

**B.Sc. Part-III (Honours) Examination, 2020**

**Subject: Physics**

**Paper: VII**

**(Old Syllabus)**

Time: 2 Hours

Full Marks: 50

*The figures in the margin indicate full marks. Candidates are required to give their answers in their own words as far as practicable.*

Answer any TEN questions from the following:

5×10 = 50

1. Show that

$$\int_{-\infty}^{+\infty} \frac{x^2 dx}{(x^2 + 1)^2(x^2 + 2x + 2)} = \frac{7\pi}{50}$$

5

2. Evaluate

(i)  $\oint_c \frac{\sin 3z}{z + \frac{\pi}{2}} dz$ , if  $c$  is the circle  $|z| = 5$

(ii)  $\oint_c \frac{e^{iz}}{z^3} dz$ , if  $c$  is the circle  $|z| = 2$

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3. State the Hamilton's variational principle. Use this principle to find the equation of motion of a simple pendulum.

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4. What are generalized co-ordinates? Obtain an expression for the generalized force and generalized potential.

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5. Consider a system of particles obeying Maxwell Boltzmann statistics and the energy of each particle can be expressed as  $E(x) = ax^2$ ,  $-\infty \leq x \leq \infty$ . Find the average energy per particle of the system. Relate it to the principle of equipartition of energy.

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6. Consider an electron gas in a metal at  $T = 0$  K. Calculate the mean energy of an electron in terms of the Fermi energy of the metal. 5
7. Derive Einstein's equation for the Brownian motion. 5
8. Using Langevin's theory, show that at high temperature and small electric field, orientational polarization is inversely proportional to the absolute temperature. 5
9. describe an experiment with suitable diagram to measure the Hall coefficient and Hall voltage. 5
10. Adopting the free electron theory of metals, find out an expression of the electrical conductivity. 5
11. Derive Laue equations of diffraction of X-rays and obtain Bragg's law from them. 5
12. Using quantum theory of paramagnetism, derive an expression for the paramagnetic susceptibility at high temperature and low magnetic field. 5