BUDDHA SERIES

(Unit Wise Solved Question & Answers)

Programme – B.Sc. Maths 3rd year 5th Semester

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Department: Science

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Course title: Physics

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Unit-1

1. Constraints are conditions that:

A) Always increase energy
B) Limit the motion of a system
C) Define force only

D) Eliminate mass from equations
Answer: B

2. A constraint that depends only on coordinates and time is called:

A) Holonomic
B) Non-holonomic
C) Rheonomic
D) Ideal
Answer: A

3. Constraints that depend on velocities are:

A) Holonomic
B) Scleronomic
C) Non-holonomic
D) Ideal
Answer: C

4. The number of degrees of freedom for a rigid body in 3D space is:

A) 3
B) 6
C) 2
D) 9
Answer: B

5. Configuration space is defined as:

A) Real space of motion
B) Space of generalized coordinates
C) Phase space
D) Velocity space
Answer: B

6. Forces of constraint:

A) Do work on the system
B) Are conservative
C) Do no work in ideal systems
D) Are velocity dependent
Answer: C

7. Generalized coordinates are:

A) Only Cartesian

B) Non-independent
C) Independent and minimal set of coordinates
D) Non-essential
Answer: C

8. Transformation equations relate:

A) Velocities to momenta
B) Cartesian coordinates to generalized coordinates
C) Forces to displacements
D) Kinetic to potential energy
Answer: B

9. Virtual work is:

A) Actual displacement work
B) Imaginary work
C) Work done in an arbitrary virtual displacement
D) Real-time displacement work
Answer: C

10. Principle of virtual work states:

A) Net work is always positive
B) Virtual work by forces of constraint is zero
C) Work is done by constraints
D) All forces do work
Answer: B

11. D'Alembert's principle incorporates:

A) Kinetic energy
B) Forces and accelerations
C) Inertial forces
D) Only potential energy
Answer: C

12. A constraint that doesn't change with time is:

A) Rheonomic
B) Holonomic
C) Scleronomic
D) Non-holonomic
Answer: C

13. Virtual displacement is:

A) Real movement in time
B) Infinitesimal change consistent with constraints
C) Random motion
D) None of these
Answer: B

14. Degrees of freedom of a system are:

A) Number of coordinates required to describe it
B) Number of particles
C) Constraint forces
D) Scalar quantities
Answer: A

15. The force of constraint is perpendicular to:

A) Displacement
B) Virtual displacement
C) Momentum
D) Position vector
Answer: B

16. In virtual work principle, only:

A) Constraint forces act
B) External forces do work
C) Internal forces act
D) Forces due to acceleration act
Answer: B

17. Generalized velocity is defined as:

A) Time derivative of generalized coordinate
B) Inverse of displacement
C) Velocity in Cartesian space
D) None
Answer: A

18. Inertial force is:

A) Imaginary force to balance dynamics
B) Real force
C) Constraint force
D) Conservative
Answer: A

19. Virtual work principle leads to:

A) Newton's laws
B) Lagrange's equations
C) Maxwell's equations
D) Bernoulli's principle
Answer: B

20. Which system is constrained?

A) Free fall
B) Pendulum
C) Free particle in vacuum
D) None
Answer: B

21. D'Alembert's principle turns a dynamic problem into:

A) Kinetic problem
B) Static equilibrium problem
C) Fluid dynamic problem
D) Random motion
Answer: B

22. Forces of constraint ensure:

A) Energy increase
B) Motion satisfies the constraints
C) Friction is zero
D) Mass is conserved
Answer: B

23. The minimum number of coordinates required to describe motion is called:

A) Degrees of freedom
B) Dimensions
C) Vectors
D) Constraints
Answer: A

24. A pendulum has how many degrees of freedom?

A) 1
B) 2
C) 3

D) 6
Answer: A

25. For a particle constrained to move on a surface, how many degrees of freedom in 3D?

A) 3
B) 1
C) 2
D) 0
Answer: C

26. Generalized coordinates depend on:

A) Choice of constraints
B) Particle type
C) External forces only
D) Time only
Answer: A

