MOTHER TERASA COLLEGE OF ARTS & SCIENCE

Mettusalai - Illuppur

THEORETICAL PHYSICS

Major : III - physics

Sub.code : 16SECPH9

Two marks questions and answers :

1. **Constraints :**

A motion that cannot proceed arbitary in any manner is called a constrain motion.

The limitation (or) geometrical Restrictions on the motion of a particle or system of particles are generally know as contrains.

2. **Degrees of freedom :**

The number of independent ways in which a mechanical system or move without violating any constraint is called the number of degrees of freedom of the system.

$$f = 3N - k.$$

3. **Generalised co. ordinates :-**

The set of independent co. ordinates sufficient to describe completely the state of configuration of a system is called

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Generalised co-ordinates

$(q_1, q_2, q_3 \ldots\ldots q_f)$

where q_f - Total number of generalised co-ordinates.

4. Principle of Virtual work:

$$\sum_i f_i^a \cdot \delta r_i = 0$$

The principle of virtual work states that in equilibrium the virtual work of the forces applied to a system is zero.

5. D' Alembert's principle:

$$\sum_i (F_i - P_i)\, \delta r_i = 0$$

The principle states that the sum of the difference b/w the forces acting on a system of mass particles and the time derivatives of the momenta of the system itself projected onto any virtual displacement consistent with the constraints of the system is zero.

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6. Define cyclic co-ordinates :-

A generalised co-ordinates on which the lagrangian of a system does not depend explicity. Also known as ignorable co-ordinates.

$$\frac{\partial L}{\partial q_k} = 0$$

7. Define principle of least action :-

The principle of least Action states that the variation of action along the actual path b/w given time Interval.

i.e $$\Delta \int_{t_1}^{t_2} 2T \, dt = 0$$

(or) $$\Delta \int_{t_1}^{t_2} \sum_j p_j \dot{q}_j \, dt = 0$$

8. What is phase space :

A combination of position space and momentum space is known as phase space. It has 6 - dimensions.

particle is specified by six co-ordinates

x, y, z, p_x, p_y, p_z.

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9. State Hamilton's principle :-

Hamilton's principle states that the development in time for a mechanical system is such that the integral of the difference b/w the kinetic & the potential energy is stationary. The motion of a mechanical system from time t_0 to t_1 is such that the functional,

$$\delta \int_{t_1}^{t_2} L \, dt = 0$$

10. What is generalised velocities ?.

The generalised velocities of a system are the total time derivatives of the generalised co-ordinates of the system.

$$\dot{q}_i = \frac{dq_i}{dt}$$

11. What is generalised momentum :-

The generalized momentum of analytical formulation of classical mechanics is defined as the partial derivative of the Lagrangian with regards to the time derivative of generalized co-ordinates.

$$P_i = \frac{\partial L}{\partial \dot{q}_i}$$

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12. Define De-Broglie waves :-

De-Broglie wave also called matter wave, any aspect of the behaviour or properties of a material object that varies in time or space in conformity with the mathematical equations that describe waves.

13. Define D-Broglie wavelength :

A photon of light of frequency ν has the momentum

$$p = h\nu/c$$

But $\nu = c/\lambda$

The momentum of the photon can be expressed in terms of wavelength λ as

$$p = h/\lambda$$

$$\boxed{\lambda = h/p}$$

Then $p = mv$ and its de broglie wavelength is accordingly

$$\lambda = \frac{h}{mv}$$

14. What is phase and group velocity ?-

phase velocity of a wave is the velocity with which its phase travels in space,

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while group velocity is the velocity with which its amplitude travels in space.

15. State Heisenberg uncertainty principle:-

The Heisenberg uncertainty principle states that it is impossible to know simultaneously the exact position and momentum of a particle, that is the more exactly the position is determined, the less known the momentum, and vice versa.

$$\Delta x \cdot \Delta p \geq \frac{\hbar}{2}$$

16. State Ehrenfest theorem:-

The theorem states that the quantum mechanics is same result as classical mechanics. For a particle for which the expectation value of any dynamical quantities are involve.

$$1^{st} \Rightarrow \frac{d}{dt}\langle x \rangle = \frac{\langle p_x \rangle}{m}$$

$$II^{nd} \Rightarrow \frac{d}{dt}\langle p_x \rangle = -\frac{dV}{dx}$$

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17. What are orthogonal wave functions?

wave function can be regarded as vector in infinite dimensional linear vector space. These eigen functions corresponding to different eigen values are orthogonal to each other.

$$\int_a^b \psi \psi^* \, dx = 0$$

18. What is normalised wave function?

The probability of finding a particle in a volume $dx.dy.dz$ is $|\psi|^2$

$$\iiint |\psi|^2 \, dx.dy \, dz = 1$$

A wave function ψ satisfying the relation is called a normalised wave function.

19. Eigen value and Eigen function :-

An eigenfunction of an operator F_{op} is a function ψ such that the application of F_{op} on ψ gives ψ again times a constant.

$$F_{op}\,\psi = f\,\psi$$

where f - eigen value

ψ - eigen function.

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20. What is zero point energy hormanic oscillator?

zero point energy or ground state energy is the lowest possible energy that a quantum mechanical system may have.

$$E = \left(n + \frac{1}{2}\right) \hbar\omega$$

$n = 0$

$$\boxed{E = \frac{1}{2} \hbar\omega}$$

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