INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**INTRODUCTION TO AEROSPACE ENGINEERING**			
Course Code	**A42104**			
Course Category	Regular			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	1	-	4
Course Coordinator	Ms. G. Sravanthi Assistant Professor			
Team of Instructors	Ms. G. Sravanthi Assistant Professor, Mr. R.Suresh Kumar, Assistant Professor			

I. COURSE OVERVIEW

Introduction to Aerospace engineering covers the fundamental concepts, and approaches of aerospace engineering, and are highlighted through lectures on aeronautics, astronautics, and design. Active learning aerospace modules make use of information technology. Student teams are immersed in a hands-on, lighter-than-air (LTA) vehicle design project, where they design, LTA vehicles. The connections between theory and practice are realized in the design exercises. The performance, weight, and principal characteristics of the LTA vehicles are estimated and illustrated using physics, mathematics, and chemistry known to freshmen, the emphasis being on the application of this knowledge to aerospace engineering and design rather than on exposure to new science and mathematics.

II. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	4	5	Basic concepts of aeronautical Engineering , principles and processes

III. MARKS DISTRIBUTION

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective test. The subjective test is for 20 marks, with duration of 2 hours. Subjective test of each semester shall contain 5 one mark compulsory questions in part-A and part-B contains 5 questions, the student has to answer 3 questions, each carrying 5 marks. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course.	75	100

IV. EVALUATION SCHEME

S. No	Component	Duration	Marks
1	I Mid examination	90 minutes	20
2	I Assignment	--	05
3	II Mid examination	90 minutes	20
4	II Assignment	--	05
5	External examination	3 hours	75

V . COURSE OBJECTIVES

I. **Discuss** the basic anatomy of aeroplane which includes jet and commercial aircrafts with a brief look into the history of the evolution of aerospace industry.

II. **Understand** the principle of flight for engineering models with a clear picture of Aerodynamic forces on a wing, force coefficients and generating lift.

III. **Analyze** the concept of flight vehicle performance and stability.

IV. **Demonstrate** knowledge in satellite engineering and the systems involved in the operation of a satellite with study of case files of all recent satellites.

V. **Understand** the evolution of human space exploration with a brief introduction to the missions conducted by various countries.

VI. **Demonstrate** the knowledge in basic engineering design of the aircrafts using the latest tools like CAD and increasing the knowledge in safety requirements while designing an aircraft.

VII. **Understand** the national and international terms and policies of air traffic control and gain information on the contribution and achievements of India in the field of aerospace.

VI . COURSE OUTCOMES

At the end of the course the students are able to:

1. **Apply** their understanding in the physics involved in the flying of aeroplane and helicopters.
2. **Differentiate** the anatomy and flight physics of a commercial, jet and fighter aeroplanes.
3. **Analyze** the concepts involved in flight vehicle performance and safety.
4. **Evaluate** the performance parameters, performance in steady flight, cruise, climb, range, endurance, accelerated flight symmetric maneuvers, turns, sideslips, takeoff and landing
5. **Analyze** the requirement of life support and flight safety systems in the satellites.
6. **Apply** the theoretical knowledge in the design and development of aircrafts.
7. **Analyze** the case studies of different types of satellites, jet, fighter and commercial aircrafts.
8. **Discuss** the principle constituents of the transportation system involved in civil and commercial aircrafts and understanding the national and international regulations of the aviation organizations.
9. **Calculate** the efficiency of the design in achieving the mission goal and safety of flight.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program outcomes		Level	Proficiency assessed by
PO1	Knowledge in fundamentals of mathematics, science and engineering.	H	Assignments
PO2	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	H	Exercise
PO3	An ability to design and conduct experiments, analyze and interpret data related to various areas of Aeronautical Engineering.	S	Assignments , Discussion
PO4	An ability in conducting investigations to solve problems using research based knowledge and methods to provide logical conclusions.	H	Exercise
PO5	Skills to use modern engineering and IT tools, software and equipment to analyze the problems in Aeronautical Engineering	S	------
PO6	Understanding of impact of engineering solutions on the society to assess health, safety, legal, and social issues in Aeronautical Engineering.	N	Exercise
PO7	The impact of professional engineering solutions in environmental context and to be able to respond effectively to the needs of sustainable development.	N	Discussion, Seminars
PO8	The knowledge of Professional and ethical responsibilities.	N	Discussion, Seminars
PO9	An ability to work effectively as an individual and as a team member/leader in multidisciplinary areas.	S	Discussions
PO10	An ability to critique writing samples (abstract, executive summary, project report), and oral presentations.	S	Discussion, Seminars
PO11	Knowledge of management principles and apply these to manage projects in multidisciplinary environments.	N	-----
PO12	The need of self education and ability to engage in life – long learning.	H	Prototype, Discussions

