Registration No :

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B.Tech
PAE6I102

6th Semester Regular Examination 2018-19
PROPULSION - II
BRANCH : AERO
Max Marks : 100
Time : 3 Hours
Q.CODE : F220
Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** (2 x 10)
   a) Define total-to-total stage efficiency of an axial flow turbine.
   b) State the methods used on turbine cooling.
   c) An ideal ramjet engine operates at M = 1.5 at an altitude of 6500m. Determine its cycle efficiency.
   d) What are the applications of integral ram-rocket propulsion system?
   e) Schematically write the configuration of bell nozzle.
   f) Determine total-to-total stage efficiency of an axial flow turbine.
   g) Determine discharge correction factor. Can it be more than one? Justify your answer.
   h) State the types of advance rocket propulsion system.
   i) What is nozzle less propulsion system?
   j) How is the nuclear rocket propulsion is advantageous compare to other propulsion system?

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** (6 x 8)
   a) With a neat sketch develop the fundamental thrust equation of a rocket.
   b) An axial turbine of high hub-tip ratio runs with zero degree of reaction and peak efficiency at design flow and speed. The nozzle exit angle is 70^0 (from the axial direction). Calculate the percentage change in torque accompanying a 20% drop in speed (from the design value) while operating with design mass flow.
   c) Analyze the important factors that govern the selection of a solid propellant
   d) Justify, why burning rate index of a solid propellant should be less than unity?
   e) Draw the velocity triangle of an axial flow turbine and explain how the torque is developed. Derive the expression for power developed by the turbine.
   f) What is constant nozzle angle design of an axial flow turbine? Explain the salient features of this design.
   g) Explain the various methods of thrust vector control with sketches.
   h) What are the limitations of an electrical rocket propulsion system? What are the various types of electrical propulsion system? Explain any one system with a neat sketch.
   i) Estimate the effect of aerodynamic losses of the Ramjet engine.
   j) Discuss the problems associated with supersonic combustion and how to overcome it?
   k) State the various cooling technique used in liquid rocket engine with suitable examples.
   l) With neat sketch explain the principle of operation of a Nuclear rocket.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 At the mean diameter of a gas turbine, the blade velocity is 350m/s. The blade angle at **(16)** inlet and exit are 20^0 and 54^0 respectively, and the blades at this section are designed to have a degree of reaction of 50%. The mean radius of the blades is 0.216m and the blade mean height is 0.07m. Assuming the blades are designed according to vortex theory, calculate
  a) The flow velocity,
  b) The angle of blades at the tip and at the root,
  c) The degree of reaction at the tip and the root of the blades.

Q4 A rocket is to be designed to produce 5MN thrust at sea level. The pressure in the **(16)** combustion chamber is 7MPa and the temperature is 2800K. If the working fluid is assumed to be a perfect gas with the properties of air at room temperature, determine the following:
  a) Specific Impulse,
  b) Mass flow rate,
  c) Throat diameter and
  d) Exit diameter

Q5 A ramjet engine propels on an aircraft at Mach No. 1.4, and at an altitude of 6000m. The **(16)** diameter of inlet diffuser at the entry is 40cm and calorific value (C.V) of fuel is 43MJ/kg. The stagnation temperature at the nozzle entry is 1500K. The properties of combustion gases are same as those of air (γ = 1.4, R =287J/kg K). Evaluate
  a) Efficiency of ideal cycle,
  b) Flight speed,
  c) Air flow rate,
  d) Diffuser pressure ratio,
  e) fuel air ratio,
  f) Nozzle pressure ratio,
  g) Nozzle jet Mach number,
  h) Propulsive efficiency,
  i) Thrust. Efficiency of diffuser is 0.92, nozzle is 0.95, combustor is 0.97 and combustor pressure loss is 0.22.

Q6 Discuss about **(16)**
  a) Radio-isotope rockets
  b) Nuclear fission rockets