Avionics System Analysis (10 Marks)		
Criteria	Description	Marks
System Understanding & Analysis	Explains FMS, GPS, TCAS and avionics	5
Application & Result Interpretation	Explains contribution to flight safety.	5
Total		10

	will be awarded based on identification, understanding, explanation, interpretation and presentation. **Avionics System Analysis (10 Marks)** Students will analyze the operation of modern avionics systems, including GPS navigation, Flight Management Systems (FMS), collision avoidance systems, and air traffic surveillance, and explain their importance in safe aircraft operation. Marks will be awarded based on the understanding of avionics architecture, accuracy of system analysis, interpretation of aircraft operational functions, application of avionics concepts, and quality of technical presentation. **Case Study on Modern Aircraft Avionics and Flight Safety (10 Marks)** Students will prepare a report on the role of modern avionics in improving aircraft safety and operational efficiency by studying recent technological advancements in commercial aviation. Marks will be awarded based on the technical accuracy of the report, understanding of avionics systems, quality of analysis, presentation of findings, and effective use of authentic technical resources.		

Suggested Specification table with Marks:

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	15%	25%	30%	15%	10%	5%

Course Outcome:

After learning the course, the students should be able to:	
CO1	Explain the fundamentals of aeronautical engineering, classify different types of aircraft, identify major aircraft components, and describe the forces and motions acting on an aircraft.
CO2	Apply the principles of basic aerodynamics to explain airflow, lift, drag, thrust, airfoil characteristics, stalling, and the effects of Mach number on aircraft performance.
CO3	Explain the structural configuration of aircraft, aerospace materials, load factors, and the functions of major structural components and landing gear.

Structural Component Identification	Identifies aircraft structural components.	5
Load Analysis & Engineering Interpretation	Explains structural loading and significance.	5
Total		10

Aerospace Material and Structural Analysis (10 Marks)		
Criteria	Description	Marks
Material Understanding & Comparison	Compares metallic and composite materials.	5
Engineering Analysis & Interpretation	Evaluates engineering applications.	5
Total		10

Module 4: Fundamentals of Propulsion

Aircraft Propulsion System Identification (10 Marks)		
Criteria	Description	Marks
Engine Identification & Working Principle	Identifies propulsion systems and working principles.	5
Performance Analysis & Engineering Applications	Compares propulsion performance and applications.	5
Total		10

Comparative Analysis of Aircraft Engines (10 Marks)		
Criteria	Description	Marks
Technical Comparison	Compares aircraft engines.	5
Analysis & Technical Interpretation	Evaluates advantages and suitability.	5
Total		10

Module 5: Fundamentals of Avionics

Aircraft Instrument and Navigation System Study (10 Marks)		
Criteria	Description	Marks
Instrument Identification & System Understanding	Identifies cockpit instruments and systems.	5
Technical Interpretation & Application	Explains operational significance.	5
Total		10

Evaluation Methods:

Sr. No.	Evaluation Methods	SEE	CCE
1	Aircraft Propulsion System Identification	10	-
2	Comparative Analysis of Aircraft Engines	10	-
3	Presentation on Emerging Aircraft Propulsion Technologies (ALA-4)	-	10
	Total	20	10

Examination Style:

Aircraft Propulsion System Identification (10 Marks)

Students will identify different aircraft propulsion systems, including piston engines, turbojet, turbofan, turboprop, turboshaft, ramjet, scramjet, and rocket engines, using technical illustrations, animations, or simulation tools. Students should explain the operating principles and typical applications of each propulsion system and compare their suitability for different categories of aircraft. The activity is designed to develop a fundamental understanding of aircraft propulsion technologies. Marks will be awarded based on the correct identification of propulsion systems, understanding of engine operating principles, technical comparison of propulsion systems, interpretation of engineering applications, and clarity of presentation.

Comparative Analysis of Aircraft Engines (10 Marks)

Students will perform a comparative analysis of various aircraft engines by evaluating their operating principles, thrust generation, fuel efficiency, operating speed, and practical applications in civil, military, and space vehicles. Students should justify the selection of a particular propulsion system for different mission requirements and discuss recent developments in aircraft propulsion technology. The activity is designed to enhance analytical and application-oriented learning. Marks will be awarded based on the accuracy of engine comparison, understanding of propulsion characteristics, analysis of engineering applications, interpretation of results, and quality of technical presentation.

