Reg. No……. Name…… **18U529**

B.Sc. DEGREE END SEMESTER EXAMINATION OCTOBER/NOVEMBER 2018

SEMESTER **–5: PHYSICS (CORE COURSE)**

COURSE: **15U5CRPHY07: THERMAL & STATISTICAL PHYSICS**

(Common for Regular 2016 admission & Supplementary 2015 & 2014 admissions)

Time: Three Hours Max. Marks: 60

PART A (Very short answer questions)

*Answer **all** questions. Each question carries **1** Mark*

1. The internal energy of the universe is zero. True or False?
2. Define specific heat at constant pressure.
3. State Carnot's theorem.
4. Define efficiency of a heat engine.
5. What is a black body?
6. Write Clausius-Clapyron equation and name the terms.
7. State Wien's displacement law.
8. Write down Maxwell Boltzmann distribution law.
9. Bosons need to obey Pauli Exclusion Principle. True or False?
10. Write Boltzmann's entropy relation. (1 x 10 = 10)

PART B (Short answer)

*Answer **any seven** questions. Each question carries **2** Marks*

11. Derive an expression for the efficiency of a heat engine in terms of the temperature of the source and sink. Suggest one method for increasing the efficiency of a Carnot's engine.
12. Define isothermal processes. Give PV diagram for an isothermal process.
13. Explain the significance of thermodynamic potentials.
14. Define enthalpy and show that for an isobaric process, the change in enthalpy is equal to the heat absorbed.
15. Explain the temperature dependence of black body radiation.
16. What is Gibbs paradox?
17. Differentiate between classical and quantum statistics.
18. Write down the basic postulates of Fermi-Dirac statistics.
19. Distinguish between Bosons and Fermions. (2 x 7 = 14)

PART C (Problem/Derivations)

*Answer **any four** question. Each question carries **4** Marks*

20. Define adiabatic processes. Show that in an adiabatic compression of a system, its internal energy increases.
21. Calculate the work done when one litre of a mono atomic perfect gas at NTP is compressed adiabatically to half its volume. Given γ = 1.67.

22. A Carnot engine has the efficiency 50% when the temperature of the sink is 27°C. Find the change in temperature of the source to get an efficiency of 60%.
23. Deduce the temperature at which a perfect black body loses thermal energy at the rate of 1 watt/cm^{-2}. Stefan's constant is 5.67×10^{-8} $Wm^{-2}K^{-4}$.
24. Describe with the help of a neat diagram, the four "strokes" of an internal combustion engine.
25. Starting from

$$n(E)dE = \frac{2\pi N}{(\pi kT)^{3/2}} E^{\frac{1}{2}} e^{-E/kT} \quad dE$$

derive Maxwell-Boltzmann speed distribution law. (4 x 4 = 16)

PART D (Long answer questions)

*Answer **any two** question. Each question carries **10** Marks*

26. Describe Carnot's ideal heat engine. Derive expression for the work done by the engine per cycle.
27. What do you mean by entropy? Show that entropy remains constant in reversible process but increases in irreversible process.
28. What is an electron gas? Starting from Fermi-Dirac distribution law, derive the expression for energy distribution of free electrons in a metal.
29. Starting from the Bose-Einstein distribution, derive Plank's law of black body radiations.

(10 x 2 = 20)

****