INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

AERONAUTICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**AIRCRAFT SYSTEMS AND CONTROL**				
Course Code	AAE010				
Programme	B.Tech				
Semester	V	AE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Mr. R.Suresh Kumar, Assistant Professor				
Course Faculty	Mr. R.Suresh Kumar, Assistant Professor Mr. P Anudeep, Assistant Professor				

I. COURSEOVERVIEW:

Aircraft Systems is a course of primary important to Aeronautical Engineering students. The aim is to impart the meaning of system in generic .The course covers, the main branching of Aircraft System Systems sub systems based on functionalities .These describes the working principles and their importance to aircraft. The course also gives basic knowledge of design procedures, failure severities Safety measures ofsystem.

II. COURSEPRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	credits
UG	AAE003	III	Fluid Mechanics And Hydraulics	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Aircraft Systems and Control	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & 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 theconcept.

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 CIEexams.

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 AREASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, andan engineering specialization to the solution of complex engineering problems.	2	Assignments
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminars
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Seminars

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	Assignments
PSO2	**Problem-solving Skills:** Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problemsof components to complete the challenge of airworthiness for flight vehicles.	2	Seminars
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	1	Assignments
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	Explain the concept and meaning of system and classify the various systems required for aircraft andtheir contribution in order to fulfill the aircraft tasks.
II	Describe the various types of Electrical power generations and distribution in aircraft and impart the knowledge of pneumatic, hydraulic and environmental control system.
III	Demonstrate the different flight control actuators and flight control system and fly-by-wire control laws and give knowledge about the landing gears systems and brake management system.
IV	Explain the concept of different aircraft gas turbine engines and their control systems and describe thefuel system characteristics and their operating modes and knowledge about the fuel safety management.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Define the System concepts, sub-systems, Generic system definition, inputs, outputs, feedback, external influence and describe the Aircraft systems- airframe systems, vehicle systems, avionics systems, mission systems and their sub-systems	CLO1	Define the meaning of the system and its Characteristics and identify different types of aircraft systems.
		CLO2	Describe the airframe systems, vehicle systems of aircraft systems.
		CLO3	Explain the generic system and operating conditions of aircraft systems.
CO 2	Describe the Electrical loads in aircraft. Explain Electrical power generation and control-DC, AC- types, variable speed constant frequency (VSCS) cycloconverter, 270 V DC systems. Explainthe Basic air cycle systems, Vapour cycle systems, boost-strap systems.	CLO4	Describe the various electrical power generations in the aircraft and discover more Electric aircraft.
		CLO5	Estimate the electrical power requirements and can optimize the load distribution.
		CLO6	Explain the basic air cycle systems and vapour cycle systems of aircraft systems.
CO 3	Define Hydraulic systems and pneumatic systems. explain their Working principles, Typical air pressure system, Brake system, landing gear systems.	CLO7	Describe the importance of hydraulic Systems and its components and develop hydraulic systems.
		CLO8	Describe the pneumatics systems and its components. Illustrate the importance and criticality of landing gears.
		CLO9	Recognize the applications of pneumatic systems and the application of the bleed air.
CO 4	Describe the Principle of operation of aircraft gas turbine engines, Engine monitoring sensors, indicators. Describe the Fuel systems-characteristics, components, operating modes, Fueltank safety-fuel inserting system.	CLO10	Explain the components of engine and fuel aircraft systems.
		CLO11	Classify the types of aircraft engine systems and advancement in it.
		CLO12	Estimate the various fuel inerting systems and indications for aircraft systems.
CO 5	Define Flight control systems- primary and secondary flight control explain Engine control systems, Push pull rod system, Modern control systems, Digital fly by wire systems Control linkages, actuation- types.	CLO13	Illustrate the importance of fly-by-wire technology in aircraft systems.
		CLO14	Identify important flight control operations and selects suitable flight control actuations.
		CLO15	Estimate the various engine performances and their application in aircraft systems.