Presentation on Emerging Aircraft Propulsion Technologies (10 Marks)

Students will prepare and deliver a technical presentation on emerging aircraft propulsion technologies such as electric propulsion, hybrid-

Suggested Assessment Guideline:

Module 1: Introduction to Aeronautical Engineering

Aircraft Component Identification and Classification (10 Marks)		
Criteria	Description	Marks
Concept Understanding & Aircraft Identification	Correctly identifies major components of aircraft and classifies the aircraft.	5
Functional Explanation & Technical Interpretation	Explains component functions with technical accuracy	5
Total		10

Aircraft Forces and Motions Demonstration (10 Marks)		
Criteria	Description	Marks
Concept Understanding & Demonstration	Demonstrates lift, drag, thrust, weight, roll, pitch and yaw.	5
Analysis & Technical Explanation	Explains aircraft axes, control surfaces and stability.	5
Total		10

Module 2: Basic Aerodynamics

Aerodynamic Force Analysis (10 Marks)		
Criteria	Description	Marks
Concept Understanding & Aerodynamic Analysis	Explains aerodynamic forces and airflow.	5
Result Interpretation & Application	Interprets aerodynamic behaviour and applications.	5
Total		10

Airfoil Analysis and Performance Study (10 Marks)		
Criteria	Description	Marks
Airfoil Identification & Analysis	Identifies and compares NACA airfoils.	5
Performance Evaluation & Interpretation	Evaluates lift, drag and stall characteristics.	5
Total		10

Module 3: Fundamentals of Aircraft Structures

Aircraft Structural Component Identification (10 Marks)		
Criteria	Description	Marks

CO4	Compare different aircraft propulsion systems and explain the operating principles of piston, jet, gas turbine, and rocket engines used in aerospace applications.
CO5	Explain the fundamentals of avionics, including flight control, navigation, communication, weather radar, flight instruments, and aircraft systems management.

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment.

Reference Books:

[1] Fundamentals of Aerospace Engineering, M. Soler, Creative Commons.
[2] Fundamentals of Aerodynamics, J. D. Anderson, Jr., McGraw-Hill, Inc.
[3] Introduction to flight, J. D. Anderson, Jr., McGraw-Hill, Inc.
[4] Aerodynamics, L.J. Clancy, Pitman Publishing Ltd., London.

	electric propulsion, hydrogen-powered aircraft, sustainable aviation fuels, or advanced gas turbine technologies. Students should explain the working principles, advantages, limitations, environmental impact, and future prospects of the selected technology using reliable technical resources. The activity is intended to enhance technical communication, research aptitude, and awareness of recent developments in aerospace engineering. Marks will be awarded based on the technical content, conceptual understanding, quality of analysis, presentation skills, ability to answer questions, and effective use of technical references.		
5	**Fundamentals of Avionics** Flight Control Systems, Navigation Systems, Communication Systems, Weather and Radar Systems, Flight Instruments, Aircraft Systems Management, Collision Avoidance and Traffic Monitoring. **Practical:** 41) Study cockpit instruments. 42) Demonstrate aircraft navigation. 43) Study aeronautical charts. 44) Observe live aircraft tracking. 45) Study aviation weather. 46) Demonstrate Flight Management concepts. 47) Case Study: Aircraft black box investigation. 48) Study Air Traffic Control procedures. 49) Compare analog and glass cockpit displays. 50) Prepare a report on modern avionics. **Evaluation Method:**	18	20%

Sr. No.	Evaluation Methods	SEE	CCE
1	Aircraft Instrument and Navigation System Study	10	-
2	Avionics System Analysis	10	-
3	Case Study on Modern Aircraft Avionics and Flight Safety (ALA-5)	-	10
	Total	20	10

Examination Style:

Aircraft Instrument and Navigation System Study (10 Marks)

Students will identify cockpit instruments and explain the working principles of flight control, navigation, communication, and weather monitoring systems using virtual resources or flight simulators. Marks

Gyanmanjari Innovative University

Syllabus
Gyanmanjari Institute of Technology
Semester- 3 (B.Tech.)

