First Year B.Sc., Degree Examinations,
December 2017
(Directorate of Distance Education)
PHYSICS
**Paper– I: DSA – 210: Mechanics, Properties of Matter,
Heat and Thermodynamics**

Time: 3 hrs] *[Max. Marks: 75/85*

Instruction to the Candidates:

1. *Students who have attended 25 marks IA scheme will have to answer for total 75 marks.*
2. *Students who have attended 15 marks IA scheme will have to answer for total of 85 marks.*
3. *Section E is compulsory for 85 marks scheme only.*

SECTION – A

I.   *Answer the following in a word, a phrase or a sentence:*   10 x 1 = 10 Marks

1. How many degrees of freedom does a diatomic molecule possess?
2. Write Van der Waal's equation of state where the symbols used have their usual meaning.
3. What is meant by weightlessness?
4. Define radiation pressure.
5. State Carnot's theorem.
6. Name any physical quantity having magnitude and direction which is not a vector.
7. What is meant by turbulent flow?
8. Give an example for a perfectly inelastic collision.
9. What is regenerative cooling?
10. What is meant by ultraviolet catastrophe?

SECTION – B

II.   *Answer any FIVE of the following questions:*   5 x 3 = 15 Marks

11. Write a note on I section girders.

12. The excess pressure inside a soap bubble of radius 1 cm is 1.5mm of oil of density $800 kg / m^3$. Calculate the surface tension of soap solution.

13. Define the terms (i) elasticity (ii) stress and (iii) strain.

14. State and prove the theorem of parallel axes.

15. State the law of equipartition of energy. Find 'γ' for a diatomic molecule.

16. What is meant by heat death of the universe? Explain.

17. Explain with diagram, the distribution of energy in the spectrum of blackbody radiation.

SECTION – C

III. *Answer any FIVE of the following questions:* 5 x 6 = 30 Marks

18. Starting from Planck's law of radiation deduce:
    i) Wien's displacement law.
    ii) Rayleigh – Jean's law.

19. Verify the law of conservation of energy in case of loaded spiral spring exerting SHM.

20. What are cohesive and adhesive forces? Give the molecular theory of surface tension.

21. What is center of mass frame? Derive an expression for instantaneous velocity of a rocket taking into account of earth's gravity.

22. What is an adiabatic process? Derive P, V T relations for an adiabatic change.

23. What is a conical pendulum? Discuss the theory of conical pendulum in an inertial and non inertial frame of reference.

24. Give the necessary theory for Poiseuille's method of determining the coefficient of viscosity of a liquid state clearly the assumptions made.

SECTION – D

IV. *Answer any TWO of the following questions:* 2 x 10 = 20 Marks

25. a) Derive expressions for radial and transverse components of velocity and acceleration of a particle moving in a plane.

    b) An artificial satellite revolves in a circular orbit at a height 300 km above the earth surface. If radius of earth = $6.4 \times 10^6 m$ and g = $9.8 ms^{-2}$. Calculate the period of satellite (7 + 3)

26. a) Derive an expression for efficiency of a Carnot's engine in terms of temperature of source and sink by explaining the various stages of the cycle.

    b) Two Carnot engines A and B are operated in series. The first engine A receives heat at 900 K and rejects to the reservoir at a temperature T K. The second engine B receives the heat rejected by A and in turn rejects heat to a reservoir at 400K. Calculate the temperature T for the situation when the efficiency of the two engines are equal. (7 + 3)

27. a) What is meant by a single cantilever? Obtain an expression for the depression produced by a load in a single cantilever.

    b) A steel wire of length 4.7m and cross section $3 \times 10^{-5} m^2$ stretches by the same amount as a copper wire of length 3.5cm and cross section $4 \times 10^{-5} m^2$ under a given load. What is the ratio of the Young's modulus of steel to that of copper?

    (7 + 3)

28. a) With relevant theory and diagram explain porous plug experiment.

    b) Calculate the change in entropy when 10 gram of ice at $0°C$ is converted into water at the same temperature. (Given: Latent heat of ice = 80 cal/gram).   (7 + 3)

SECTION – E

V.   *Answer any ONE of the following questions:*   1 x 10 = 10 Marks

(Compulsory question for 85 marks scheme only)

29. a) State Kepler's laws of planetary motion.

    b) Derive second (law of areas) and third law (law of periods) of Kepler's planetary motion from Newton's law of gravitation.   (3 + 7)

30. a) State and Prove perpendicular axes theorem of moment of intertia.

    b) What is radius of gyration? Obtain the expression for radius of gyration about an axis passing through C.M point and perpendicular to the plane of a rectangular plate.   (4 + 6)

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