MAR IVANIOS COLLEGE (AUTONOMOUS)
THIRUVANANTHAPURAM

Reg. No. :…… **Name :…….**

Third Semester B.Sc. Degree Examination, November 2015
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. Obtain the dimensions of coefficient of thermal conductivity.
3. Explain the application of Kelvin – Plank statement of the second law of thermodynamics.
4. What is the concept of first law of thermodynamics ?
5. Define entropy.
6. Describe Clausius inequality.
7. Define Gibb's function.
8. What do you mean by first order phase transition ?
9. Explain the term phase space.
10. What are micro and macro states ?

(10 × 1 = 10 Marks)

SECTION – B

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

11. How will you estimate the temperature of Sun using Stefan's law and solar constant ?
12. Derive an expression for thermal conductivity considering the cylindrical flow of heat.

13. Calculate the work done in an adiabatic process.
14. State the Clausius statement of second law of thermodynamics. Explain its application.
15. Which cycle of operations are performed by a Carnot's engine ?
16. Obtain the relation $C_p - C_v = R$, using the first law of thermodynamics.
17. What is the change in entropy in i). reversible process and ii). irreversible process ?
18. Deduce Clausius – Clapeyron equation.
19. Explain the third law of thermodynamics and unattainability of absolute zero temperature.
20. Distinguish between liquid helium I and II.
21. What is an ensemble ? Differentiate between the three types of ensembles.
22. What is Bose – Einstein condensation ?

(8 × 2 = 16 Marks)

SECTION – C

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

23. The efficiency of a Carnot's engine increases from 70% to 80% when the temperature of sink is lowered by 100° C. Calculate the temperatures of source and sink.
24. With help of 200 J work from an external agency, a refrigerator absorbs 800 J from its interior in a cycle. What is its coefficient of performance and how much it rejects in a cycle ?
25. The temperature of the source of a Carnot's engine is 400 K. It takes 840 J of heat from source and rejects 630 J of heat to the sink. What is the temperature of the sink ? Also find out the efficiency of the engine.
26. A quantity of air (Υ = 1.4) at 27° C and atmospheric pressure is adiabatically compressed to half of its volume. Calculate the final temperature and pressure.
27. What is the work done when one gram molecule of an ideal gas expands isothermally at 27° C to three times its original volume ? given R = 8.3 J/mol K.

28. The filament of a lamp is heated to 1500 K. If its surface area is 0.2×10^{-4} m^2 and relative emittance is 0.80, calculate the energy radiated from it in one minute. Given $\sigma = 5.672 \times 10^{-8}$ SI units.
29. Calculate the change in entropy when 15 gm of ice at 0° C is converted to boiling water. Given latent heat of fusion of ice = 3.36×10^5 JKg^{-1} and specific heat 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 distribution if the particles are i). Bosons ii). Fermions & iii). Classical particles.
31. Obtain an expression for Maxwell's distribution law for number of molecules with velocity components in the interval range dv_x, dv_y and dv_z.

(6 × 4 = 24 Marks)

SECTION – D

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

32. Describe Lee's disc method for finding the thermal conductivity of a bad conductor.
33. Briefly discuss the working of Otto engine. What is its efficiency ? Compare Otto and Diesel engines.
34. Derive the general expression for Maxwell's thermodynamical relations. Hence, obtain the relations i). $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$ and ii). $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$
35. Distinguish between classical and quantum statistics. What are the postulates of Fermi – Dirac statistics ? Derive an expression for F – D distribution Law.

(2 × 15 = 30 Marks)

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