B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2013

Fifth Semester

Core Course—THERMAL AND STATISTICAL PHYSICS

(Common for Model I and Model II B.Sc. Physics, B.Sc. Physics EEM and
B.Sc. Physics Instrumentation)

Time : Three Hours   Maximum Weight : 25

Part A (Objective Type Questions)

Answer **all** *questions.*
Each bunch of four questions carries a weight of 1.

BUNCH I

1. Entropy of an irreversible isolated system :

   (a) increases.   (b) decreases.

   (c) remains unchanged.   (d) may increase or decrease.

2. When ice is added to water, the entropy :

   (a) increases.

   (b) decreases.

   (c) first decreases and then increases.

   (d) remains unchanged.

3. During adiabatic expansion, an ideal gas cools because :

   (a) internal energy decreases.

   (b) internal energy increases.

   (c) internal energy remains the same.

   (d) nothing can be said

4. The efficiency of a steam engine is more at ———— season.

   (a) summer.   (b) winter.

   (c) either (a) or (b).   (d) independent of season.

BUNCH II

5. Enthalpy is defined to be :

   (a) $U - PV$.   (b) $U - TS$.

   (c) $U + TS$.   (d) $U + PV$.

6. The function associated with volume and entropy is called :

    (a) internal energy.   (b) Helmholtz function.

    (c) Enthalpy.   (d) Gibb's function.

7. Photons obey ――――― Statistics.

    (a) M.B.   (b) F.D.

    (c) B.E.   (d) all.

8. In B.E. Statistics, the volume of the cell is :

    (a) $< h^3$.   (b) $= h^3$.

    (c) $> h^3$.   (d) $\lessgtr h^3$.

BUNCH III

9. What is the number of coordinates in phase space of a single particle ?

    (a) 1.   (b) 2.

    (c) 3.   (d) 6.

10. If temperature of source is increased, the efficiency of a car not engine :

    (a) increases.   (b) decreases.

    (c) remains constant.   (d) first increases then decreases.

11. When a rubber band is quickly stretched, its temperature :

    (a) rises.   (b) remains unchanged.

    (c) falls.   (d) first falls then rises.

12. The efficiency of a steam engine is 100%, when the temperature of the sink is :

    (a) $0°$ C.   (b) 0 K.

    (c) $27°$ C.   (d) 27 K.

BUNCH IV

13. Raleigh-Jeans law holds good for :

    (a) shorter wavelength.   (b) longer wavelength.

    (c) high frequency.   (d) none of these.

14. Which one is an extensive parameter ?

    (a) length.   (b) area.

    (c) heat capacity .   (d) all.

15. Heating of water under atmospheric pressure is an ———— process.

    (a) isothermal.

    (b) isobaric.

    (c) adiabatic.

    (d) isochoric.

16. Pion is a :

    (a) fermion.

    (b) boson.

    (c) either (a) or (b).

    (d) none of these.

$(4 \times 1 = 4)$

Part B (Short Answer Questions)

Answer any **five** *questions.*
Each question carries a weight of 1.

17. What is a reversible process ? Give two examples.

18. A heat engine cannot attain 100% efficiency. Explain why ?

19. What is meant by the principle of increase of entropy ?

20. Define microstate and macro state of a system.

21. Briefly explain the concept of phase space.

22. What is a degenerate gas ?

23. State and explain Rayleigh-Jean's law.

24. Distinguish between bosons and fermions.

$(5 \times 1 = 5)$

Part C (Short Essay/Problems)

Answer any **four** *questions.*
Each question carries a weight of 2.

25. The efficiency of an ideal engine increases from 20% to 30 %, when the temperature of the sink is lowered by 40°C. Find the temperature of the source and sink.

26. What is an indicator diagram ? State first law of thermodynamics.

27. Obtain the relation between entropy and thermodynamic probability.

28. Briefly explain Bose Einstein distribution law.

29. Explain Gibb's Paradox.

30. Calculate the change in entropy when 100 gm of water at 30°C IS mixed with 50 gm of water at 80°C.

$(4 \times 2 = 8)$

Part D (Essays Type Questions)

Answer any **two** *questions.*
Each question carries a weight of 4.

31. Deduce thermodynamic potentials and derive Maxwell's relations.

32. What is F-D Statistics ? Derive an expression for Fermi-Dirac distribution law of electrons.

33. Explain with a neat diagram, the working of a petrol engine. Comment on its efficiency. Also compare with diesel engine.

$(2 \times 4 = 8)$