



# GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE03001021

Course / Subject Name : Fundamentals of Aeronautical Engineering

w. e. f. Academic Year:	2024-25
Semester:	3
Category of the Course:	PCC

<b>Prerequisite:</b>	Zeal to learn the subject
<b>Rationale:</b>	The subject on basic and applied Aeronautical engineering is important to understand the concept and overview of aeronautical equipment.

### Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Describe the components of an aircraft and their roles in achieving stability and control during flight..	Remember
2	Understand the principles of lift, drag, and airfoil behavior across different flow regimes.	Understand
3	Analyze the structural configuration and materials used in aircraft construction.	Analyze
4	Compare various propulsion systems and their suitability for different flight missions.	Create
5	Discuss the integration of avionics systems in enhancing navigation, safety, and communication..	Evaluate

### Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	TH		Theory		Tutorial / Practical			
						ESE (E)	PA (M)	PA (I)	PBL/ (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

\* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.



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## Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	<b>INTRODUCTION:</b> History of flight, types of Ariel vehicles, Types of aircrafts, Aircraft Components, phases of flight, four forces acting upon an aircraft. Three axis of aircraft, movements around three axis Primary control surfaces- *Ailerons, Elevators, Rudder, Secondary control surfaces- Flaps, Trim Tabs, Air brakes, Spoilers. Integrated control surfaces- Flaperon, Ruddervator, Elevons.	9	20
2.	<b>BASIC AERODYNAMICS:</b> Introduction of Basic Aerodynamics, review of atmospheric physics (Different regimes of atmosphere), Airfoil nomenclature, elementary aerodynamics (lift, drag, thrust, moments and airfoil stalling), Pressure Coefficient, Mach number, Types of Flow- (Subsonic, Transonic, Supersonic, Hypersonic), Definitions of Critical Mach Number, Critical Pressure Coefficient and Drag Divergence Mach Number, Swept wing.	9	20
3.	<b>FUNDAMENTALS OF AIRCRAFT STRUCTURE:</b> Introduction to aircraft structure, Classification of aircraft parts, Basic function of aircraft structure, *Aircraft configuration and principle types of Construction. * Details of constructional features of conventional aircraft- Fuselage, Wings, tail planes. *Introduction to Landing gears and types of landing gears/Under Carriage.	9	20
4.	<b>FUNDAMENTALS OF PROPULSION:</b> Fundamentals of Propulsion, Geometry of propeller, Classification of different propulsion systems- *Piston engines, types of turbojet, turbofan, turboprop, turbo shaft, ram jet, scramjet, pulse jet and solid propellant, liquid propellant rocket engines	8	15
5.	<b>FUNDAMENTALS OF AVIONICS:</b> VOR, NDB-ADF, ILS, MLS, Primary and Secondary Radar, TCAS, VORTAC, DME, GPS, Airborne Weather Radar, Radio altimeter.	11	25
<b>Total</b>		<b>46</b>	<b>100</b>

\* This topic should be covered during laboratory sessions as well.

## Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	20	20	20	10	10

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)



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## References/Suggested Learning Resources:

### (a) Books:

1. Aerodynamics by L. J. Clancy, Published by Sterling Book House, Indian Edition.
2. Fundamentals of Aerodynamics by John D. Anderson, Jr. McGraw Hill, Inc.
3. Introduction to Flight by John D. Anderson, Jr. McGraw Hill, Inc.
4. Flight without Formulae by A. C. Kermode.
5. Aircraft Maintenance and Repair: Watkins, Delp, TATA McGraw-Hill.
6. Elements of Gas Turbine Propulsion by Mattingly.
7. Gas Turbine by V. Ganesan, Tata-McGraw Hill Publishing Company Ltd, New Delhi.
8. Principles of Avionics: by Albert Helfrick.
9. Avionics Systems: by: D H Middleton.
10. Aircraft Structures for Engineering Students (Elsevier Aerospace Engineering) by T H G Megson.

### (b) Open source software and website:

1. <https://archive.nptel.ac.in/courses/101>
2. <https://archive.nptel.ac.in/courses/101/105/101105088/?>
3. <https://archive.nptel.ac.in/courses/101/105/101105059/?>

## Suggested Course Practical List:

1. Introduction to basic aircraft science.
2. Interpretation of aero model drawings.
3. Preparation of wing layout of RC plane.
4. Preparation of fuselage layout of RC plane.
5. Preparation of tail plane layout of RC plane.
6. Introduction to flight simulator and its familiarization.
7. Pre-flight checks, take off, hover, Climbing and climbing turns, Descending and descending turns in flight simulator.
8. Flight Simulator Circuit Flying Test – rectangle/square; circles/orbit; pattern of 8.
9. Preparation of 3D printed airfoil NACA 0012.
10. Seminar/Poster on an aircraft / System of interest.

## List of Laboratory/Learning Resources Required:

The major equipment required for this syllabus includes a low-speed wind tunnel for aerodynamic studies; 3D printers for airfoil fabrication; RC plane assembly materials like wings, fuselage, servos, and motors; flight simulators with Controller.

## Suggested Project List:

1. Airfoil Aerodynamics: Test lift and drag on different Airfoil designs using simple setups.
2. Model Rocket Design: Build and test rockets for stability and range.

## Suggested Activities for Students:

1. Paper Airplane Experiment: Study how wing shapes affect flight performance.



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2. RC Glider: Design and test a lightweight glider for maximum glide distance.

• **List of suggested activities for Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5hrs., Report preparation = 5hrs. Total = 10hrs.	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 4hrs. each. Total = 20hrs.	Based on the correctness of submitted assignment.
4.	Problem solving/Coding using C, C++, MATLAB, Python, SCILAB, modeling and Analysis software or any other software	5 small coding-based assignment of 2hrs. each. Total = 10hrs.	Based on the coding solution submitted.
5.	Self-learning online course	Minimum duration of the course should be 10hrs.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Identification and solution of Complex problem	Maximum 2 problems. Study of the problem and solution finding, Total = 10hrs.	Based on the depth of the solution submitted.
7.	Videos on Industrial safety/Disaster Management aspects based on subject	Duration of video = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on quiz/report submitted
8.	Technical paper reading and summarization of research papers based on relevant subject	5 research papers = 20 hrs.	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 hrs.	Based on poster/chart preparation and presentation skills
10.	Working/non-working model on technical topics	Working = 12 hrs. Non- working = 8 hrs.	Based on inter department/external



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			evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/sustainability/any other issue	Duration = 15 hrs. for industrial exposure Problem identification and tentative solution = 10 hrs. Total = 20 hrs.	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = Min. 1 hr.per subject. Max. 3 hrs. per subject	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5hrs. Report preparation = 5hrs. Total = 10hrs.	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 hrs.	Depending on the complexity of the Application/Software
15.	Research paper publication	Duration = 10 hrs.	Based on submission of proof of publication
16.	Upgradation/Reverse engineering studies of existing equipment of the laboratory	Duration 10 hrs.	Based on the performance of the equipment
17.	Expert lecture/session	Duration 3 hrs. For attending the lecture/session– 2 hrs. and for report writing 1 hr.	Based on the proof of attendance and report submitted
18.	Annotated Video Explanation of Concept/Problem	10h (Preparation + Recording + Submission)	Based on accuracy of explanation, clarity, and presentation style.
19.	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.

Note:

1. All the suggested activity should be related to the subject.
2. The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
3. Rubrics for the evaluation can be prepared by the faculty.
4. Subject teacher can add the relevant activities other than those listed above, with the consent of head of the department and DQAC.

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