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	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.	H	Lectures and Assignments
PSO 2	**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.	S	Tutorials
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.	S	Seminars and Projects
PSO 4	**Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats.		Structural design of aircraft model

N - None **S - Supportive** **H – Highly Related**

IX. SYLLABUS

UNIT – I

HISTORY OF FLIGHT

Balloons and dirigibles, heavier than air aircraft, commercial air transport, introduction of jet aircraft, helicopters, missiles, conquest of space, commercial use of space, exploring solar system and beyond, a permanent presence of humans in space.

THE SPACE ENVIRONMENT

Earth's atmosphere, the standard atmosphere. The temperature extremes of space, laws of gravitation, low earth orbit, microgravity, benefits of microgravity. The near earth radioactive environment. The magnetosphere. Environmental impact on spacecraft. Meteoroids and micrometeoroids, space debris. Planetary environments.

UNIT – II

AERODYNAMICS AND FLIGHT VEHICLE PROPULSION

Anatomy of the airplane, helicopter, launch vehicles and missiles, space vehicles. Static forces and moments on the vehicle. Understanding engineering models Aerodynamic forces on a wing, force coefficients. Generating lift. Moment coefficients, center of pressure aerodynamic of wings. Sources of drag. Thrust for flight, the propeller and the jet engine, governing equations, rocket engines.

UNIT – III

Flight Vehicle Performance and Stability

Performance parameters, performance in steady flight, cruise, climb, range, endurance, accelerated flight symmetric maneuvers, turns, sideslips, takeoff and landing, Flight vehicle Stability, static stability, dynamic stability. Longitudinal and lateral stability, handling qualities of the airplanes.

UNIT-IV

SATELLITE SYSTEMS ENGINEERING

Satellite missions, an operational satellite system, elements of satellite, satellite bus subsystems. Satellite structures, mechanisms and materials. Power systems. Communication and telemetry. Thermal control. Attitude determination and control. Propulsion and station keeping. Space missions. Mission objectives. Case studies.

HUMAN SPACE EXPLORATION

Goals of human space flight missions.Historical background.The Soviet and US missions.The Mercury, Gemini, Apollo (manned flight to the moon), Skylab, Apollo-Soyuz, Space Shuttle. International Space Station, extravehicular activity. The space suit. The US and Russian designs. Life support systems.Flight safety.Indian effort in aviation, missile and space technology.

UNIT – V

ENGINEERING DESIGN

Design as a critical component of engineering education. Design as a skill. The design process, design thinking and design drawing. Design for mission, performance and safety requirements. Concurrent engineering. Computer aided engineering, design project. Example: the lighter-than – air vehicle student design project of MIT.

AIR TRANSPORTATION SYSTEM

Civil, Military, the objectives, principle constituents, the vehicle, the ground constituents, the organization role, Regulation – National and International, Flight safety and security.Indian effort in aviation, missile and space technology and in the field of the aerospace engineering.

Text Books:

- Newman, D., Interactive Aerospace Engineering and Design, (with software and reference material on CD), McGraw-Hill, 2002, ISBN 0-07-112254-0
- Aircraft Flight, 3rd edition, Barnard, R. H. and Philpot, D.R., Pearson, 2004, ISBN: 81-297-0783-7.
- Anderson, J.D., Introduction to Flight, fifth edition, Tata McGraw-Hill, 2007, ISBN: 0-07-006082-4.

References:

- Numerous references cited in Newman's book.
- The Wikipedia: Transportation Systems, Air Transportation, Aviation.

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1-3	**Describe** history of flight	**UNIT – I** **HISTORY OF FLIGHT** Balloons and dirigibles, heavier than air aircraft, commercial air transport	T3
3-5	**Describe** the anatomy and basic working principles of jet helicopters and missiles	introduction of jet aircraft, helicopters, missiles	T3
5-7	**Describe** the conquest of space and exploration of the solar system	Conquest of space, commercial use of space, exploring solar system and beyond, a permanent presence of humans in space.	T3
7-10	**Explain** the components of the earth's atmosphere	Earth's atmosphere, the standard atmosphere. The temperature extremes of space	T1
10-12	**Explain** the laws of gravitation and the concept of the microgravity	laws of gravitation, low earth orbit, microgravity, benefits of microgravity	T1
12-14	**Describe** the environmental impact on the spacecraft	The near earth radiative environment. The magnetosphere. Environmental impact on spacecraft.	T1
14-19	**Explain** about meteoroids and space debris	Meteoroids and micrometeoroids, space debris. Planetary environments.	T1
19-21	**Describe** the anatomy of aero plane, helicopter, launch vehicles, missiles and space vehicles	**UNIT – II** **AERODYNAMICS AND FLIGHT VEHICLE PROPULSION** Anatomy of the airplane, helicopter, launch vehicles and missiles, space vehicles.	T3
21-23	**Explain**Static forces and moments	Static forces and moments on the vehicle	T2
23-25	**Describe**engineering models Aerodynamic forces on a wing	Understanding engineering models Aerodynamic forces on a wing, force coefficients. Generating lift.	T3
25-27	**Explain** moment coefficients, center of pressure aerodynamic of wings with sources of drag	Moment coefficients, center of pressure aerodynamic of wings. Sources of drag	T2
27-30	**Describe** the thrust for flight,	Thrust for flight, the propeller and the jet engine,	T2

