B.Sc.(Honours) Examination, 2018
Semester-I
Physics (Allied)
Course Code: BPA-11
(Mechanics& Thermal Physics)

Time: 3 Hours **Full Marks: 40**

Questions are of value as indicated in the margin.
*Answer **any four** questions.*

1. a) Write down two basic assumptions of kinetic theory of gas. 2
   b) Establish Avogadro's hypothesis on the basis of kinetic theory gases. 2
   c) What is law of equipartition of energy? 2
   d) Calculate the temperature (in ^oC) at which the root mean square velocity of nitrogen molecule would be four time its value at 0^oC. [Assume the pressure to be constant] 2
   e) Find out the value of γ (where, $\gamma = C_P / C_v$, symbols have their usual significance) for a tri-atomic gas molecule. 2

2. a) What are the important conclusions that you would like to make from the results of Andrew's experiment. Draw the necessary pV-indicator diagram for your explanation. 3
   b) Deduce the expression for critical constants in terms of van der Waals' constants. 5
   c) The critical pressure of a gas is 14 atm and the critical volume is 8×10^{-5} m^3. Calculate the van der Waals' constant of the gas. [Given: 1 atm = 101325 Nm^{-2}] 2

3. a) Write down the unit of thermal conductivity in SI system. Distinguish between thermal conductivity and thermal diffusivity of a substance. 1+2
   b) Deduce Fourier's equation for one dimensional rectilinear flow of heat. Find out its solution under steady state. 5+2

4. a) Draw the pV-indicator diagram for the following process (i) isobaric (ii) isochoric. 1+1
   b) Show that adiabatics are steeper than isotherms. 2
   c) A certain volume of gas at 10^7 N/m^2 pressure expands isothermally till its volume is three fold and then adiabatically till its volume is again three fold. Calculate the final pressure of the gas [Consider $\gamma = 1.5$]. 3
   d) Write down one limitation of First Law of thermodynamics. 1
   e) Write down Kelvin-Planck Statement and Clausius Statement regarding Second Law of thermodynamics. 1+1

5. a) Define Moment of inertia and radius of gyration. 1+1
   b) State the theorems of parallel and perpendicular axes as applied to moment of inertia. 1+1
   c) Determine the moment of inertia of a circular disc about an axis through its centre perpendicular to its plane. 3
   d) A fly wheel in the form of a solid disc of 5000 Kg and 1 meter radius is rotating with 120 revolutions per minute. Compute its kinetic energy. 3

P.T.O.

6. a) Deduce the expression for velocity and acceleration of a particle in plane polar co-ordinates. 3+2

   b) What do you mean by conservative force? Mention its features. 1+1

   c) Examine whether the following force is conservative or not.

$$\vec{F} = \hat{i}\left(y^2 - 2xyz^3\right) + \hat{j}\left(3 + 2xy - x^2z^3\right) + \hat{k}\left(6z^3 - 3x^2yz^2\right).$$ 3

7. a) What is the unit vector perpendicular to both $\vec{A}$ and $\vec{B}$? Consider $\vec{A} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{B} = 3\hat{i} + 4\hat{j} - \hat{k}$. 3

   b) Distinguish between "G" and "g". 2

   c) What is escape velocity? Deduce the expression for the escape velocity of a particle. 1+4

———