

Elements of Aeronautical Engineering

Course Code	22EAE13	Course type	ESC	Credits L-T-P	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100 marks
Flipped Classes content	10 Hours			SEE Marks	100 marks

Course learning objectives	
Students should	
1.	Understand the history, basic principle of aviation, trends in aerospace Industry.
2.	Understand the basics of flight & aircraft propulsion.
3.	Understand the various flight controls and dynamics of aircraft
4.	Understand different systems of an aircraft

Unit – I	Contact Hours = 8 Hours
Introduction to Aircrafts	Flipped Classes Content = 2 Hours
History of aviation; History of Indian Aviation Sector, History of Unmanned Air Vehicles, Basic components of an aircraft; structural members; Helicopters, their parts and functions. Introduction to Military Aircraft, Transport Aircraft, Unmanned Aircraft, Classification of aircraft and space vehicles, Classification and Applications of Unmanned Air Vehicles, global and Indian Aircraft scenario. Aircraft materials.	
Topics for Flipped Classes: History of aviation; History of Indian Aviation Sector	

Unit – II	Contact Hours = 8 Hours
Basic principles of flight	Flipped Classes Content = 2 Hours
International standard atmosphere and its properties; significance of speed of sound; Mach number, airspeed and groundspeed; Bernoulli's theorem and derivation for Bernoulli's equation, measurement of airspeed; aerofoil nomenclature, Types of Aerofoils, forces acting on Aerofoil, pressure distribution over aerofoil. Centre of pressure, Aerodynamic center, Aspect Ratio, Introduction to Lift and drag components. Circulation and its effects. Magnus effect and Kutta condition, Introduction to wind tunnel testing. Introduction to rotary wing and flapping wing aerodynamics. Introduction to Boundary layer, Types and effect of boundary layer.	
Topics for Flipped Classes: Aerofoil nomenclature, Types of Aerofoils	

Unit – III	Contact Hours = 8 Hours
Aircraft Propulsion	Flipped Classes Content = 2 Hours
Classification of Aircraft power plants, Aircraft power plants – basic principles of piston & jet engines and Rocket engine, Brayton cycle and its application to gas turbine engines; SFC, TSFC, Specific Impulse,	

Propulsive Efficiency, Thermal efficiency, Overall efficiency, production of thrust by propellers and jets. Introduction to Rocket and Missile propulsion.

Topics for Flipped Classes: classification of Aircraft power plants

Unit – IV Aircraft Performance and Stability	Contact Hours = 8 Hours Flipped Classes Content = 2 Hours
Phases of flight, Steady level flight, stalling speed, High lift Devices, Thrust and power curves, Excess power, Range and endurance, Introduction to maneuver and accelerated flight performance. Aircraft axis system; aircraft motions; static and dynamic stability; longitudinal, lateral and directional static stability; Numerical on trim conditions, Effect of wings and Tail configurations on static stability. Introduction to transonic and supersonic flight.	
Topics for Flipped Classes: High lift Devices, Aircraft axis system	

Unit – V Aircraft Systems	Contact Hours = 8 Hours Flipped Classes Content = 2 Hours
Cockpit instrumentation and displays; Basic flight control system & FBW, navigation system, Environment control system and oxygen system, hydraulic and pneumatic systems, fuel system, communication system, APU, Instrument landing system.	
Topics for Flipped Classes: APU, Instrument landing system	

Unit No.	Self-Study Component
1	Drones (flapping wing, MAV, quad copters)
2	Bernoulli's theorem and its application for generation of lift, Flight regimes.
3	Ramjet, Scramjet
4	Effect of flaps and stats on lift, control tabs, stalling, gliding, landing, turning
5	power generation & Distribution systems

Books	
	Text Books:
1.	John D. Anderson, "Introduction to Flight", McGraw-Hill Education, 2011. ISBN 9780071086059.
2.	Lalit Gupta and O P Sharma, "Fundamentals of Flight Vol-I to Vol-IV", Himalayan Books, 2006, ISBN-13: 978-8170020974
	Reference Books:
1.	Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 2011. ISBN 978111965006.
2.	Nelson R.C., "Flight stability and automatic control", McGraw-Hill International Editions, 1998. ISBN 9780071158381.
3.	Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 8th Ed., 2011; ISBN: 1118174208, 9781118174203.

E-resources (NPTEL/SWAYAM.. Any Other)- mention links	
1.	NPTEL: Online Resources: Lecture by: Prof. Rajkumar S. Pant, IIT Bombay https://swayam.gov.in/nd1_noc19_ae05/preview
2.	NPTEL: (Unit III) Online Resources: Lecture by: Prof. Debi Prasad Mishra, IIT Kanpur https://swayam.gov.in/nd1_noc19_ae08/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes (Surprise and Scheduled)
3.	Flipped Classes	3.	Open Book Tests (OBT)
4.	Online classes	4.	Course Seminar
		5.	Semester End Examination

Course Outcome (COs)				
At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Explain the types of Aircrafts & industries	L2 (Un)	1,12	1,2,3
2.	Estimate various Aerodynamic forces & Compare various Atmosphere layers properties	L3 (Ap)	1,2,12	1,2,3
3.	Interpret the air-breathing engines & its components	L2 (Un)	1,12	1,2,3
4.	Illustrate the basics of flight dynamics, aircraft performance and maneuverability.	L2 (Un)	1,12	1,2,3
5.	Demonstrate the various systems of aircraft	L2 (Un)	1,9,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE): **Theory course**

Components	Addition of two IA tests	Online Quiz	Addition of two OBAs	Course Seminar	Total Marks
Marks	25+25 = 50	4* 5 marks = 20	10+10 =20	10	100
OBA - Open Book Assignment					
Minimum score to be eligible for SEE: 40 OUT OF 100					

Scheme of Semester End Examination (SEE):

1.	It will be conducted for 100 marks of 3 hours duration. It will be reduced to 50 marks for the calculation of SGPA and CGPA.
2.	Minimum marks required in SEE to pass: Score should be > 35%, however overall score of CIE + SEE should be > 40%
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

Rubrics:Levels	Target
1 (Low)	60% of the students score Less than 50 % of the total marks.
2 (Medium)	60% of the students score 50 – 70 % of the total marks.
3 (High)	60% of the students score More than 70 % of the total marks.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	√											√	√	√	√
2	√	√										√	√	√	√
3	√											√	√	√	√
4	√											√	√	√	√
5	√											√	√	√	√
Tick mark the CO, PO and PSO mapping															