

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institution of Manipal University

## V SEMESTER B.TECH. (AERONAUTICAL ENGINEERING) END SEMESTER EXAMINATIONS, NOV/DEC 2017

## SUBJECT: AERODYNAMICS OF ROCKETS AND MISSILES [AAE 4001]

## REVISED CREDIT SYSTEM (23/12/2017)

Time: 3 Hours

MAX. MARKS: 50

## **Instructions to Candidates:**

- ✤ Answer ALL the questions.
- Missing data may be suitable assumed.
- **1A.** Write the classifications of missiles based on the range. (03)
- **1B.** Differentiate between the ballistic missiles and cruise missiles. **(03)**
- **1C.** List the basic aerodynamic design considerations for the development of air **(04)** to air missiles. What are the factors that limits the range of such missiles?
- 2A. Explain the airframe components of a missile with suitable sketch. (03)
- **2B.** Obtain an expression for the normal force coefficient for a wedge shaped **(03)** supersonic airfoil using linearized theory.
- 2C. The following data apply to a turbojet flying at an altitude where the ambient (04) conditions are 0.458bar and 248K. Speed of the engine 805Km/h, compressor pressure ratio 4:1, Turbine inlet temperature:1100K, Nozzle outlet area 0.0935 m<sup>2</sup>. Heat of rejection of the fuel 43MJ/kg. Find the thrust and TSFC.
- **3A.** With a neat sketch, explain the concept of base pressure in rockets and **(03)** missiles.
- **3B.** Write a note on solid, liquid and cryogenic propellants. (03)
- **3C.** Explain how the maximum speed of a cruise missile for a given operating **(04)** altitude is determined if the engine performance and missile drag characteristics are known?
- **4A.** Define fineness ratio. Explain with examples.

- (03)
- **4B.** Describe the steps involved in calculating the wave drag of a blunted **(03)** forebody?

- 4C. Consider a blunt nose missile of base diameter 0.6m and 10% of the nose tip (04) bluntness is climbing from an altitude of 2km, speed of M=1.3, angle of climb=10° to a cruise altitude of 5km where rate of climb is 3900 m/min. Determine the total range of the missile. Given fineness ratio is 2.4
- **5A.** What are critical points related to conformal transformation? **(03)**
- **5B.** Show that under the transformation w=(2z+3)/(z-4), the circle  $x^2+y^2=4x$  is (03) transformed into the straight line 4u+3=0 in the w plane
- **5C.** What is a Jowkowski transformation? Explain in detail. (04)