19U611S (Pages: 3) Name: ……

Reg. No. ……

SIXTH SEMESTER. B.Sc. DEGREE EXAMINATION, APRIL 2022

(CUCBCSS-UG**)**

CC15U PH6 B10 - THERMAL AND STATISTICAL PHYSICS

(Physics – Core Course)

(2016 to 2018 Admissions – Supplementary/Improvement)

Time: Three hours Maximum: 80 Marks

Section A

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

1. Photons obey _____ statistics.
2. Entropy of a system can never become zero. (True/False)
3. Emissivity of an ideal black body is _____
4. In a refrigerator, the heat exhausted to the outer atmosphere is greater than that absorbed from the source. (True/False)
5. Give the name of the process in which exchange of heat is zero.
6. Write the expression for work done in a thermal process.
7. State the process for which the work done by a thermodynamic system is minimum.
8. Write the relation between the slope of an adiabatic process and slope of isothermal process.
9. Give an example of an intensive variable and an extensive variable.
10. Write the process for which the Gibbs' function is zero.

(10 × 1 = 10 Marks)

Section B

Answer ***all*** questions. Each question carries 2 marks.

11. Explain Planck's radiation law.
12. What are the properties of fermions?
13. Briefly explain the second law of thermodynamics.
14. State and explain Nernst heat theorem.
15. Obtain the expression for work done in an adiabatic process.
16. Write the Clausius-Clapyron equation and explain each term.
17. State Equipartition theorem and use it to obtain the average energy for a monoatomic particle in three dimensions.

(7 × 2 = 14 Marks)

Section C

Answer any ***five*** questions. Each question carries 4 marks.

18. Derive the expression for work done for isobaric and isochoric process.
19. Show that Cp – Cv = R.
20. Obtain an expression for the change in entropy of an ideal gas in terms of (a) P & T and (b) V & T.
21. What are thermodynamic potentials? Obtain its expressions.
22. Explain Clausius theorem and Clausius inequality.
23. Explain the concept of concept of thermal equilibrium with a suitable example. State the zeroth law of thermodynamics.
24. What is Fermi energy? Explain about the concept of degeneracy pressure in the context of white dwarf.

(5 × 4 = 20 Marks)

Section D

Problems. Write all relevant formulas. Each important steps carry separate marks.

Answer any ***four*** questions. Each question carries 4 marks

25. Obtain the value of Stephan's constant (σ) if the temperature of the filament of a 60W lamp is 2500K and the effective area of the filament is 0.5×10^{-4} m^2. The relative emittance of the filament is 0.35. Radiation from glass envelope may be neglected.
26. An ideal refrigerator takes heat from a cold body and rejects to a hot reservoir at 300K.Calculate the amount of work which must be done in order to remove one calorie of heat when the cold body is at 1k.
27. Calculate the change in entropy, when 1 litre of water at 27^0C is heated to 77^0C.
28. The efficiency of a Carnot engine is 1/6, on reducing temperature of sink by 60^0C efficiency becomes 1/3. Find out initial temperatures of source and sink.
29. The initial temperature of a gas is 27^0C. Calculate the temperature when the gas is compressed suddenly to 6 times it's original pressure. (γ=1.5)
30. Water boils at 100.5^0C and 99.5^0C under pressures of 0.77371 and 0.7465 m of Mercury respectively. Calculate the specific volume of steam at 100^0C when latent heat 'L' is 537000 cal/kg.
31. An object is at a temperature of 100^0C. At what temperature would it radiate energy three times faster?

(4 × 4 = 16 Marks)

Section E

Answer any ***two*** questions. Each question carries 10 marks.

32. Explain the concept of a distribution function. Discuss the Maxwell-Boltzmann velocity distribution for an ideal gas. Obtain the expression for rms speed, most probable speed and mean speed.
33. Discuss Carnot cycle with a neat diagram and derive an expression for the efficiency.
34. Obtain the Maxwell's thermodynamics relations using thermodynamic potential.
35. Explain the working of Otto engine with a neat PV diagram and obtain an expression for its efficiency.

(2 × 10 = 20 Marks)

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