Tribhuvan University
2079
Bachelor Level (4 Yrs.)/Science & Tech. / III year Full Marks: 100
Math Physics & Classical Mechanics (Phy.301) Time: 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

New Course

Attempt ALL the questions.

1. Explain Legendres differential equation. Obtain the series solution for the Legenders polynomial.

OR

Explain covariant, contravariant and mixed tensors. [10]

2. State and prove Kepler's second and third law of planetory motion.

OR

Define Lorentz transformation. By using Lorentz transformation equations deduce expressions for length contraction, time dilation and addition of velocities.

3. Distinguish between Laplace and Poisson's equation. Deduce the Laplace equation in spherical coordinates. [10]

4. What do you mean by virtual work? State D' Alembert's principle. By using this principle derive Lagrange's equation of motion. [8]

5. Explain representation of vectors and linear operators with respect to a basis. Describe Schmidt orthogonalization process with an example. [10]

6. State and explain Rutherford's scattering. Also explain differential scattering cross- section. [8]

7. Answer all questions [2×3=6]

(a) What do you mean by Hamilton's principle?

OR

What do you mean by rotating coordinate system and hence define coriolis force.

(b) Differentiate between rotational and irrotational vectors.

OR

Describe Dirac Delta function.

8. Answer all questions [3×5=15]
   (a) Explain Eulerian angles.
   (b) Explain conservation theorems and symmetry properties and show that the generalized momentum conjugate to a cyclic co-ordinate is conserved.
   (c) Explain orthogonal and hermitian matrix.
   (d) Explain hyperbolic and parabolic coordinate systems.
   (e) Explain stress tensor.

9. A particle describes a circular orbit given by $r = 2a\cos\theta$ under the influence of an attractive central force directed towards a point on the circle. Show that $f(r)\alpha\frac{1}{r^5}$ [5]

10. At what speed is a particle moving if the mass is equal to three times its rest mass. [5]

11. Find the Laplace transform of sinat [5]

12. Find the volume bounded by the cylinder $x^2 + y^2 = 4$ and the planes $y + z = 3$ and $z = 0$ [5]

13. Find the inverse of matrix $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ [5]

□

Old Course

Attempt ALL the questions.

1. Obtain the series solution for the Legendre's polynomial.

OR [10]

Discuss the Fourier transform. Obtain Fourier series expansion of the function. $f(x) = x\ ; -\pi < x < \pi$.

2. State and deduce Kepler's first law of motion. [8]

OR

Explain Rutherford scattering and find angle of scattering in terms of impact parameter, energy, charge on the nucleus and charge on the particle.

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3. Describe transformation laws of Christoffel's symbols. Show that Kronecker delta is a tensor. [10]

4. Show that the square of the time period of revolution of planet around the sun is proportional to the cube of the semi-major axis of the ellipse. [8]

5. Define line and volume integrals and prove Gauss divergence theorem of vector analysis. [10]

6. Show that in the centre of mass frame of reference the magnitude of velocities of the particles in an collision do not change. [8]

7. Answer all questions [3×2=6]

(a) What are central and non -central forces?

OR

What do you mean by cyclic co-ordinates?

(b) Differentiate between solenoidal and irrotational vectors.

OR

Explain convolution theorem.

8. Answer all questions [3×5=15]

a) Define covariant and contravariant tensors.

b) Explain elastic and inelastic collision.

c) Explain the meaning of the curl of a gradient of a scalar function.

d) Find the Fourier transform of e^{-ax^2}.

e) Find gradient of scalar field $xy^2z^2 + 2y^2$.

9. A particle describes a circular orbit under the influence of an attractive central force directed towards a point on the circle. Show that the force varies as the inverse fifth power of the distance. [5]

10. Obtain the equations of motion of a particle moving in a conservatives force field on the Lagrangian an formulation in a cylindrical polar co-ordinate system. [5]

11. Find lap lace transform of coslx [5]

12. Obtain a relation for $J_{\frac{1}{2}}(x)$. [5]

13. Show that $\nabla^2 \left(1/r\right) = 0$; where $r = (x^2 + y^2 + z^2)^{\frac{1}{2}}$.