

## PROPULSION LABORATORY

A propulsion system is a machine that produces thrust to push an object forward. On airplanes, thrust is usually generated through some application of Newton's third law of action and reaction. A gas, or working fluid, is accelerated by the engine, and the reaction to this acceleration produces a force on the engine. To make students aware of various elements of aircraft propulsion systems, this laboratory is equipped with the following facilities.

### LOW-SPEED CASCADE WIND TUNNEL

The setup is used to test the linear cascade at different speeds. The pressure loss across the linear cascade can be evaluated and the corresponding loss coefficient can be found out. The tests can also be conducted on cascades with different blade cross-sections with different orientations of the blades. Cascade testing of a model of axial compressor blade row and turbine cascade is carried out.

#### **Specifications and items available:**

- Air velocity : 20 m/s
- Material : Mild Steel
- Inlet : Bell mouth inlet
- Test section : 120 mm × 400 mm
- Fan : Axial flow fan 600 mm Driven by DC motor
- Drive : Variable speed Thyristor Controller
- Motor capacity : 3HP



### **Cascade details:**

#### **Compressor cascade**

No. of airfoils : 5

Axial chord : 12cm

Aspect ratio : 1.25

Total turning : +/- 450

#### **Turbine cascade**

No. of aero foils: 5

Axial chord : 10cm

Aspect ratio : 1.5

Total turning : +/- 45o

#### **Instrumentation**

- Prandtle type pitot – static tube with traverse in vertical direction with differential manometer
- Instrumented cascade blade (pressure tapings of 10 points) connected to multi-tube manometer for pressure distribution study.
- Speed of the blower fan is measured by digital indicator with sensor.

## AXIAL FLOW COMPRESSOR TEST RIG (3 STAGES)

The axial flow compressor test rig is to conduct performance test on the three stage axial flow compressor

### Specification and items available:

Number of stages :3

Inlet section :300mm diameter

Outlet section :180 mm diameter

Motor capacity :3 HP AC motor with 2,800 rpm

Power measurement : By energy meter

VFD / AC Drive

Control panel



## **PROPELLER TEST RIG**

The propeller test rig is used to measure the thrust produced by the propeller at different speeds. The facility also explores the effect of pitch angle on the thrust force.

### **Specification and items available:**

2 Blade/A1uminum propeller with constant pitch and wooden propeller with variable pitch

Diameter of propeller 600 mm.

Drive: Driven by electric motor with variable speed of suitable capacity.

Thrust: The whole assemble of motor is mounted on a linear bearing motion shaft with housing (free suspension) and load cell with digital thrust indicator.

Speed: by digital speed indicator

Air velocity: measured by a digital anemometer.

The Whole assembly is housed inside the circular duct with sturdy base frame.

Control panel: consists of speed controlled digital speed indicator, digital Thrust indicator and necessary mains indicator and it is isolated from the test bench.





## HEAT TRANSFER IN FREE/NATURAL CONVECTION OVER AN AEROFOIL MODEL

The setup is used to find the free and forced convective heat transfer rate over a given model. The set up is also used to calculate the influence of model orientation and velocity on convective heat transfer rate.

### **Specification and items available:**

Uniformly heated airfoil model (**NACA 0015**) & Span of **150mm(Aluminum)** maintained at constant temperature by using heat control.

Pencil heater: capacity of 250 Watts.

Digital temperature indicator & channel selector with thermocouples on heated surface

Digital Voltmeter & Ammeter or digital power meter for heat input measurement

Provision for mounting the plate in any position. The whole instrumentation is mounted on - control board/table as a self-contained unit.



### **MEASUREMENT OF BURNING VELOCITY OF PRE-MIXED FLAME**

This facility enables the understanding of basic combustion phenomenon and also the influence of variable volume flow rate of fuel and air on burning velocity.

#### **Specification and items available:**

Specially designed burner with wire mesh to generate a laminar pre-mixed flame

Gaseous fuel from the fuel supply (LPG gas cylinder) through an orifice in to the mixing chamber.

Gas (LPG) Rotameter with control valve for gas flow

Air flow Rotameter with control valve for air flow

Mini gas cylinder is supplied along with the setup

Glass chamber for clear visualization