

EASTERN UNIVERSITY, SRI LANKA  
SECOND YEAR FIRST SEMESTER EXAMINATION IN SCIENCE

- 2021/2022

(March/April - 2024)

PH 2031 STATISTICAL PHYSICS

Time: 01 hour

Answer ALL Questions

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1. The thermodynamics probability of a system obeying Maxwell-Boltzmann statistics can be written as;

$$\Omega = N! \prod_j \frac{g_j^{n_j}}{n_j!}$$

where the symbols have their usual meanings.

- i. If the system is in equilibrium state, prove that

$$\sum_j \ln \left( \frac{n_j}{g_j} \right) dn_j = 0 \quad (30 \text{ Points})$$

- ii. show that

$$\sum_j dn_j = 0 \quad \text{and} \quad (10 \text{ Points})$$

$$\sum_j \varepsilon_j dn_j = 0 \quad (10 \text{ Points})$$

- iii. Using the results in (i) and (ii), obtain the Maxwell-Boltzmann distribution function. (20 Points)

- iv. Hence, obtain an expression for the Maxwell-Boltzmann distribution function in terms of partition function. (30 Points)

2. i. What do you understand by the terms macrostate, microstate, thermodynamic probability and partition function of a system in Statistical physics. (30 Points)
- ii. Express a relationship in terms of entropy and the thermodynamic probability of a system and identify their variables. (20 Points)
- iii. Describe the terms "partition function" and "density of states" as used in statistical physics. (20 Points)
- iv. Consider a system consists of two particles each of which can be occupied in any three quantum states of energies 0, E and 2E. Indicate the possible microstates if the system obeys;
- (a) Maxwell-Boltzmann Statistics, (10 Points)
  - (b) Bose-Einstein Statistics and (10 Points)
  - (c) Fermi-Dirac Statistics. (10 Points)

...End of Exam...