MAR IVANIOS COLLEGE (AUTONOMOUS)
THIRUVANANTHAPURAM

Reg. No. :…… **Name :…….**

Third Semester B.Sc. Degree Examination, November 2016
First Degree Programme under CBCSS
Core Course: Physics – II
AUPY341: Thermodynamics and Statistical Physics

Time: **3** Hours Max. Marks: **80**

SECTION – A

*Answer **ALL** questions in a word or one or two sentences.*

1. State Stefan's law.
2. State the law which connects thermal and electrical conductivities.
3. What is the significance of first law of thermodynamics ?
4. Distinguish between isothermal and adiabatic processes.
5. What is Clausius inequality ?
6. Define Helmholtz function.
7. State Nernst heat theorem.
8. Explain the term phase space.
9. Differentiate between canonical and grand canonical ensemble.
10. What are Bosons ?

(10 × 1 = 10 Marks)

SECTION – B

*Answer any **EIGHT** questions, not exceeding a paragraph.*

11. Considering cylindrical flow of heat, obtain an expression for thermal conductivity.
12. How will you determine Stefan's constant ?

13. State the zeroth law of thermodynamics. What is its significance ?
14. Obtain an expression for work done in an adiabatic process.
15. State the Clausius statement of the second law of thermodynamics. Mention its practical application.
16. Compare the performances of a petrol and diesel engine.
17. Write a note on entropy and available energy.
18. Obtain Clausius – Clapeyron equation.
19. Define Gibb's function. What is the importance of Gibb's free energy in characterizing first order phase transition ?
20. Obtain the relation between entropy and thermodynamical probability.
21. How does Fermi Dirac Statistics differ from Bose- Einstein Statistics ?
22. Explain the principle of a refrigerator.

(8 × 2 = 16 Marks)

SECTION – C

*Short essay type / Problems : Answer any **SIX** questions.*

23. Calculate the temperature at which a black body loses thermal energy at the rate of $1 Wcm^{-2}$.
24. A quantity of dry air at 27^0C is compressed suddenly to half of its volume. Calculate the change in temperature if $\gamma = 1.4$.
25. Calculate the work done when a gram molecule of ideal gas expands isothermally at 27^0C to double its original volume. Given $R = 8.3\ JK^{-1}mol^{-1}$.
26. The temperature of 1 kg of air is raised by 10^0C at constant volume. What is the increase in its internal energy ? Given $\gamma = 1.67$ and $Cp = 993\ Jkg^{-1}K^{-1}$.
27. A Carnot's engine whose temperature of the source is 400 K takes 840 J of heat at this temperature and rejects 630 J of heat to the sink. What is the temperature of the sink ? Also calculate the efficiency of the engine.
28. A Carnot's engine has an efficiency 40% when the temperature of the sink is 300 K. How much should the temperature of the source be increased to get 60% efficiency ?

29. Calculate the change in entropy when 1kg of ice at 0^0C is converted to water at 100^0C. Given specific latent heat of water = $335 \times 10^3 Jkg^{-1}$ and specific heat capacity of water = 4.2×10^3 $Jkg^{-1}K^{-1}$.
30. Four particles are to be distributed in five energy levels. Calculate the possible ways of this distribution for (i) Classical particles (ii) Bosons.
31. A system consisting of 6 particles are arranged in two compartments. The first compartment is divided into 5 cells and the second into 8 cells. The cells are of equal size. Calculate the number of microstates in the macrostate (2, 4), if the particles obey Fermi – Dirac Statistics.

(6 × 4 = 24 Marks)

SECTION – D

*Long essay type : Answer any **TWO** questions.*

32. Describe with necessary theory the determination of thermal conductivity of a bad conductor using Lee's disc method.
33. Discuss the principle and working of Carnot's engine. Derive an expression for its efficiency.
34. Obtain the general expression for Maxwell's thermodynamic relations.
35. Starting from Bose – Einstein energy distribution law, derive Planck's law of black body radiation.

(2 × 15 = 30 Marks)

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