL'. The message is transmitted in ISO Alphabet No. 5 format (alphanumeric). The alphanumeric codes are given below. | 16 | CO3 | [K <sub>3</sub> ] |

Character	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
A	1	0	0	0	0	0	1
I	1	0	0	1	0	0	1
5	0	1	1	0	1	0	1
3	0	1	1	0	0	1	1
8	0	1	1	1	0	0	0
M	1	0	0	1	1	0	1
D	1	0	0	0	1	0	0
E	1	0	0	0	1	0	1
L	1	0	0	1	1	0	0
STX	0	0	0	0	0	1	0

Show the complete bits of the message for all the words, including the label, SSM, and parity bits. Use pad zeros for bits 17–22 for the initial word of the message, and use the octal label of 360 for all the words of the message. The flight information should be presented only in the intermediate/final words.

13. a) Explain the working of secondary surveillance radar in air traffic control. 10 CO4 [K<sub>2</sub>]  
 b) The mode S transponder's short message (56 bits) for the altitude reply is shown as follows: 6 CO4 [K<sub>3</sub>]

MSG = "2000171806A983"

For the above message, find the altitude in feet.

For the reference, the structure of Mode S altitude reply is shown below.

FIELD	MSG	BITS
Downlink format	1–5	5
Flight status	6–8	3
Downlink request	9–13	5
Utility message	14–19	6
Altitude code	20–32	13
Address parity	33–56	24

And, the 13 bits of the altitude code are defined as follows:

<b>C1</b>	<b>A1</b>	<b>C2</b>	<b>A2</b>	<b>C4</b>	<b>A4</b>	<b>M</b>	<b>B1</b>	<b>Q</b>	<b>B2</b>	<b>D2</b>	<b>B4</b>	<b>D4</b>
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14. a) Explain the basic principle and operation of VOR navigation system. 8 CO4 [K<sub>2</sub>]  
 b) Explain the complete algorithm used in strapdown inertial navigation to compute the position of a vehicle in NED coordinate frame. 8 CO4 [K<sub>2</sub>]
15. With a block diagram explain the airspeed and altitude hold control systems for aircraft. 16 CO5 [K<sub>2</sub>]
16. Describe the components of instrument landing system (ILS) and explain the operation of ILS. 16 CO6 [K<sub>2</sub>]

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