



'সমানো মন্ত্র: সমিতি: সমানী'

UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 1st Semester Examination, 2021

CC2-PHYSICS

MECHANICS

Time Allotted: 2 Hours

Full Marks: 40

*The figures in the margin indicate full marks.
All symbols are of usual significance.*

GROUP-A

1. Answer any *five* questions from the following: 1×5 = 5
- (a) Is Lorentz force equation invariant under Galilean transformation?
 - (b) Why gravitational potential is always negative?
 - (c) A pendulum inside a rocket moving with velocity $0.6c$ oscillate with time period of 1 sec. What will be the time period of the pendulum observed by an observer on earth?
 - (d) A particle is subjected to a linear restoring force $F = -kx$, (k is constant). Find out the potential energy.
 - (e) What is the radius of a Geosynchronous orbit?
 - (f) What is the amount of angular deflection of a projectile shot horizontally at the north pole having the time of flight 200 sec.?
 - (g) What is the effect of damping on the time period of oscillation of a pendulum?
 - (h) Show that Poisson's ratio lies between -1 and 0.5 .

GROUP-B

Answer any *three* questions from the following 5×3 = 15

2. Show that the total energy of a system of particles moving under action of conservative forces (both the internal and external) is conserved. 5
3. (a) What is the potential energy curve of a particle undergoing SHM? What significant information does it give about the behaviour of the particle? 1+2
- (b) The energy of a particle is given by $U = A - \frac{B}{x} + \frac{C}{x^2}$, where A , B and C all are positive constants. Find out the position of stable equilibrium of the particle. 2

4. (a) What is meant by real and fictitious (pseudo) forces? Give example of each. 2
 (b) Derive the following differential operator 3
- $$\left(\frac{d}{dt}\right)_{\text{fix}} = \left(\frac{d}{dt}\right)_{\text{rot}} + \vec{\omega} \times \vec{A},$$
- where symbols have their usual meaning.
5. (a) State Kepler's laws of planetary motion and deduce them from Newton's law of gravitation. 4
 (b) What is an artificial satellite? 1
6. (a) Explain what is torsional rigidity? 2
 (b) Two cylindrical shafts have the same length and mass and are made of the same material. One is solid while the other is hollow having an external radius twice the internal radius. What is the ratio of their rigidities? 3

GROUP-C

Answer any two questions from the following

10×2 = 20

7. (a) Define moment of inertia (M.I.) and radius of gyration of a rigid body. 2
 (b) What is the physical significance of M.I.? 2
 (c) Derive expression for the moment of inertia of a 3+3
 (i) uniform rod about a transverse axis through one end
 (ii) rectangular lamina about an axis perpendicular to its plane and passing through the centre of mass.
8. (a) Define coefficient of viscosity of a fluid. 2
 (b) Deduce Poiseuille's formula for the flow of liquid through a narrow horizontal tube. 6
 (c) What are the corrections to Poiseuille's formula? 2
9. (a) Write down the expression for the differential equation of motion of a particle under damped oscillation. 2
 (b) Solve it for all possible types of damping. 6
 (c) Estimate energy lost per cycle of oscillation. 2
- 10.(a) State Einstein's postulates of special theory of relativity. 2
 (b) Derive the Lorentz space-time transformation formulae using these postulates. 5
 (c) On the basis of Lorentz transformation discuss the phenomenon of length contraction. 3

—×—