INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

AERONAUTICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**AVIONICS AND INSTRUMENTATION**				
Course Code	AAE525				
Programme	B.Tech				
Semester	VIII	AE			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Mrs.M. MaryThraza, Assistant Professor				
Course Faculty	Mrs.M. MaryThraza, Assistant Professor				

I. COURSEOVERVIEW:

The aim of avionics and instrumentation is to introduce students the overview of the avionics and instrumentation systems. The course covers basic principles of aircraft systems design process of an aircraft and the related details of avionics technology. After completion of the course the student gains adequate knowledge on technology which is involved for communication and navigation systems and also adaption of military aircraft systems and radar sensing system for spacecraft.

II. COURSEPRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AAE010	V	Aircraft Systems And Control	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Avionics And Instrumentation	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✔	Marker & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✘	Videos
✘	Open Ended Experiments						

V. EVALUATIONMETHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in aquestion.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the Concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Theory**		**Total Marks**
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentations on real world problems
PO 2	**Problem analysis**: An ability to identify, formulate and solve problems in key areas of Aerodynamics, Structures, Propulsion, Flight Dynamics and Control, Design, Testing, Space and Missile Technologies and Aviation of Aeronautical Engineering discipline.	3	Assessing real-world problems by case study
PO 3	**Design/development of solutions**: An ability to design and conduct experiments, analyze and interpret data related to various areas of Aeronautical Engineering.	2	Seminar/ Research papers
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid Conclusions.	1	Assignments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES AREASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products.	2	Lectures, Assignments, Seminars
PSO2	**Problem-solving Skills:** Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of Components to complete the challenge of airworthiness for flight vehicles.	2	Tutorials, Software Practice
PSO 3	**Practical implementation and testing skills:** Providing different types of in house and training and industry	-	-

	practice to fabricate and test and develop the products with more innovative technologies		
PSO 4	**Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aeronautical/aerospace Allied systems to become technocrats.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES:

The course should enable the students to:	
I	Impart the knowledge in various types of Avionics systems, its components & its applications in aerospace industries.
II	Offer a rigorous avionics technology, Review of the basic system integration and the different type of avionics architectures.
III	Provide necessary knowledge to study the aircraft instrumentation sensors, displays and different type of sensors
IV	Give knowledge about military aircraft adaptation, avionics and mission system interface and gives the difference between civilian aircraft avionics and military aircraft avionics

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Describing aviation technology, bus systems and few basics of aircraft systems	CLO 1	Understanding the evolution of electronics and microelectronics in avionics technology
		CLO 2	Interpret the need of bus systems in avionics
		CLO 3	Constructing the integrating modular avionics architectures, shelf systems and avionics packaging systems
CO 2	Differentiating aircraft instrumentation - sensors and displays systems	CLO 4	Understanding the concept of sensing system in aircraft instrumentation system.
		CLO 5	Development of different types of indication systems.
		CLO 6	Constructing different display systems in instrumentation system.
		CLO 7	Developing the concept of different communication system.
CO 3	Understanding communication systems and navigation aids	CLO 8	Understanding different navigation systems, global and local area augmentation
		CLO 9	Understanding flight management system control and display unit
		CLO 10	Measuring of avionic and mission system interface, navigation and flight management
CO 4	Estimation of military aircraft adaptation mission system interface, navigation and flight management	CLO 11	Arranging airborne early warning, ground surveillance
		CLO 12	Labeling of electro-optics and the infra-red
		CLO 13	Characterizing of types of radar- pulse Doppler
CO 5	Acquiring knowledge on airborne radar, astrionics, avionics for spacecraft	CLO 14	Determination Attitude and control of spacecraft, magnetometers
		CLO 15	Construction of command and telemetry in aviation technology

