

Total number of printed pages-47

3 (Sem-6/CBCS) PHY RE 1/2/3/4/5
2022

PHYSICS

(Regular Elective)

Answer the Questions from any one Option.

OPTION - A

(Communication Electronics)

Paper : PHY-RE-6016

Full Marks : 60

Time : Three hours

OPTION - B

(Digital Signal Processing)

Paper : PHY-RE-6026

Full Marks : 60

Time : Three hours

OPTION - C

(Advanced Mathematical Physics-II)

Paper : PHY-RE-6036

Full Marks : 80

Time : Three hours

OPTION - D

(Astronomy and Astrophysics)

Paper : PHY-RE-6046

Full Marks : 80

Time : Three hours

OPTION - E

(Classical Dynamics)

Paper : PHY-RE-6056

Full Marks : 80

Time : Three hours

**The figures in the margin indicate
full marks for the questions.**

Answer either in English or in Assamese.

Contd.

OPTION - E

(Classical Dynamics)

Paper : PHY-RE-6056

1. Give short answer to **any ten** the following questions : 1×10=10
- (a) An electron is subjected in a magnetic field of 1 Tesla. Find its Larmor frequency.
 - (b) What is scleronomous constrain ?
 - (c) What kind of system the principle of virtual work deals with ?
 - (d) Write the Lagrange's equation of motion for conservative systems.
 - (e) What is canonical or conjugate momentum ?
 - (f) Define generalized coordinates.
 - (g) What do you means by dispersion relation ?
 - (h) Draw potential energy *vs* displacement curve tor stable equilibrium.

- (i) What do you mean by inertial frames of reference ?
- (j) Write the dimensional formula of coefficient of viscosity for a fluid.
- (k) What do you mean by proper time ?
- (l) What is the angle made by the world line of light wave with the spatial axis ?
- (m) Write the Navier-Stokes equation for an incompressible fluid.
- (n) What do you mean by world point in a Minkowski space ?
- (o) Define central force.

2. Briefly answer **any five** of the following questions : 2×5=10

- (a) Show that if the Lagrangian of a system does not contain a coordinate q_k explicitly the conjugate momentum is a constant of motion.
- (b) What are holonomic and non-holonomic constraints ?
- (c) What is Hamilton's principle ?

- (d) What are stable and unstable equilibrium ?
- (e) What do you understand by normal modes of vibration ?
- (f) State the postulates of special theory of relativity.
- (g) What do you mean by laminar and turbulent flow of fluids ?
- (h) Draw the world line of a particle with velocity v when (i) $v < c$ and (ii) $v > c$ in two-dimensional space-time diagram.

3. Answer **any four** of the following questions : 5×4= 20

- (a) What is virtual displacement ? State and explain the principle of virtual work. 1 +4=5
- (b) Find the Hamiltonian and the equation of motion of a harmonic oscillator by using Hamiltonian formulation.

(c) A charged particle is placed in a constant uniform magnetic field. Find the expression of the Larmor radius and Larmor frequency. Draw and explain the motion of a charged particle in a cross electric and magnetic field. $3+2=5$

(d) Deduce Lagrange's equations of motion for small oscillations of a system in the neighbourhood of the stable equilibrium.

(e) What is Reynold's number? On what factors does Reynold's number depend? What is its dimensional formula? $2+2+1=5$

(f) Define four-vector. Show that the scalar product of two four-vectors is an invariant quantity. $1+4=5$

(g) What do you mean by length contraction in special relativity? Discuss the concept using space-time diagram. $1+4=5$

(h) Prove that space-time interval is invariant under Lorentz transformation equation.

4. Answer **any four** of the following questions :

$$10 \times 4 = 40$$

(a) Two equal masses m are connected by springs having equal spring constant c so that the masses are free to oscillate on a frictionless table. The ends of the springs are attached with the fixed walls. Find out the Lagrangian and the equations of motion of the system.

$$3+7=10$$

(b) What is Hamiltonian function? Write the physical significance of the Hamiltonian function. Derive the Hamilton's equations of motion for a system of particles.

$$1+2+7=10$$

(c) Find out the Lagrange's equations of motion for the following systems :

$$5+5=10$$

(i) one dimensional harmonic oscillator

(ii) a body of mass m falling freely under gravity near the surface of earth

(d) Derive the Lagrange's equation of motion for a conservative system. 10

(e) Discuss the vibration of linear triatomic molecules and obtain eigenvectors for different modes of vibrations.

(f) Obtain the general solution for the displacement of the n^{th} particle in case of transverse oscillations of n -coupled masses.

(g) What is four-dimensional space-time? Using Minkowski's space-time diagram, discuss space-like, time-like and light-like events. What is a light cone?

$$2+2+2+2+2=10$$

(h) What do you mean by an ideal fluid? How is it different from a real fluid? Obtain the continuity equation for steady one-dimensional flow of fluids.

$$2+2+6=10$$

(i) Obtain Lorentz transformation equation. Show that for classical limit when $v \ll c$, Lorentz transformation reduces to Galilean one.

$$7+3=10$$

(j) What is the difference between classical and relativistic Doppler effect? What do you mean by transverse Doppler effect? Can it be found in classical relativity? Using the concept of four-vector, obtain an expression for relativistic Doppler effect.

$$2+2+1+5=10$$