27. Virtual work is performed:

A) Over time interval
B) Without time progression
C) With constant acceleration
D) On real trajectories
Answer: B

28. In D'Alembert's principle, inertial force equals:

A) mv
B) -ma
C) F/m
D) 0
Answer: B

29. Holonomic constraint can be expressed as:

A) $f(x, y, z, t) = 0$
B) $dx = dy$
C) $x^2 + y^2 + z^2$
D) $v > 0$
Answer: A

30. Which of these is a non-holonomic constraint?

A) Inequality constraints
B) $x^2 + y^2 = R^2$
C) z = constant
D) $r = f(\theta)$
Answer: A

31. Which does not belong to generalized coordinates?

A) r, θ, φ
B) Cartesian coordinates only
C) Angular coordinates
D) Polar coordinates
Answer: B

32. Total number of degrees of freedom for N particles in 3D is:

A) 3N
B) N
C) 6N
D) N/3
Answer: A

33. When are forces of constraint said to be ideal?

A) When they do work
B) When they oppose motion
C) When they do no work on virtual displacements
D) When they are maximum
Answer: C

34. Which concept leads to generalized force?

A) Real motion
B) Constraint forces
C) Virtual work
D) Damping
Answer: C

35. D'Alembert's principle uses which type of displacement?

A) Real displacement
B) Virtual displacement
C) Imaginary path
D) Circular motion
Answer: B

36. Which of the following is not a generalized coordinate?

A) x
B) θ
C) φ
D) m
Answer: D

37. Which is a holonomic system?

A) Simple pendulum
B) Rolling without slipping
C) Disk with friction
D) Bouncing ball
Answer: A

38. Work done by constraint forces in ideal systems is:

A) Positive
B) Zero
C) Negative
D) Infinite
Answer: B

39. In D'Alembert's principle, dynamic equations are written as:

A) F = ma
B) F - ma = 0
C) F = 0
D) a = constant
Answer: B

40. Which of the following has configuration space of one dimension?

A) Bead on a wire
B) Free particle in space
C) Rigid body in 3D
D) Particle on a plane
Answer: A

UNIT – 2

1. The Lagrangian is defined as:
A) T + V
B) T - V
C) V - T
D) T/V
Answer: B
2. In Lagrangian mechanics, T stands for:

A) Temperature
B) Time
C) Kinetic energy
D) Tension
Answer: C
3. Lagrange's equations are derived from:
A) Newton's laws

B) Virtual work principle

C) D'Alembert's principle

D) Conservation of energy
Answer: C
4. Lagrange's equation of motion (no derivation) is:
A) d/dt (L/q) - L/ = 0

B) d/dt (L/) - L/q = 0

C) F = ma

D) L = 0
Answer: B
5. A coordinate is called cyclic if:
A) It changes with time

B) It does not appear in the Lagrangian

C) It is constrained

D) It is virtual
Answer: B
6. Conservation of linear momentum is due to:
A) Time invariance

B) Space translation invariance

C) Rotational symmetry

D) Frictionless motion
Answer: B
7. Which formulation uses fewer equations for systems with constraints?
A) Newtonian

B) Lagrangian

C) Both same

D) Hamiltonian

Answer: B

8. The kinetic energy function is:

A) Scalar

B) Vector

C) Tensor

D) Imaginary

Answer: A

9. In Lagrangian mechanics, generalized coordinates are:

A) Always Cartesian

B) Not restricted to physical dimensions

C) Only angular

D) Unmeasurable

Answer: B

10. The Lagrangian for a conservative system is:

A) Time dependent

B) Energy dependent

C) T - V

D) T + V

Answer: C

11. Cyclic coordinates lead to:

A) Changing energy

B) New equations of motion

C) Conserved generalized momenta

D) Variable potential

Answer: C

12. Newtonian mechanics uses:

A) Force-based equations

B) Energy-based equations

C) Lagrangians

D) Generalized coordinates
Answer: A
13. In Lagrangian formalism, non-conservative forces are handled by:
A) Adding them to the potential

B) Modifying the kinetic energy

C) Using generalized forces

D) Ignoring them
Answer: C
14. Conservation of energy is associated with:
A) Time invariance of the Lagrangian