X. COURSE LEARNING OUTCOMES(CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AAE017.01	CLO 1	Understanding the evolution of electronics and microelectronics in avionics technology	PO 1	3
AAE017.02	CLO 2	Interpret the need of bus systems in avionics.	PO 2	3
AAE017.03	CLO 3	Constructing the integrating modular avionics architectures, shelf systems and avionics packaging systems	PO 2	2
AAE017.04	CLO 4	Understanding the concept of sensing system in aircraft instrumentation system.	PO 2	3
AAE017.05	CLO 5	Development of different types of indication systems.	PO 3	2
AAE017.06	CLO 6	Constructing different display systems in instrumentation system.	PO 3	3
AAE017.07	CLO 7	Developing the concept of different communication system.	PO 2	2
AAE017.08	CLO 8	Understanding different navigation systems, global and local area augmentation	PO 1	2
AAE017.09	CLO 9	Understanding flight management system control and display unit	PO 3	1
AAE017.10	CLO 10	Measuring of avionic and mission system interface, navigation and flight management	PO 4	1
AAE017.11	CLO 11	Arranging airborne early warning, ground surveillance	PO 1	2
AAE017.12	CLO 12	Labeling electro-optics and the infra-red optics	PO 3	3
AAE017.13	CLO 13	Characterizing of types of radar- pulse Doppler	PO 2	2
AAE017.14	CLO 14	Determination Attitude and control of spacecraft, magnetometers	PO 1	3
AAE017.15	CLO 15	Construction of command and telemetry in aviation technology	PO 2	1

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)				Program Specific Outcomes(PSOs)	
	PO 1	PO 2	PO 3	PO 4	PSO 1	PSO 2
CO 1	3	3			2	
CO 2		3	3			2
CO 3	2		1	1	2	2
CO 4	2	2	3			
CO 5	3	1			2	2

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XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFICOUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO 1	3															
CLO 2		3											3			
CLO 3	2													2		
CLO 4		3														
CLO 5			2										2			
CLO 6			3											2		
CLO 7		2														
CLO 8	2															
CLO 9			1											2		
CLO 10				1									2			
CLO 11	2												2			
CLO 12			3											2		
CLO 13		2											2			
CLO 14	3															
CLO 15		1												2		

3 = High; 2 = Medium; 1 = Low

XIII.ASSESSMENTMETHODOLOGIES–DIRECT

CIE Exams	PO 1, PO 2 PO 3, PO 4 PSO1, PSO2	SEE Exams	PO 1, PO 2 PO 3, PO 4 PSO1, PSO2	Assignments	PO 4	Seminars	PO 2
Laboratory Practices	PO 4	Student Viva	-	Mini Project	-	Certification	-
Term Paper	-						

XIV.ASSESSMENTMETHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

UNIT-I	AVIONICS TECHNOLOGY
Evolution of electronics; The nature of microelectronic devices, processors, memory devices; Introduction to avionics, systems integration, need - data bus systems, MIL STD 1553 bus system, ARINC 429/ARINC 629 bus systems, optical data bus systems; Integrated modular avionics architectures , commercial off the shelf systems; Avionics packaging.	
UNIT-II	**AIRCRAFT INSTRUMENTATION - SENSORS AND DISPLAYS**
Air data sensors, magnetic sensing, inertial sensing, and radar sensors. The electromechanical instrumented flight deck, early flight deck instruments, attitude direction indicator, horizontal situation indicator, altimeter, airspeed indicator; Advanced flight deck display system architectures, display systems, display media, future flight deck displays.	
UNIT-III	**COMMUNICATION AND NAVIGATION AIDS**
Radio frequency spectrum, communication systems, HF, VHF, satellite communications; ATC transponder, traffic collision avoidance system; Navigational aids; Automatic direction finding, VHF Omni range, distance measuring equipment; TACAN, VORTAC; Satellite navigation systems, the GPS. Basic navigation, radio, inertial navigations, satellite navigation; GPS, differential GPS, wide area augmentation systems, local area augmentation system, and GPS overlay program; Integrated navigation, sensor usage; Flight management system (FMS); FMS control and display unit; Lateral navigation.	
UNIT-IV	**MILITARY AIRCRAFT ADAPTATION**
Avionic and mission system interface, navigation and flight management; Navigation aids, flight deck displays, communications, aircraft systems; Applications, personnel, material and vehicle transport, air-to-air refueling, maritime patrol, airborne early warning, ground surveillance; Electronic warfare, the EW spectrum, electronic support measures, electronic countermeasures, electro-optics and the infra-red.	
UNIT-V	**AIRBORNE RADAR, ASTRIONICS - AVIONICS FOR SPACECRAFT**
Propagation of Radar waves, functional elements of radar, antenna- transmitter; Types of radar- pulse Doppler, civil aviation applications, military applications; Attitude determination and control of spacecraft, magnetometers, sun sensors, star trackers, earth and horizon sensors;Command and telemetry	
Text Books:	
1. Moir, I. and Seabridge, A., Civil Avionics Systems, AIAA Education Series, AIAA, 2002. 2. Collinson, R.P.G., Introduction to Avionics Systems, second edition, Springer, 2003.	
Reference Books:	
1. Helfrick, A., Principles of Avionics, Avionics Communications Inc. Leesburg, 2000. 2. Henderson, M. F., Aircraft Instruments & Avionics for A &P Technicians, Jeppesen Sanderson Training Products, 1993.	