Subject: Basics of Aeronautical Engineering - BET2AE13306

Type of course: Professional Core

Prerequisite: Engineering Mechanics, Engineering Graphics, Engineering Physics, and Engineering Mathematics.

Rationale:

The aviation and aerospace sector play a significant role in modern transportation, defence, space exploration, and technological advancement. With the rapid growth of the aerospace industry, there is an increasing demand for engineers possessing a fundamental understanding of aircraft systems and flight principles. This course introduces students to the basic concepts of aeronautical engineering, including aircraft classification, aerodynamics, aircraft structures, propulsion systems, and avionics. It provides a multidisciplinary perspective by integrating principles of mechanical engineering, fluid mechanics, materials science, and control systems The course emphasises conceptual understanding through interactive learning, simulation-based activities, case studies, and engineering applications. The knowledge acquired through this course enables students to appreciate the engineering principles behind aircraft design and operation, while preparing them for higher studies, interdisciplinary projects, research, and careers in the aviation and aerospace industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
2	0	4	4	100	50	150

Legends CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; SEE - Semester End Evaluation, CCE-Continuous and Comprehensive Evaluation.

Course Content:

Sr. No	Course content	Hrs.	% Weigh tage
1	**Introduction to Aeronautical Engineering** Overview of Aeronautical Engineering, Basic flight principles and classification of aircraft vehicles, Parts of the aircraft, Forces acting on an aircraft, Three axes of aircraft and movements around three axes. **Practical:** 1) Identify major aircraft components. 2) Classify different aircraft.	18	20%

	Examination Style: **Aircraft Structural Component Identification (10 Marks)** Students will identify major structural components of an aircraft, explain their functions, and discuss the loads experienced by each component. Marks will be awarded based on correctness and understanding. **Aerospace Material and Structural Analysis (10 Marks)** Students will compare metallic and composite aerospace materials and analyze their suitability for aircraft applications based on strength, weight, corrosion resistance, and durability. Marks will be awarded based on material comparison, understanding of properties, engineering applications, interpretation and presentation. **Case Study on Composite Aircraft Structures (10 Marks)** Students will prepare a technical report on the use of composite materials in modern aircraft (e.g., Boeing 787 or Airbus A350) and discuss their advantages over conventional metallic structures. Marks will be awarded based on technical accuracy, depth of analysis, engineering relevance, report quality and presentation.		
4	**Fundamentals of Propulsion** Fundamentals of Propulsion, Propeller and Jet Propulsion, Jet Engines, Piston Engines, Turbojet, Turbofan, Turboprop, Turboshaft, Ramjet, Scramjet, Pulse Jet, Solid Propellant and Liquid Propellant Rocket Engines. **Practical:** 31) Identify aircraft propulsion systems. 32) Compare turbojet, turbofan and turboprop engines. 33) Study jet engine operation. 34) Observe piston engine operation. 35) Compare propulsion systems. 36) Study rocket propulsion. 37) Case Study: Evolution of aircraft engines. 38) Compare different propulsion systems. 39) Prepare a seminar on electric and hydrogen propulsion. 40) Analyze propulsion applications.	18	20%

3) Virtual exploration of airport layouts.
4) Demonstrate Roll, Pitch and Yaw
5) Study aircraft coordinate system and control surfaces.
6) Compare civil, military and cargo aircraft.
7) Case Study: Evolution of aircraft.
8) Study Indian aerospace organizations.
9) Aircraft identification exercise.
10) Prepare an aircraft specification sheet for two commercial aircraft by comparing their manufacturer, dimensions, engine type, seating capacity, cruising speed, range, and application using Airbus and Boeing official websites.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	Aircraft Component Identification and Classification	10	
2	Aircraft Forces and Motions Demonstration	10	
3	Aircraft Specification Sheet and Comparative Study (ALA-1)		10
	Total	20	10

Examination Style:

Aircraft Component Identification and Classification (10 Marks)

Students will identify the major parts of a given aircraft using aircraft images, models, or virtual visualization tools. They should classify the aircraft based on lift generation, wing configuration, propulsion system, and application, and explain the function of each identified component. Marks will be awarded based on the accuracy of identification, correctness of classification, understanding of aircraft components, and clarity of explanation.

