INDIAN INSTITUTE OF ENGINEERING SCIENCE AND TECHNOLOGY, SHIBPUR
B.E. 6th Semester (Aerospace Engineering) End Semester Examination, May 2014
Theory of propulsion (AE 603)

Full Marks: *70* **Time:** *3 hrs*

*Answer any **five (5)** questions from Part A and any **four (4)** questions from Part B*

Part A (2 Marks each)any five(5)

1. Define turbomachinery.
2. Write a short note on thrust augmentation?
3. Explain the significance of nacelle in subsonic inlets.
4. Define gas generator.
5. What are the parameters on which performance of flight depends? Explain in brief.
6. Explain nozzle choking.

Part B (15 Marks each)any four (4)

7. (a) Draw the velocity triangles for axial flow compressor and derive expression for Euler's work in terms of blade angles. Derive another expression for Euler's work in terms of relative velocities and absolute velocities.
   (b) The following data refers to axial flow compressor stage at mean diameter.
   Blade velocity = *250 m/s*
   Constant velocity of flow = *200 m/s*
   Absolute air angle at inlet $(\alpha_1) = 40^o$
   Absolute air angle at outlet $(\alpha_2) = 15^o$
   The density of air may be assumed to be constant, *1.1 kg/m*^{3}
   Determine
   i) The pressure rise in stage
   ii) Stage work per kg of air.
   [8+7]
8. (a) Draw and explain the enthalpy-entropy diagram for flow through a general turbine stage with some degree of reaction. Write the expressions for enthalpy loss and pressure loss coefficients in stator and moving blades.
   (b) Derive an expression for degree of reaction for an axial turbine in terms of relative velocity and Euler work.
   [8+7]
9. (a) Mention the various advantages and disadvantages of turboprop engine and also bring out the applications.
   (b) What is meant by thrust? Derive the thrust equation for a general propulsion system.
   [7+8]

10. A turbojet engine requires *0.18 kg* per *hr N* of thrust *(TSFC)*, when the thrust is *9 kN*. The aircraft velocity is *500 m/s* and mass of air passing through the compressor of turbine is *27 kg/s*.

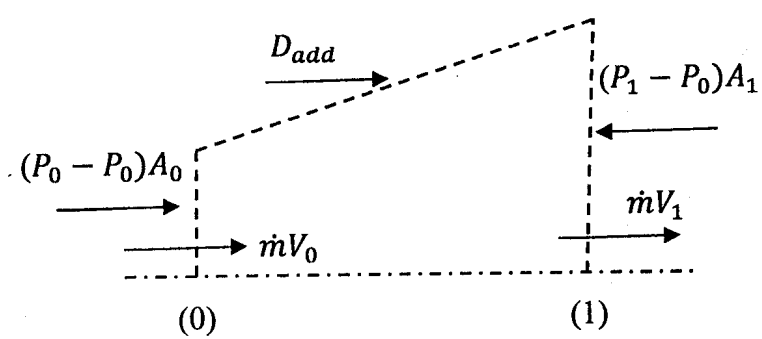
Determine
i. air fuel ratio
ii. thrust power
iii. thermal efficiency
iv. propulsive efficiency
v. overall efficiency.
Take $C.V. = 44000\ kJkg^{-1}$

[15]

11. Define parametric cycle analysis and explain the engine performance parameters for real turbojet engine.

[15]

12. a. Define installed engine thrust, uninstalled engine thrust, nacelle drag and additive drag.
b. Derive the expression for additive drag ($D_{add} = P_1A_1(1 + \gamma M_1^2) - P_0A_0\gamma M_0^2 - P_0A_1$) applying momentum equation to a stream tube of engine air from '0' to '1' shown in the following figure:



[7+8]