



Reg. No. :

Name :

Third Semester B.Sc. Degree Examination, December 2017

First Degree Programme under CBCSS

PHYSICS

Core Course

**PY 1341 : Thermodynamics and Statistical Physics
(2013 Admission)**

Time : 3 Hours

Marks : 80

SECTION - A

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

1. What is meant by thermal gradient ?
2. Define Stefan's law.
3. State the Zeroth law of thermodynamics.
4. Give the differential form of first law of thermodynamics.
5. Distinguish between reversible and irreversible processes.
6. What is the significance of Clausius statement of second law of thermodynamics ?
7. What happens to entropy when a system undergoes
 - (a) a reversible process ?
 - (b) an irreversible process ?
8. State the third law of thermodynamics.
9. What is phase space ?
10. Explain the term microcanonical ensemble. **(10×1=10 Marks)**



SECTION - B

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

11. Explain Wiedemann-Franz Law.
12. Derive an expression for thermal conductivity considering cylindrical flow of heat.
13. Explain the significance of the first Law of thermodynamics.
14. Obtain an expression for work done in an isothermal process.
15. Draw an isothermal and adiabatic processes in the same indicator diagram and compare their slopes.
16. Sketch the cycle of operations performed by a Diesel engine in an indicator diagram.
17. Distinguish between first and second order phase transitions.
18. Explain the term Gibb's free energy.
19. What are the important properties of liquid Helium II ?
20. Define probability. Explain the principle of equal probability.
21. What are the basic postulates of Fermi-Dirac statistics ? Write down the F.D. Distribution formula.
22. What is Bose-Einstein condensation ?

(8×2=16 Marks)

SECTION - C

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

23. Compare the radiant emittance of a black body at 300 K and 3000 K. Given $\sigma = 5.672 \times 10^{-8}$ SI units.
24. Determine the quantity of heat conducted through a piece of metal per second whose opposite faces are at a temperature difference of 70°C . The area of each face of the metal piece is 0.2 m^2 and its thickness is 8 cm. The coefficient of thermal conductivity is 9.



25. A gas occupying one litre at 80 cm pressure is expanded adiabatically to 1190 CC. If the pressure falls to 60 cm in the process. Calculate the value of γ .
26. Calculate the change in internal energy when the temperature of one kilogram of dry air is raised by 5°C at constant volume. ($\gamma = 1.5$, $C_p = 990 \text{ J kg}^{-1} \text{ K}^{-1}$)
27. A Carnot's engine works between 200°C and 1000°C . Calculate its efficiency. What will be the change in efficiency if the temperature of the source is raised by 100°C ?
28. A refrigerator takes heat from water at 0°C and rejects it to a room at 27°C . One kilogram of water at 0°C is to be changed to ice at 0°C . How many calories of heat are discarded to the room? What is the coefficient of performance of the refrigerator?
29. Calculate the change in entropy when 2 kg of ice melts into water at the same temperature. Specific latent heat of water $= 335 \times 10^3 \text{ J kg}^{-1}$.
30. Four particles are to be arranged in five different energy levels. Calculate the possible number of ways of distribution of the particles if they are
i) Fermions and ii) Bosons.
31. Calculate the average kinetic energy in eV of electrons in metals at 27°C considering that electrons are behaving like molecules of a gas. Given, $K_B = 1.38 \times 10^{-23} \text{ J/K}$.

(6×4=24 Marks)

SECTION - D

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

32. With necessary theory describe the Lee's disc method for determination of thermal conductivity of a bad conductor.
33. Explain the working of a petrol engine and derive an expression for its efficiency.
34. Derive the general expression for Maxwell's relations and hence derive the relation
$$\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$$
35. Distinguish between classical and quantum statistics. Derive the Bose-Einstein distribution Law.

(2×15=30 Marks)