B) Space invariance

C) Angular momentum

D) Mass conservation
Answer: A
15. The Lagrangian of a free particle in 1D is:
A) m^2/2

B) 0

C) V

D) T + V
Answer: A
16. Generalized momenta are obtained by:
A) Differentiating potential

B) Differentiating Lagrangian with respect to q

C) L/

D) Integrating force
Answer: C
17. If L/q = 0, then:
A) q is fixed

B) is conserved

C) q is cyclic

D) Motion stops
Answer: C
18. The Lagrangian of a simple pendulum (θ as coordinate) is:
A) T - V = (1/2)mL22 - mgLcos
B) mgh

C) T + V

D) mL
Answer: A
19. Comparison of Lagrangian and Newtonian:
A) Both use same coordinates

B) Newton uses forces, Lagrangian uses energy

C) Lagrangian is older

D) Newtonian avoids constraints
Answer: B
20. Which law is not directly used in Lagrangian mechanics?
A) Newton's third law

B) Conservation of momentum

C) D'Alembert's principle

D) Principle of least action
Answer: A
21. The conserved quantity for rotational symmetry is:
A) Energy

B) Momentum

C) Angular momentum

D) Power
Answer: C
22. Time-independent Lagrangian implies:
A) Force is zero

B) System is frictionless

C) Energy is conserved

D) L is zero
Answer: C

23. The kinetic energy in polar coordinates is:
A) (1/2)m(^2 + r22)

B) (1/2)m

C) m

D) r Answer: A
24. Which principle leads to Lagrange's equation?
A) Least action

B) Conservation of force

C) Energy principle

D) Torque law
Answer: A
25. A non-conservative force example:
A) Gravity

B) Spring force

C) Friction

D) Electrostatic force
Answer: C
26. For a system with damping, Lagrangian is:
A) Not applicable

B) Modified with generalized force

C) Same as conservative system

D) Infinite
Answer: B
27. Lagrangian is not unique because:
A) Coordinates vary

B) Total derivative can be added

C) Energy is zero

D) Force is undefined
Answer: B
28. If L doesn't depend on q, then:
A) Motion stops

B) q is conserved

C) Generalized momentum is conserved

D) Energy is undefined
Answer: C
29. The number of Lagrange equations equals:
A) Number of constraints

B) Number of generalized coordinates

C) Degrees of symmetry

D) Conserved quantities
Answer: B
30. In Newtonian mechanics, equations depend on:
A) Energy difference

B) Coordinate transformations

C) Vectorial force laws

D) Scalar potential only
Answer: C
31. Lagrangian formulation is particularly useful for:
A) Systems with few forces

B) Systems with constraints

C) Simple harmonic motion only

D) Non-mechanical systems only
Answer: B
32. For a charged particle in EM field, Lagrangian includes:
A) Magnetic energy only

B) Electric potential and vector potential terms

C) Only kinetic energy

D) No additional terms
Answer: B
33. If q is cyclic and $L/q = 0$, then:
A) L is constant

B) L/ is conserved

C) q is constant

D) Motion ceases
Answer: B
34. The kinetic energy is quadratic in:
A) Position

B) Generalized velocity

C) Time

D) Force
Answer: B
35. A system with time-dependent constraints is called:
A) Scleronomic

B) Rheonomic

C) Holonomic

D) Non-holonomic
Answer: B
36. If L = T - V is constant:
A) Total energy is conserved

B) Work is zero

C) Velocity is zero

D) Motion is chaotic
Answer: A
37. In Lagrangian, which is not a coordinate:
A) q

B) q

C) p
Answer: D
38. The action integral involves:
A) Total force

B) Total energy

C) Integral of Lagrangian over time

D) Product of kinetic and potential energy
Answer: C
39. In Lagrangian mechanics, the constraint forces are:
A) Explicit

B) Implicitly accounted via coordinates

C) Calculated manually

D) Ignored
Answer: B
40. Lagrange's equation handles constraints by:
A) Adding reaction forces

B) Reducing variables

C) Using generalized coordinates

D) Ignoring motion equations
Answer: C