Reg. No…….. Name…… **15U525**

B.Sc. DEGREE END SEMESTER EXAMINATION OCTOBER 2017

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

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

(For Regular 2015 admission)

Time: Three Hours Max. Marks: 60

PART A (Very short answer questions)

*(Answer **all** questions) Each question carries 1 Mark*

1. State the zeroth law of thermodynamics.
2. During an adiabatic process $TV^{\gamma+1}$ is a constant. True or False?
3. The work done by an engine is equal to the area enclosed by the indicator diagram. True or False?
4. In an Otto engine, _____ is the working substance.
5. State the principle of increase of entropy.
6. What is T-S diagram?
7. State Nernst's heat theorem.
8. State Plank's Radiation law.
9. Sketch the nature of the blackbody spectra for two arbitrary temperatures T_1 and T_2, assuming $T_1 < T_2$.
10. Define thermodynamic probability. (1 x 10 = 10)

PART B (Short answer)

*(Answer **any seven** questions) Each question carries 2 Marks*

11. State first law of thermodynamics. Give its physical significance.
12. Define internal energy of a system. Specify the components contributing to internal energy.
13. Sketch Searle's apparatus for measuring the thermal conductivity of solids. Write the formula for thermal conductivity.
14. Name four thermodynamic potentials. Give expression for them.
15. What is the physical significance entropy? What is the unit of entropy?
16. Find the increase in entropy when 1 gram of ice at 0^oC is converted to water at 0^o C, if latent heat of ice is 80 cal/gram.
17. What do you mean by microstates and macro states of a system of particles?
18. State and prove Boltzmann's entropy relation.

19. Discuss the conditions under which Bose-Einstein and Fermi-Dirac Statistics are reduced to Maxwell-Boltzmann distribution. (2 x 7 = 14)

PART C (Problem/Derivations)

*(Answer **any four** question) Each question carries 4 Marks*

20. Show that the slope of an adiabatic is γ times the slope of the isothermal, where $r = \frac{Cp}{Cv}$
21. Describe with the help of a diagram, the four "strokes" of an internal combustion engine.
22. The efficiency of an ideal engine increases from 20% to 30 %, when the temperature of the sink is lowered by 40°C. Find the temperature of the source and sink.
23. Show that during a Carnot's cycle the entropy of the system remains constant.
24. 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} $Wm^{-2}K^{-4}$.
25. If Wien's constant is 0.3 *cm K*, calculate the temperature of Sun whose radiation has maximum energy at wavelength 550 nm. (4 x 4 = 16)

PART D (Long answer questions)

*(Answer **any two** question) Each question carries 10 Marks*

26. Define specific heat of a material. Define specific heat at constant volume and constant pressure for a gas. Derive Mayer's relation starting from first law of thermodynamics, assuming volume and temperature are independent variables.
27. Derive the Maxwell's thermodynamic relations from thermodynamic potentials with state variables.
28. What is Fermi-Dirac Statistics? Obtain the Fermi-Dirac distribution law.
29. Derive an expression for Plank's radiation law starting from Bose-Einstein distribution for bosons.

(10 x 2 = 20)

****