XVI. COURSEPLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Evolution of electronics; The nature of microelectronic devices, processors, memory devices	CLO 1	T2: 1.1-1.5, T1: 4.1
3-4	Introduction to avionics, systems integration, need - data bus systems	CLO 1	T2: 2.1-2.2, R1: 3.1
5-6	MIL STD 1553 bus system	CLO 2	T2: 2.3-2.4
7-8	ARINC 429/ARINC 629 bus systems, optical data bus systems	CLO 2	T2: 2.5-2.6,
9-10	Integrated modular avionics architectures , commercial off the shelf systems; Avionics packaging	CLO 3	T2: 3.3
11	Air data sensors, magnetic sensing, inertial sensing, and radar sensors.	CLO 4	T2: 3.4, R1:4.1

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
12	The electromechanical instrumented flight deck, early flight deck instruments,	CLO 5	T2: 3.4
13-14	Attitude direction indicator, horizontal situation indicator, altimeter, airspeed indicator;.	CLO 5	T2: 3.3
15-16	Advanced flight deck display system architectures,	CLO 6	T2: 4.2
17-18	Display systems, display media, future flight deck displays	CLO 6	T2: 5.1
19-20	Radio frequency spectrum, communication systems, HF, VHF, satellite communications;	CLO 7	T2: 5.2
21-22	ATC transponder, traffic collision avoidance system; Navigational aids; Automatic direction finding, VHF	CLO 7	T2: 5.3
23-24	Omni range, distance measuring equipment; TACAN, VORTAC; Satellite navigation systems, the GPS.	CLO 8	T2: 4.5
25	Basic navigation, radio, inertial navigations, satellite navigation; GPS, differential GPS, wide area augmentation systems,	CLO 8	T1: 4.1
26	Local area augmentation system, and GPS overlay program; Integrated navigation, sensor usage;	CLO 9	T1: 4.2
27-28	Flight management system (FMS); FMS control and display unit; Lateral navigation.	CLO 9	T1: 4.3
29-30	Avionic and mission system interface, navigation and flight management; Navigation aids, flight deck displays,	CLO 10	T2: 5.2
31	Communications, aircraft systems; Applications, personnel, material and vehicle transport,	CLO 10	T2: 5.2
32	Air-to-air refueling, maritime patrol,	CLO 11	T2: 5.2
33	Airborne early warning,	CLO 11	T2: 5.3
34	Ground surveillance; Electronic warfare, the EW spectrum, ,	CLO 11	T2: 5.3
35-36	Electronic support measures	CLO 11	T1: 6.1-6.2
37-38	Electronic countermeasures,	CLO 12	T1: 6.3, R2:6.1
39-40	Electro-optics and the infra-red.	CLO 12	T1: 6.4
41-42	Propagation of Radar waves	CLO 13	T1: 6.5
43-44	Functional elements of radar,	CLO 13	T1: 7.1
45-46	Antenna- transmitter;	CLO 14	T1: 7.2
47-49	Civil aviation applications	CLO 14	T1: 7.4
50	Types of radar- pulse Doppler	CLO 15	T1: 7.5, R2: 7.3
51	Military applications	CLO 15	T1: 7.5
52	Attitude determination and control of spacecraft	CLO 15	T1: 7.6
53	Magnetometers and its characteristics	CLO 15	T1: 7.5, R2: 7.4
54	Sun sensors, star trackers, earth and horizon sensors;	CLO 15	T1: 7.7
55	Command and telemetry	CLO 15	R2:7.5

XVII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSIONREQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Application of knowledge and skills in the estimation of avionics systems in presentation aviation industry	Seminars / Expert Lectures	PO 2, PO 4	PSO 1
2	Experimental knowledge of aircraft Detecting technology which is used in present synerio.	Seminars / Expert Lectures	PO 2, PO 4	PSO 2

Prepared by:

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