Aircraft Forces and Motions Demonstration (10 Marks)

Students will demonstrate the four forces acting on an aircraft (Lift, Drag, Thrust, and Weight) and explain the aircraft motions (Roll, Pitch, and Yaw) using a flight simulator, animations, or suitable diagrams. Students should relate each motion to its corresponding control surface and aircraft axis. Marks will be awarded based on conceptual understanding, demonstration, technical explanation, and interpretation.

	Airfoil Analysis and Performance Study (10 Marks) Students will compare different NACA airfoils and analyze their camber, thickness, pressure distribution, lift generation, and stall characteristics using available aerodynamic software or online resources. Marks will be awarded based on technical understanding, observations, and interpretation. **Comparative Study of Airfoil Profiles and Wing Configurations (10 Marks)** Students will compare different airfoil sections and wing planforms used in modern aircraft and submit a technical report highlighting their applications and aerodynamic advantages. Marks will be awarded based on technical correctness, comparative analysis, interpretation, report quality and timely submission.		
3	**Fundamentals of Aircraft Structures** Introduction to aircraft structure, Materials used in aircraft, Structural integrity and load factors (Lift, Landing and Maneuver Loads), Structural components of aircraft, Landing gears. **Practical:** 21) Study aircraft structural components. 22) Compare aerospace materials. 23) Virtual tensile test demonstration. 24) Study landing gear arrangements. 25) Observe wing and fuselage structure. 26) Compare metallic and composite aircraft. 27) Case Study: Boeing 787 composite structure. 28) Analyze aircraft structural failures. 29) Reverse engineering of aircraft models. 30) Prepare a report on advanced aerospace materials. **Evaluation Method:** **Sr. No. | Evaluation Methods | SEE | CCE** 1 | Aircraft Structural Component Identification | 10 | - 2 | Aerospace Material and Structural Analysis | 10 | - 3 | Case Study on Composite Aircraft Structures (ALA-3) | - | 10 **Total** | 20 | 10	18	20%

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Aircraft Specification Sheet and Comparative Study (10 Marks)
Students will prepare a comparative specification sheet for any two commercial aircraft using authentic aerospace resources. The report should include manufacturer, dimensions, engine type, seating capacity, cruising speed, range, and applications. Marks will be awarded based on technical accuracy, comparison, presentation quality, and report submission.
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Basic Aerodynamics
Introduction to Basic Aerodynamics, Air properties, Types of airflow, Continuity equation and Bernoulli's equation, Airfoil nomenclature, Aerodynamic forces (Lift, Drag and Thrust), Airfoil stalling, Critical Mach Number, Critical Pressure Coefficient, Drag Divergence Mach Number and Swept Wing.
Practical:
11) Study lift and drag characteristics.
12) Demonstrate airflow over different airfoil sections.
13) Analyze pressure distribution over an airfoil.
14) Study the effect of angle of attack.
15) Observe aircraft stall.
16) Demonstrate Bernoulli's principle.
17) Compare NACA airfoils.
18) Case Study: Boeing 787 wing design.
19) Analyze wing planforms.
20) Study lift enhancement devices using.

Evaluation Method:
<table>
<tr><th>Sr. No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr>
<tr><td>1</td><td>Aerodynamic Force Analysis</td><td>10</td><td>-</td></tr>
<tr><td>2</td><td>Airfoil Analysis and Performance Study</td><td>10</td><td>-</td></tr>
<tr><td>3</td><td>Comparative Study of Airfoil Profiles and Wing Configurations (ALA-2)</td><td>-</td><td>10</td></tr>
<tr><td></td><td>Total</td><td>20</td><td>10</td></tr>
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Examination Style:

Aerodynamic Force Analysis (10 Marks)
Students will analyze the aerodynamic forces acting on an aircraft and explain the effects of lift, drag, thrust, weight, angle of attack, and airflow using simulation tools or diagrams. Marks will be awarded based on conceptual understanding, analysis, and interpretation.
</td>
<td>18</td>
<td>20%</td>
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