

## **AE6013 HYPERSONIC AERODYNAMICS**

### DETAILED SYLLABUS

#### **OBJECTIVES**

- To introduce fundamental concepts and features peculiar to hypersonic flow to students to familiarize them with the aerodynamical aspects of hypersonic vehicles and the general hypersonic flow theory.

#### **UNIT I FUNDAMENTALS OF HYPERSONIC AERODYNAMICS**

Introduction to hypersonic aerodynamics – differences between hypersonic aerodynamics and supersonic aerodynamics - concept of thin shock layers and entropy layers – hypersonic flight paths – hypersonic similarity parameters – shock wave and expansion wave relations of inviscid hypersonic flows.

#### **UNIT II SIMPLE SOLUTION METHODS FOR HYPERSONIC INVISCID FLOWS**

Local surface inclination methods – Newtonian theory – modified Newtonian law – tangent wedge and tangent cone and shock expansion methods – approximate methods - hypersonic small disturbance theory – thin shock layer theory.

#### **UNIT III VISCOUS HYPERSONIC FLOW THEORY**

Boundary layer equations for hypersonic flow – hypersonic boundary layers – self similar and non self similar boundary layers – solution methods for non self similar boundary layers – aerodynamic heating and its adverse effects on airframe.

#### **UNIT IV VISCOUS INTERACTIONS IN HYPERSONIC FLOWS**

Introduction to the concept of viscous interaction in hypersonic flows - Strong and weak viscous interactions - hypersonic viscous interaction similarity parameter – introduction to shock wave boundary layer interactions.

#### **UNIT V HIGH TEMPERATURE EFFECTS in HYPERSONIC FLOWS**

Nature of high temperature flows – chemical effects in air – real and perfect gases – Gibb's free energy and entropy - chemically reacting boundary layers – recombination and dissociation.

#### **TEXT BOOKS:**

1. John D. Anderson. Jr., "Hypersonic and High Temperature Gas Dynamics", Mc. Graw hill Series, New York, 1996.

#### **REFERENCES:**

1. John D. Anderson. Jr., "Modern Compressible flow with historical Perspective", Mc.Graw Hill Publishing Company, New York, 1996.