INDIAN STATISTICAL INSTITUTE

Recruitment for posts of Scientific Assistant A (*Specialization: Physics*)

SECTION II

Syllabus for Online and Skill Tests

- **General Properties of Matter:** Elasticity, Deforming force and restoring force, Elastic and plastic body, Stress and strain, Hooke's law, Stress – strain diagram, Young's modulus, Bulk modulus, Rigidity modulus and Poisson's ratio, Surface tension, Capillarity.

- **Simple Harmonic Motion:** Periodic and oscillatory motions, Simple harmonic motion, Simple harmonic motion and uniform circular motion, Velocity and acceleration in SHM, Force law for SHM, Energy in SHM, Some systems executing SHM, Damped SHM, Forced oscillations and resonance.

- **Classical Mechanics and Applications:** Laws of Mechanics, Mechanics of a system of particles, Conservation laws, Conservative force, Principle of virtual work, D'Alembert's principle.

- **Properties of Fluid and Fluid Flow:** Pascal's law, Buoyancy, Equilibrium of floating body, Archimedes' principle, Streamline flow and turbulent flow of a fluid, critical velocity, Equation of continuity and Bernoulli's theorem. Viscosity.

- **Electromagnetic Theory:** Maxwell's equations, Wave equation, Plane electromagnetic waves, Energy-momentum, Poynting's theorem, Electromagnetic boundary conditions, Reflection and refraction, Interference, Young's experiment, Interferometers, Diffraction, Fraunhofer diffraction (single slit), Dispersion, Radiation.

- **Heat, Thermodynamics and Statistical Physics:** Thermal expansion of solid: Linear, areal and cubical expansion and their coefficients and their relation. Change of density with temperature. Transmission of heat: Conduction, convection and radiation, Thermal conductivity, Kinetics of gases, Laws of thermodynamics, Ideal and non-ideal gases.

- **Optics:** Photometry, Luminous flux, luminous intensity, Principle of Photometry, Refraction of light, Refraction of light through plane surface, Laws of refraction, Refractive index, Optical fibre, Optical lens, Huygen's principle of propagation of wave front, Principle of superposition of waves, Coherent sources, Interference of light waves, constructive and destructive interference, Young's double slit experiment.

- **Semiconductor Physics:** Energy band in solids, Distinction between conductor, Insulators & semi-conductors in terms of energy band diagram, Intrinsic and extrinsic (P-type; N-type) semiconductor, P – N junction diode, Depletion region, Potential barrier, Forward and reverse biasing; Forward and reverse bias characteristic curve. Application of P – N junction diode as –(i) half wave rectifier, (ii) full wave rectifier (Bridge circuit only) (only circuits and explanation with input and output curves).

- **Modern Physics:** Photoelectric Effect: Photoemission, Work function, Photoelectric current, its variation with intensity and frequency of incident radiation, Stopping potential, Threshold frequency, Concept of photon, Einstein's photoelectric equation. Principle of solar photo-voltaic cell and its uses.
- **Basics of Computer and its Operations:** Knowing computer, Basic applications of computer, Components of computer system, Central processing unit (CPU), VDU, Keyboard and mouse, Other input/output devices, Computer memory, Concepts of hardware and software; Concept of computing, Data and information, Applications of IECT, Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.

Sample Questions for the Online Test

Note: For each of the questions there are four suggested answers, of which only one is correct. You will score

4 marks for each correctly answered question,
0 mark for each incorrectly answered question, and
1 mark for each unattempted question.

1. A bus accelerates from rest at a constant rate α for some time and then it retards to rest at the constant rate β. If the total distance covered by the bus is γ, then the velocity of the bus is

   (a) $\sqrt{\frac{\gamma(\alpha+\beta)}{2\alpha\beta}}$ (b) $\sqrt{\frac{\gamma(\alpha-\beta)}{2\alpha\beta}}$ (c) $\sqrt{\frac{2\alpha\beta\gamma}{\alpha+\beta}}$ (d) $\sqrt{\frac{2\alpha\beta\gamma}{\alpha-\beta}}$.

2. What is the pressure difference between inside and outside of a droplet of water?

   (a) $\frac{2\sigma}{d}$ (b) $\frac{4\sigma}{d}$ (c) $\frac{8\sigma}{d}$ (d) $\frac{12\sigma}{d}$.

3. A simple harmonic oscillator has an amplitude a and time period T. The time required by it to travel from $x = a$ to $x = a/2$ is

   (a) $T/2$ (b) $T/4$ (c) $T/6$ (d) $T/8$.

4. Two bulbs take 50 watts each when connected in parallel to $100V$ source. The total power consumed by them when they are connected in series with the same source is

   (a) 25 watt (b) 50 watt (c) 75 watt (d) 100 watt .

5. The potential difference across a conductor is doubled, the rate of generation of heat will

   (a) be doubled (b) be halved (c) become one fourth (d) become 4 times .

6. The number of turns per unit length of a coil of solenoid is doubled, the self-inductance of the solenoid will

   (a) remain unchanged (b) be halved (c) be doubled (d) become four times .

7. In photoelectric effect, the number of photoelectrons emitted is proportional to

   (a) velocity of the incident beam (b) frequency of the incident beam
   (c) intensity of the incident beam (d) work function of photo cathode

8. Which of the following memories must be refreshed many times per second?

   (a) static RAM (b) dynamic RAM (c) EPROM (d) ROM .

9. If angle of contact of a drop of liquid is acute then

   (a) adhesion is more than cohesion
   (b) cohesion is more than adhesion
   (c) cohesion is equal to adhesion
   (d) adhesion and cohesion have no bearing with angle of contact

10. Which one of the following is the bulk modulus K of a fluid? (Symbols have the usual meaning)

    (a) $\rho\frac{dp}{d\rho}$ (b) $\frac{dp}{\rho d\rho}$ (c) $\rho\frac{d\rho}{dp}$ (d) $\frac{d\rho}{\rho dp}$.
