COURSE CONTENT

AERODYNAMICS AND PROPULSION LABORATORY								
IV Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAEE15	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	0	2	1	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 36**				**Total Classes: 36**		
Prerequisite: Aerodynamics and Propulsion								

I. COURSE OVERVIEW:

The aerodynamics and propulsion laboratory course typically involves hands-on experiments and practical applications to reinforce the theoretical concepts learned in aerodynamics and propulsion courses. The lab is designed to provide students with a deeper understanding of the principles related to the behaviour of aerodynamic concepts and propulsion systems used in aircrafts. This course offers a wide range of applications in aerodynamics and propulsion such as measurement of lift, drag, moment, boundary layer and thrust measurements. It forms an essential cornerstone for aerospace engineers, plays a pivotal role in the efficient design and testing of various aircraft components.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Perform wind tunnel tests to assess aerodynamic characteristics of different symmetric and cambered airfoils
II. Undertake force measurement, wake analysis and flow visualization of flat plate, cylinder and airfoils by using wind tunnel, Six component balance, and smoke generator.
III. Estimate the thrust, performance parameters and efficiency of gas turbine engine using axial flow gas turbine engine
IV. Experimental Aerodynamic analysis of the complex shapes by using wind tunnel and determine the flight performance and stability criteria.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO1 Compare Wind tunnel, Six component balance with variation of RPM and wind velocity

CO2 Analyze the pressure distribution, flow pattern and wake over the cylinder, flat plate and airfoils by using wind tunnel, wake rack and manometer.

CO3 Evaluate the aerodynamic forces and moments of symmetric and cambered airfoils by using 6- Components balance in the Wind tunnel flow.

CO4 Interpret the flow field results of airfoils, flat plate and cylinder considering different aerodynamic laws of flow.

CO5 Analyze the thermodynamic cycle using Specific Enthalpy vs. Specific Entropy and Temperature vs. Specific Entropy diagrams.

CO6 Calculate the propeller efficiency and thrust availability using propeller test rig at various blade pitch angles.

IV. COURSE CONTENT:

EXERCISE -1: GETTING STARTED EXERCISES

a) Introduction to Low-Speed Wind Tunnel
b) Introduction to Axial Flow Gas Turbine

EXERCISE -2: EXERCISES ON CALIBRATION AND FLOW VISUALIZATION

a) Measurement of pressure and flow velocity
b) Flow visualization over a symetric airfoil and car model

EXERCISE -3: EXERCISES ON PRESSURE DISTRIBUTION

a) Pressure distribution over airfoil
b) Pressure distribution over cylinder

EXERCISE -4: EXERCISES ON WAKE ANALYSIS

a) Wake analysis of a circular cylinder / Car model
b) Wake analysis of a symmetrical airfoil

EXERCISE -5: EXERCISES ON FORCE MEASUREMENT

a) Force measurement of Aircraft model
b) Force measurement of Car model

EXERCISE -6: EXERCISES ON FLOW OVER A FLAT PLATE

a) Boundary layer measurements on flat plate
b) Prediction of skin friction drag by boundary layer measurement

EXERCISE -7: EXERCISES ON LIFT AND DRAG ESTIMATION FOR AIRFOILS

a) Estimation of lift and drag on symmeric airfoil
b) Estimation of lift and drag on unsymmeric airfoil

EXERCISE -8: EXERCISES ON ANGLE OF ATTACK AND STALL STUDY

a) Lift and dragvariation with angle of attack
b) Experimental determination of stall angle for an airfoil

EXERCISE -9: EXERCISES ON GAS TURBINE PARAMETERS CALCULATION

a) Prediction of Gas Turbine parameters
b) Prediction of Gas Turbine temperature variation

EXERCISE -10: EXERCISES ON BLOWER TEST RIG

a) Estimation of blower efficiency
b) Estimation of blower Performance

EXERCISE -11: EXERCISES ON COMPRESSOR

a) Centrifugal compressor
b) Axial flow compressor

EXERCISE -12: EXERCISES ON NOZZLE PERFORMANCE

a) Estimation of nozzle discharge and head
b) Performance of nozzle parameters at different sections

EXERCISE -13: EXERCISES ON PROPELLER TEST RIG

a) Estimation of Propeller Thrust
b) Draw the different charecteristic curve varaitions on propeller

EXERCISE-14: EXERCISES ON SPORTS AERODYNAMICS

a) Cricket ball aerodynamic analysis
b) Javelin throws aerodynamics

V. TEXT BOOKS:

1. E. L. Houghton and P. W. Carpenter, "Aerodynamics for Engineering Students", Edward Arnold Publishers Ltd., London, 5th edition, 1982,
2. J. D. Anderson, "Fundamentals of Aerodynamics", McGraw Hill Book Co., New York, 5th edition, 1985.
3. Mark Drela "Flight Vehicle Aerodynamics" The MIT Press, Cambridge, Massachusetts, London, England, 2014.

VI. REFERENCE BOOKS:

1. L. J. Clancy, "Aerodynamics", Pitman, 1st edition, 1986.
2. L. H. Milne, S. Thomson, "Theoretical Aerodynamics", Dover, 2nd edition, 1985
3. K. Karamcheti, "Principles of Ideal-Fluid Aerodynamics", Krieger Pub Co; 2nd edition, 1980.

VII. ELECTRONICS RESOURCES:

1. https://www.loc.gov/rr/scitech/tracer-bullets/aerodynamicstb.html
2. https://www.myopencourses.com/subject/aerodynamics-2
3. https://tocs.ulb.tu-darmstadt.de/211658790.pdf
4. https://www.princeton.edu/~stengel/MAE331Lecture3.pdf

VIII. MATERIALS ONLINE

1. Course Outline Description
2. Lab Manual