Seat No: _____ Enrollment No: _____

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

MTech, Winter 2019-20 Examination

Semester: 1 **Date: 16/12/2019**
Subject Code: 203210101 **Time: 10:30 am to 1:00 pm**
Subject Name: Advanced Thermodynamics **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 A) Derive the differential form of the S.F.E.E. **(05)**

B) What do you understand by the entropy principle? **(05)**

C) Explain are Helmholtz function and Gibbs function with their physical significance. **(05)**

Q.2 **Answer the following questions**. (Attempt any three) (Each five mark) **(15)**

A) Deduce the expression for available energy from a finite energy source at temperature T when the environmental temperature is T_0.

B) Define the second law efficiency. How is it different from the first law efficiency in the case of simple power plant?

C) Calculate the specific exergy of air for a state at 2 bar, 393.15K when the surrounding are at 1 bar, 293.15K. Take Cp=1 kJ/kg K and R=0.287kJ/kg K

D) Explain the principle of operation of a hydrogen-oxygen fuel cell. What is the maximum work obtainable in the cell?

Q.3 A) Determine the maximum work obtainable by using one finite body at temperature T and a thermal energy reservoir at temperature T_0, $T_1>T_2$. **(07)**

B) Write down the first and second Tds equations, and derive the expression for the difference in heat capacities (Cp and Cv). What does the expression signify? **(08)**

OR

B) **I.** What is the condition for exact differential? Derive Maxwell's equations. **(08)**

II. Explain Joule-Kelvin effect. What is inversion Temperature?

Q.4 A) A domestic food freezer maintains a temperature of -15^0C. The ambient air temperature is 30^0C. If heat leaks into the freezer at the continuous rate of 1.75 kJ/s. What is the least power necessary to pump this heat out continuously? **(07)**

OR

A) Show that the Maxwell-Boltzmann distribution fuction of particles among cells in phase space at equilibrium is given by: $N_i/g_i = 1/\left(B.e^{\beta\varepsilon_i}\right)$, where β is a constant. **(07)**

B) Write short note on: **(08)**

I. Continuum concept and how will you define density and pressure using this concept?
II. Enthalpy
III. Define Triple point and critical point of water and write the pressure and temperature value for both conditions.
IV. Define external and internal irreversibility.