B.Tech. AEROSPACE ENGINEERING (BTAE)

Term-End Examination

June, 2017

□□320

BASE-002 : ROCKET PROPULSION

Time : 3 hours   *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted. Assume missing data suitably.*

1.   Give reasons for the following :   7+7

   (a)   Rocket is a non-air breathing engine.

   (b)   Liquid propellant rocket engine produces less thrust than solid propellant rocket engine.

2.   (a)   What is the purpose of an injector in a rocket engine ? Describe an injector with the help of a neat sketch.

   (b)   A spacecraft engine ejects mass at a rate of 30 kg/s with an exhaust velocity of 3100 m/s. The pressure at the nozzle exit is 5 kPa and the exit area is 0.7 m^2. Calculate the thrust of the engine in vacuum. Determine the change in velocity if the spacecraft burns its engine for 1 minute. Assume its initial mass as 30,000 kg.   7+7

3. (a) Explain regenerative cooling in a liquid propellant rocket.

    (b) Discuss the significance of linear burning rate and equilibrium combustion pressure in a solid propellant rocket.   7+7

4. Describe a multistage rocket vehicle system with the help of a diagram and explain its salient features in brief.   *14*

5. (a) Derive the expression for propulsion efficiency and overall efficiency of a rocket.

    (b) Describe the physical problems encountered with turbulent flows in a rocket engine.   7+7

6. A rocket engine burning liquid O_2 and kerosene operates at a mixture ratio of 2·26 and a combustion chamber pressure of 50 atm.

    (a) If the nozzle is expanded to operate at sea level, calculate the exhaust gas velocity relative to the rocket. (Assume critical temperature of kerosene 3470 K, M = 21·40 and K = 1·221)

    (b) If the propellant flow rate is 500 kg/s, calculate the area of the exhaust nozzle throat.   *14*

7. Write short notes on any *two* of the following :   7+7

    (a) Cryogenic Propellant

    (b) Nozzleless Propulsion

    (c) Chemical Rocket

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