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
AAE0010.01	CLO1	Define the meaning of the system and its Characteristics and identify different types of aircraft systems.	PO1	2
AAE0010.02	CLO2	Describe the airframe systems, vehicle systems of aircraft systems.	PO1	2
AAE0010.03	CLO3	Explain the generic system and operating conditions of aircraft systems.	PO1	2
AAE0010.04	CLO4	Describe the various electrical power generations in the aircraft and discover more electric aircraft.	PO1	2
AAE0010.05	CLO5	Estimate the electrical power requirements and can optimize the load distribution.	PO3	2
AAE0010.06	CLO6	Explain the basic air cycle systems and vapour cycle systems of aircraft systems.	PO2	2
AAE0010.07	CLO7	Describe the importance of hydraulic systems and its components and develop hydraulic systems.	PO3	2
AAE0010.08	CLO8	Describe the pneumatics systems and its components. Illustrate the importance and criticality of landing gears.	PO2	1
AAE0010.09	CLO9	Recognize the applications of pneumatic systems and the application of the bleed air.	PO3	1
AAE0010.10	CLO10	Explain the components of engine and fuel aircraft systems.	PO3	3
AAE0010.11	CLO11	Classify the types of aircraft engine systems and advancement in it.	PO2	2
AAE0010.12	CLO12	Estimate the various fuel inerting systems and indications for aircraft systems.	PO3	3
AAE0010.13	CLO13	Illustrate the importance of fly-by-wire technology in aircraft systems.	PO2	1
AAE0010.14	CLO14	Identify important flight control operations and selects suitable flight control actuations.	PO3	1
AAE0010.15	CLO15	Estimate the various engine performances and their application in aircraft systems.	PO3	2

3 = High; 2 = Medium; 1 = Low

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	PSO1	PSO2	PSO3
CO 1	2			1	2	
CO 2	2	2	2		2	

CO 3		1	2	3	3	1
CO 4		2	3	2		1
CO 5		1	2	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	2												1			
CLO 2	1															
CLO 3	2													2		
CLO 4	2													1		
CLO 5			2											3		
CLO 6		2													1	
CLO 7			2												1	
CLO 8		1												3		
CLO 9			1										3			
CLO 10			3												1	
CLO 11		2											1			
CLO 12			3										2			
CLO 13		1													2	
CLO 14			1										1			
CLO 15			2											2		

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XIII. ASSESSMENTMETHODOLOGIES–DIRECT

CIE Exams	PO1, PO2, PO3	SEE Exams	PO1,PO2, PO3	Assignments	PO1	Seminars	PO2, PO3
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO3						

XIV. ASSESSMENTMETHODOLOGIES-INDIRECT

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

XV. SYLLABUS

UNIT-I	INTRODUCTION TO AIRCRAFT SYSTEMS
System concepts, everyday examples of systems, sub-systems; Generic system definition, inputs, outputs, feedback, external influence. Aircraft systems- airframe systems, vehicle systems, avionics systems, mission systems and their sub-systems; Specification of requirements, mission requirements, performance requirements; Operating environment conditions.	
UNIT-II	**ELECTRICAL SYSTEMS AND AIR CONDITIONING, PRESSURIZING SYSTEMS**
Electrical loads in aircraft. Electrical power generation and control- DC, AC- types. Power distribution primary, secondary. Power conversion and energy storage; Load protection; Electrical load management systems, variable speed constant frequency (VSCS) cycloconverter, 270 V DC systems; Basic air cycle systems; Vapour cycle systems, boost-strap air cycle system; Evaporative vapour cycle systems; Evaporativeair cycle systems; Oxygen systems; Fire protection systems, deicing and anti icing systems.	
UNIT-III	**HYDRAULIC SYSTEMS AND PNEUMATIC SYSTEMS**
Hydraulic systems: Study of typical workable system, function, merits, application, system loads, design requirements; Principal components; Hydraulic fluid: required properties, operating fluid pressures, temperatures, and flow rates; Hydraulic piping, pumps, reservoir, accumulator; Landing gear and brake management systems. Pneumatic systems ; Advantages;- Working principles ; Typical air pressure system ; Brake system; Typical pneumatic power system ; Components, landing gear systems ; Classification.	
UNIT-IV	**ENGINE CONTROL AND FUEL SYSTEMS**
Principle of operation of aircraft gas turbine engines; Engine - airframe interfaces; Control of fuel flow, air flow, exhaust gas flow- need, means, system parameters, basic inputs and outputs; Limited authority control systems, full authority control systems- examples; Engine monitoring- sensors, indicators; Power off takes- need, types, effect on engine performance; Fuel systems- characteristics, components, operating modes; Fueltank safety- fuel inserting system.	
UNIT-V	**AIRPLANE CONTROL SYSTEMS**
Flight control systems- primary and secondary flight control conventional systems; Power assisted and fully powered flight controls ; Power actuated systems; Engine control systems; Push pull rod system; Components; Modern control systems; Digital fly by wire systems , control laws, implementation; Auto pilot system active control technology, communication and navigation systems instrument landing systems; Control linkages,actuation- types, description and redundancy.	
Text Books:	
1. Moir, I. and Sea bridge, A, ―Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration‖, John Wiley, 3rd Edition2008. 2. Moir, I. and Sea bridge, A, ―Design and Development of Aircraft Systems- An Introduction‖, AIAA Education Series‖, AIAA, 2004.	
Reference Books:	
1. Pallett, E.H.J., ―Aircraft Instruments and Integrated Systems‖, Longman Scientific &Technical 10th edition, 1992. 2. Harris, D, ―Flight Instruments and Automatic Flight Control Systems‖, 6th edition,2004. 3. Bolton, W., "Pneumatic and Hydraulic Systems",Butterworth-Heinemann.	

