# SSR DEGREE COLLEGE (AUTONOMOUS) NIZAMABAD
# SEM –I INTERNAL – II
# M.SC. PHYSICS
# (Classical mechanics)
# QUESTION BANK

## I. Multipule Choice

1. Which quantity replaces force in Hamiltonian mechanics?
   A) Energy B) Momentum C) Hamiltonian
   D) Generalized momentum
   Answer: D
2. For a conservative system, the Hamiltonian represents:
   A) Kinetic energy B) Potential energy C) Total energy D) Work done
   Answer: C
3. For central force motion, which coordinate is cyclic?
   A) Radial coordinate B) Time C) Azimuthal angle D) Polar angle
   Answer: C
4. If a system has two cyclic coordinates, the number of constants of motion is:
   A) One B) Two C) Three D) Zero
   Answer: B
5. .If a coordinate q is cyclic, then the corresponding conserved quantity is:
   A) Energy B) Force C) Generalized momentum D) Velocity
   Answer: C
6. Which of the following is equivalent to Hamilton's equations?
   A) Newton's laws B) Lagrange's equations
   C) Poisson bracket relations D) Schrödinger equation
   Answer: C
7. The Hamilton–Jacobi equation plays an important role in
   A) Thermodynamics B) Quantum merchanics
   C) Fluid mechanics D) Statistical mechanics
   Answer: B

8. The Hamilton–Jacobi method is mainly used to
   A) Quantize classical systems B) Solve equations of motion by separation of variables
   C) Find forces D) Derive Newton's laws
   Answer: B
9. If two eigenfunctions correspond to different eigenvalues of a Hermitian operator, they are
   A) Equal B) Linearly dependent C) Orthogonal D) Parallel
   Answer: C
10. Which of the following operators has continuous eigenvalues?
   A) Position operator B) Spin operator
   C) Angular momentum operator D) Hamiltonian of harmonic oscillator
   Answer: A
11. The principle of least action states that the actual path followed by a system is the one for which
   A) Kinetic energy is minimum B) Potential energy is minimum
   C) Action is minimum (or stationary) D) Momentum is minimum
   Answer: C
12. The equations of motion obtained from the principle of least action are
   A) Newton's equations B) Hamilton's equations
   C) Euler–Lagrange equations D) Poisson equations
   Answer: C
13. Hamiltonian mechanics is especially useful in
   A) Rigid body dynamics only B) Fluid mechanics
   C) Quantum mechanics and statistical mechanics D) Optics only
   Answer: C
14. A transformation generated by a generating function is
   A) Always non-canonical B) Always canonical
   C) Sometimes canonical D) Never canonical
   Answer: B
15. Which of the following quantities remains invariant under a canonical transformation?
   A) Hamiltonian B) Action integral
   C) Kinetic energy D) Potential energy
   Answer: B
16. Action–angle variables are mainly used for
   A) Non-conservative systems B) Systems with constraints
   C) Periodic (bound) systems D) Relativistic systems
   Answer: C

17. The angle variable \theta increases
    A) Linearly with time B) Exponentially with time
    C) Randomly with time D) Quadratically with time
    Answer: A
18. Hamilton's characteristic function W is related to Hamilton's principal function S by
    A) S = W + Et B) S = W – Et
    C) W = S – Et D) W = Et – S
    Answer: C
19. Hamilton's characteristic function is applicable when the Hamiltonian is
    A) Time-dependent B) Explicitly time-independent
    C) Relativistic D) Dissipative
    Answer: B
20. The constants of integration appearing in W correspond to
    A) Generalized coordinates B) Generalized velocities
    C) Canonical momenta D) Action variables
    Answer: C

## II. Fill in the blanks

1. The Hamilton–Jacobi method is based on a special type of ____ transformation.
   Answer: canonical
2. There are ____ standard types of generating functions used in canonical transformations.
   Answer: four
3. The Lagrange bracket of a variable with itself is always ____.zero
4. Poisson brackets are ____ with respect to their operands. Antisymmetric
5. The Poisson bracket of two functions A and B is denoted by ____. {A, B}
6. A linear triatomic molecule consists of ___ atoms arranged in a ___ line. three, straight
7. The number of vibrational degrees of freedom of a linear triatomic molecule is ____. 4
8. The force constant of the bond is denoted by ____.k
9. Action–angle variables are useful in studying ____ mechanical systems.integrable
10. Action–angle variables are obtained using a ____ transformation. Canonical
11. The Kepler problem describes the motion of a particle under an inverse-square ____ force.
    Answer: central

12. The angular action variable is equal to the magnitude of the ____ momentum.
    Answer: angular
13. The equality of frequencies leads to the closure of ____ orbits.
    Answer: elliptical
14. The two bending vibrations in a linear triatomic molecule are ____.
    Answer: degenerate
15. Normal coordinates are obtained by forming linear combinations of the ____ coordinates.
    Answer: internal
16. The principle of least action states that the actual path of a system makes the action ____.
    Answer: stationary
17. The variation of the Hamiltonian action leads to ____ equations of motion.
    Answer: Hamilton's
18. The Hamiltonian equations obtained from the action principle are ____-order differential equations.
    Answer: first
19. The Lagrange bracket [q_i, q_j] is equal to ____.
    Answer: 0
20. Poisson brackets are defined in ____ space.
    Answer: phase

## III. Descriptive Questions

1. show that poisson brackets are invariant under canonical transformation
2. Derive Hamiltons equation of motion for system of particles
3. Explain principal axis transformation and obtain frequencies and normal coordinates
4. explain the Hamiltonian characteristic function and discuss harmonic oscillator
5. what are action angle variables?
6. show that the momentum corresponding the cyclic coordinate is conserved