	the propeller and the jet engine, governing equations	governing equations, rocket engines.	
30-32	**Explain** the performance parameters, performance in steady flight	**UNIT – III** **Flight Vehicle Performance and Stability** Performance parameters, performance in steady flight	T2
32-34	**Explain** takeoff and landing parameters	cruise, climb, range, endurance, accelerated flight symmetric maneuvers, turns, sideslips, takeoff and landing	T2
34-36	**Describe** flight stability and performance	Flight vehicle Stability, static stability, dynamic stability. Longitudinal and lateral stability, handling qualities of the airplanes.	T2
36-39	**Explain** satellites working and the systems involved in it	**UNIT-IV** **SATELLITE SYSTEMS ENGINEERING** Satellite missions, an operational satellite system, elements of satellite, satellite bus subsystems	T1
39-41	**Describe** satellite structures and mechanisms	Satellite structures, mechanisms and materials	T1
41-44	**Explain** the communication system in the satellite	Communication and telemetry. Thermal control. Attitude determination and control	T1
44-48	**Describe** Propulsion and station keeping	Propulsion and station keeping. Space missions. Mission objectives. Case studies.	T1
48-50	**Explain** thegoals of human space flight missions	Goals of human space flight missions. Historical background. The Soviet and US missions	T1
50-52	**Describe** different space shuttles	The Mercury, Gemini, Apollo (manned flight to the moon), Skylab, Apollo-Soyuz, Space Shuttle. International Space Station, extravehicular activity.	T1
52-54	**Explain** the US and Russian space suits	The space suit. The US and Russian designs. Life support systems. Flight safety.	T1
54-57	**Analyze** the design requirement and tools of aircraft design	**UNIT – V** **ENGINEERING DESIGN** Design as a critical component of engineering education. Design as a skill.	T1
57-60	**Describe** the design process and design drawing	The design process, design thinking and design drawing.	T1
60-61	**Analyze** the performance and safety requirements	Design for mission, performance and safety requirements. Concurrent engineering.	T1
61-62	**Explain** the Lighter than air design project	Computer aided engineering, design project. Example: the lighter-than –air vehicle student design project of MIT.	T1
63-64	**Describe** the transportation systems and organizing bodies	Civil, Military, the objectives, principle constituents, the vehicle, the ground constituents	T1
64-65	**Explain and understand** the importance of Regulations	The organization role, Regulation – National and International, Flight safety and security.	T1
65-67	**Describe** the Indian effort in field of aerospace	Indian effort in aviation, missile and space technology and in the field of the aerospace engineering.	T1

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

Course Objectives	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
I	H	H	S	H	S		S					H	H		S	S
II		H	S		S		S					S	H	S		
III			H	H	H	S				S		S	S	H	S	S
IV	H	S	H	H								H	H		H	
V	S		S	H	S		S					S	S			
VI		S	S		H	S	S			S			S	H		
VII	S	S		H							S	H	H	S	S	

N = None **S = Supportive** **H = highly related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF TSHE PROGRAM OUTCOMES

Course Objectives	Program Outc Mr omes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
1	H	S		S	S					S		S		S	S	
2	S	H	S	S	S						S		H	S		
3			H	H	H							H	H	S		
4	H	S	H	H						S	S			S		
5	H	S	H		S								H	S		
6	H		H	H				S		S			H	S		
7	S		H	S		S				S		S	S	H		
8	S		S	H		H						S	S		S	
9	H		S		H		S		S		S		H	S		

N = None **S = Supportive** **H = Highly related**

Prepared by: Ms. G Sravanthi Assistant Professor, Mr R. Suresh Kumar, Assistant Professor

HOD, AERONAUTICAL ENGINEERING