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
1-3	Aircraft systems- airframe systems.	CLO 1	T2:2.4
4-7	vehicle systems, avionics systems, mission systems and their sub-Systems.	CLO 2	T2:2.4.3
8-10	Specification of requirements- mission requirements, performance requirements	CLO 2	T2:2.5
11-13	Operating environment conditions.	CLO 3	T2:7.4
14-15	Electrical loads in aircraft.	CLO 4	T1:3.1
16-18	Electrical power generation and control- DC, AC- types.	CLO 5	T1:3.1.1
19-20	Power distribution- primary, secondary	CLO 5	T1:3.2
21-22	Power conversion and energy storage. Load protection.	CLO 6	T1:3.4
23-25	Advanced systems- electrical load management systems, variable speed constant frequency (VSCS), Cycloconverter, 270 V DC systems.	CLO 4	T1:3.5
26-28	Basic air cycle systems, Vapour cycle systems, boost-strap air cycle system.	CLO 6	T1:4.2
29-31	Evaporative vapour cycle systems, Evaporative air cycle systems, Oxygen systems.	CLO 6	T1:4.3
32	Fire protection systems, deicing and anti icing systems.	CLO 6	T1:4.5
33	Aircraft hydraulic systems- function, merits, application, system loads, design requirements.	CLO 7	T1:5.1
34	Principal components, description, applications.	CLO 7	T1:5.2
35	Hydraulic fluid- required properties, operating fluid pressures, temperatures, and flow rates Hydraulic piping, pumps, reservoir, accumulator	CLO 7	T1:5.3
36	Landing gear and brake management systems, Brake management systems.	CLO 8	T1:5.9
37	Pneumatic systems, advantages, working principles.	CLO 9	T1:6.1
38	Typical air pressure system, Brake system, Typical pneumatic power system, Components.	CLO 9	T1:6.2
39	Landing gear systems, Classification.	CLO 9	T1:5.9
40	Principle of operation of aircraft gas turbine engines.	CLO 10	T1:9.1
41	Engine - airframe interfaces; Control of fuel flow, air flow, exhaust gas flow- need, means, system parameters, basic inputs and outputs	CLO 11	T1:9.2 R2: 3.4
42	Limited authority control systems, full authority control systems- examples. Engine monitoring- sensors, indicators.	CLO 11	T1:9.3
43	Power off takes- need, types, effect on engine performance. Fuel systems- characteristics, components, operating modes.	CLO 12	T1:9.4
44	Flight control systems- primary and secondary flight control conventional systems.	CLO 13	T1:9.5
45	Systems control linkages, actuation- types, and description.	CLO 14	T1:3.6
46	Redundancy. Fly-by-wire control- control laws, Fly- by-wire control-control laws, implementation	CLO 15	T1:3.7, R1:5.5
47	Auto pilot system active control technology, communication and navigation systems instrument landing systems	CLO 15	T1:3.8 R3: 9.8

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

S No	Description	Proposed actions	Relevance with POs	Relevancew ithPS Os
1	Gain information about autopilot system active control technology.	Seminars	PO3	PSO 2
2	Encourage students to make case studies on different types of engine instruments, flight instruments and navigation instruments.	Guest Lecture	PO2	PSO1,PS O3

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