[Time: Three Hours] **[Marks:100]**

N. B.: (1) **All** questions are **compulsory**.
(2) **Figures** to the **right** indicate **full** marks.
(3) Draw **neat** diagrams wherever **necessary**.
(5) Symbols have usual meaning unless otherwise stated.
(5) Use of **non-programmable** calculator is allowed.

Q.1. A) **Select the correct alternative** **12**

(i) For homogeneous isotropic material Poisson's ratio(σ) is given as _____

a. $\frac{Y}{\eta}-1$ b. $\frac{Y}{2\eta}-1$

c. $\frac{Y}{2\eta}+1$ d. $\frac{Y}{\eta}+1$

(ii) In the equation of continuity Area of cross section of pipe is inversely proportional to _____

a. volume of fluid b. density of fluid
c. velocity of fluid d. pressure of fluid

(iii) If the focal length of Ramsden's Eyepiece is 11.25 cm then the distance between field lens and eye lens is _____

a. 15cm b. 10cm
c. 12cm d. 8cm

(iv) The defect in a lens due to prismatic action of the lens is _____

a. Spherical aberrations b. Chromatic aberrations
c. Distortion d. Coma

(v) Temperature of the gas arises due to _____

a. Random motion of gas molecules. b. Mass of the gas
c. Weight of the gas d. None of the above

(vi) In Van der Waals equation, correction to volume is _____

a. a/V^2 b. a/V
c. $V-b$ d. b/V^2

B) **Answer in one sentence** **3**

(i) What is streamline flow?
(ii) Define linear magnification of a lens.
(iii) What is critical temperature?

C) **Fill in the blanks** **5**

(i) The ratio of shear stress and shear strain is _____
(ii) A person standing in an elevator feels an increase in his weight when the elevator is _____
(iii) The radius of the n^{th} bright Newton's rings is directly proportional to the square root of _____ natural numbers in the reflected system.

(iv) To have complete achromatism, the distance between the two coaxial lenses must be equal to the _____ focal length of the two lenses.

(v) Work is _____ dependent function.

Q. 2 A) **Attempt ANY ONE** **8**

(i) Show that for steady flow of incompressible fluid $P + \rho gh + \frac{1}{2}\rho v^2 = constant$. where, symbols have their usual meanings.

(ii) Show that torque required to twist the cylinder is $\tau = \frac{\pi \eta r^4}{2l}$ If the 'l' is a length and 'r' the radius of cylinder

B) **Attempt ANY ONE** **8**

(i) Write the applications of Bernoulli's theorem.

(ii) For a homogeneous isotropic material derive the relation between Young's modulus, modulus of rigidity η and Poisson's ratio σ.

C) **Attempt ANY ONE** 4

(i) A 10 kg block rests on a smooth frictionless table. A string attached to the block passes over a frictionless pulley and a 5 kg mass hangs from the string. Find the acceleration and tension produced in the string.

(ii) For silver Young's modulus is 7.3×10^{10} N/m^2 and bulk modulus(K) is 1.2×10^{11} N/m^2. Find the Poisson's ratio of Silver.

Q. 3 A) **Attempt ANY ONE** **8**

(i) Derive the expression for optical path difference between two rays in the case of interference due to transmitted light in thin film.

(ii) Derive the expression for the fringe width of interference pattern in the case of a wedge shaped film.

B) **Attempt ANY ONE** **8**

(i) Derive an expression for equivalent focal power for a system having two thin lenses separated by a finite distance.

(ii) Describe and explain the working of Huygens eyepiece.

C) **Attempt ANY ONE** **4**

(i) In Newton's rings experiment, diameter of the 15th ring is 6.9mm and that of the 5th ring is 4.36mm. If the radius of the curvature of lens is 1.1m, calculate wavelength of the light used.

(ii) Two thin convex lenses having focal length 15cm and 12cm are coaxial and separated by a distance of 10cm.Find the equivalent focal length and positions of principal points.

Q. 4 A) **Attempt ANY ONE** **8**

(i) With the corrections to pressure and volume, arrive at Van der Waals equation.

(ii) Show for Reversible adiabatic process

$$\left(\frac{\partial T}{\partial V}\right) = \frac{(C_V - C_P)}{\alpha V C_V}$$

where α is the isobaric volume coefficient of expansion.

B) **Attempt ANY ONE** **8**

(i) Show that for isothermal process work done, W is

$$W = RT \times 2.303 \log_{10} \frac{P_1}{P_2}$$

A perfect gas at room temperature having volume of $3m^3$ and initial pressure of 2 atm undergoes isothermal expansion to a volume of 5 m^3. Calculate the work done by the gas.

(ii) Derive Mayer's relation.

C) **Attempt ANY ONE** **4**

(i) Pressure p, Volume V and temperature $T$of a certain material are related by,

$$p = \frac{AT - BT^2}{V}$$

Find the expression for the work done by the material if the temperature changes from T_1 to T_2 while the pressure remains constant. What is work done if volume is to be kept constant?

(ii) Show that for adiabatic process work done, W is

$$W = \frac{R}{\gamma - 1}(T_1 - T_2)$$

Q. 5 **Attempt ANY FOUR** **20**

(i) Write short note on limiting value of Poisson's ratio

(ii) Show that velocity of fluid flowing through a pipe is inversely proportional to area of cross sections of a pipe.

(iii) Derive an expression for achromatic combination of two thin lenses in contact.

(iv) Derive Newton's lens equation

(v) What are the limitations of Van der Waals equations?

(vi) If T_C= 132K, P_C = 32.7 atm and R = 82.07 cm^3 atoms K^{-1}, calculate b.
