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Reg. No. : .....

Name : .....

Second Semester B.Sc. Degree Examination, September 2022

First Degree Programme under CBCSS

Physics

Complementary Course for Mathematics

PY 1231.1 : THERMAL PHYSICS AND STATISTICAL MECHANICS

(2018 & 2019 Admission)

Time : 3 Hours

Max. Marks : 80

SECTION – A

Answer **all** questions in **one** or **two** sentences. **Each** question carries **1** mark.

1. What is the dimension and unit of thermometric conductivity?
2. State Wiedemann Franz law.
3. What are pyrheliometers?
4. What is the speciality of Wien's displacement law?
5. Is pressure a macroscopic quantity? Explain.
6. What is the difference between isochoric and isobaric processes?
7. "Entropy is considered as an extensive property". Why?
8. What is a heat engine?

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9. Write down the Kelvin's statement for the second law of thermodynamics.

10. What is an isolated system?

(10 × 1 = 10 Marks)

SECTION – B

Answer any **eight** questions, not exceeding a paragraph. **Each** question carries **2** marks.

11. Explain why it is necessary to sandwich the experimental disc between 2 copper discs in the Lee's disc experiment.

12. Draw the blackbody spectrum for three temperatures with emissive power as a function of wavelength.

13. List out the assumptions made in stating Rayleigh Jeans law.

14. What are the properties of thermal radiation?

15. What is ultraviolet catastrophe?

16. Which are the steps involved in the procedure for determining the most probable statistical distribution?

17. Explain the TS diagram of a Carnot's cycle.

18. List out the features of entropy.

19. What are the significances and limitations of first law of thermodynamics?

20. Is it possible to get a Carnot's engine with 100% efficiency? Explain.

21. Show that for the whole system on which the Carnot engine operates, the algebraic sum of the entropy changes for the whole cycle is zero.

22. Explain why adiabatic compression causes heating.

(8 × 2 = 16 Marks)

SECTION – C

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

23. The solar radiation with maximum energy is found to be at 490 nm. If the Wien's constant is 0.002898, find the temperature of the sun. Also find the temperature of the moon, if the 14 μm radiations are the most intense from the moon.

24. How can the surface temperature of sun be determined from the measurement of solar constant?

25. A bar of length 20 cm and uniform area of cross section 4 cm^2 is made up of two equal halves of copper and aluminium welded together. The free end of copper is maintained at steam point and the free end of aluminium is at ice point. The sides of the bar are thermally isolated. Find the rate of flow of heat along the bar when the steady state is reached. Thermal conductivity of copper is 386 $Wm^{-1}K^{-1}$ and that of aluminium is 237 $Wm^{-1}K^{-1}$.

26. Show that the value of v_x is $(2kT/m)^{0.5}$ for which the probability falls to 1/e times the maximum value.

27. Find the change in entropy when a perfect gas expands isothermally and adiabatically.

28. Determine the work done when one litre of monatomic perfect gas at NTP is compressed adiabatically to half its volume. γ = I.66.

29. Find the adiabatic compression ratio for a Diesel engine if the combustion expansion ratio is 4. Given the efficiency of the engine as 52.0% and y = 1.4.

30. A Carnot's engine is working between room temperature and boiling point of water. Find its efficiency. Compare the efficiency of another Carnot's engine working between room temperature and ice point.

31. Calculate the change in entropy when 1 g ice at 0°C is converted to steam at 100°C. Given latent heat of melting = 3.34×10^5 Jkg^{-1}; latent heat of steam = 2.257×10^6 Jkg^{-1}; specific heat of water = 4.2×10^3 $Jkg^{-1}K^{-1}$.

(6 × 4 = 24 Marks)

SECTION – D

Answer any **two** questions. **Each** question carries **15** marks.

32. Derive Planck's radiation law.

33. What are ensembles? Explain the statistical ensembles and their uses.

34. Discuss briefly about entropy of reversible and irreversible processes. Differentiate between these two processes.

35. Describe the working of petrol engine with schematic diagram and theory. Derive the expression for its efficiency.

(2 × 15 = 30 Marks)
