2021

Time : 3 hours

Full Marks : 100

Pass Marks : 45

Candidates are required to give their answers in their own words as far as practicable.

The questions are of equal value.

*Answer **five** questions selecting at least **one** from each Group in which Q. No. 1 is compulsory.*

1. Choose the correct answer from the given alternatives :

(a) Divergence of vector $\vec{D}$ is equal to :

(i) $\operatorname{div} \vec{D} = \vec{\nabla} \cdot \vec{D}$

(ii) $\operatorname{div}\vec{D} = \vec{\nabla} \times \vec{D}$

(iii) $\operatorname{div} D = \vec{D} \times \vec{\nabla}$

(iv) None of these

(b) The gradiant of any position vector is :

  (i) 0

  (ii) 2

  (iii) 3

  (iv) 1

(c) Which of the following theorem use the Curl operation ?

  (i) Green's theorem

  (ii) Gauss divergence theorem

  (iii) Stoke's theorem

  (iv) Maxwell equation

(d) Stoke's theorem is in relation between :

  (i) Line integral and surface integral

  (ii) Line integral and volume integral

  (iii) Surface integral and volume integral

  (iv) None of these

(e) The maximum value of θ is spherical coordinates can be :

  (i) $\pi/2$

(ii) π

(iii) 2π

(iv) None of these

(f) A force $\vec{F}$ is conservative, if :

(i) $\vec{\nabla} \times \vec{F} = 0$

(ii) $\vec{\nabla} \cdot \vec{F} = 0$

(iii) $\vec{\nabla} \times \vec{F} = $ constant

(iv) $\vec{\nabla} \cdot \vec{F} = $ constant

(g) In classical mechanics we study the motion of :

(i) Microscopic object

(ii) Macroscopic object

(iii) Both (i) and (ii)

(iv) None of these

(h) Hamiltonian is given by :

(i) Sum of kinetic and potential energy

(ii) Different of K. E. and P. E.

(iii) Both (i) and (ii)

(iv) None of these

(i) If there are n particles, the number of generalised co-ordinates in Lagrange's square are :

(i) n = N – K

(ii) n = 3N – K

(iii) n = 3N

(iv) None of these

(j) Work down by external force in N-particles system is known as :

(i) Work

(ii) Total work

(iii) Virtual work

(iv) None of these

(k) The number of independent ways in which mechanical system can move without violating any constrant is called :

(i) Constraint

(ii) Number of freedoms

(iii) Degree of freedom

(iv) Generalized coordinate

(l) To determine the value of Lagrangian L we assume :

    (i) Kinetic energy

    (ii) Potential energy

    (iii) Both (i) and (ii)

    (iv) None of these

(m) Quantum of electromagnetic energy is called :

    (i) Particles

    (ii) Photons

    (iii) Waves

    (iv) Energy

(n) Gas atoms that exert negligible electrical force on each other are :

    (i) Molecule

    (ii) Compound

    (iii) Isotopes

    (iv) Isolated atoms

(o) The wave function of particles lies in which region ?

    (i) $x > 0$

(ii)　$x < 0$

(iii)　$0 < x < L$

(iv)　$x > V$

(p)　The minimum energy possessed by the particle in a box ?

(i)　Zero

(ii)　$\dfrac{\pi^2 \hbar^2}{2mL^2}$

(iii)　$\dfrac{\pi^2 \hbar^2}{2mL}$

(iv)　$\dfrac{\pi^2 \hbar}{2mL}$

(q)　To solve Schrodinger's equation we need Potential and :

(i)　Boundary condition

(ii)　Physical requirements of system

(iii)　Both (i) and (ii)

(iv)　None of these

(r)　Schrodinger equation is a :

(i)　1st order differential equation

(ii) Second order differential equation

(iii) Both (i) and (ii)

(iv) None of these

(s) In bound state have energy E and Potential V then :

(i) $E < V$

(ii) $E > V$

(iii) $E = V$

(iv) None of these

(t) If Lagrangian of a conservative does not contain time explicity, then :

(i) $T - V =$ Constant

(ii) $T + V =$ Constant

(iii) $T = 0$

(iv) $V = 0$

Group – A

2. What is Laplace's equation ? Find solution of Laplace's equation in Cartesian Co-ordinates.

3. What is divergence of a vector ? State and prove Gauss divergence theorem.

4. State the residue theorem and prove it.

Group – B

5. Derive Langrange's equation of motion for conservative system.

6. Discuss the harmonic oscillator problem using Hamilton Jacobi method.

7. Obtain Euler's equation of motion of regid body.

Group – C

8. State and prove Heisenberg uncertainty relation.

9. Describe a hydrogen atom with a quantum mechanical approach.

10. Explain Hermiltion operator and obtain its eigen value.

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