Sem-1 Honours Examination, 2020

Internal Examination

Sub – PHSA Paper - CC-1

FM – 20 Time - 30 mins

Answer any ten questions. Each question carries 2 marks.

1. What is the form of power series expansion of a function about $x=0$. What is the nature of this point ?

2. State Taylor's theorem related to power series expansion in one dimension.

3. What is the condition for ratio test to check the nature of an infinite series.

4. Write an example of linear, homogeneous, ordinary differential equation.

5. Consider the following series and check its nature with comparison test.
$$1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\ldots$$

6. Find the velocity of a particle which moves along the curve $x = 2\sin(3t)$, $y = 2\cos(3t)$ and $z = 8t$ at any time $t > 0$. Also find the magnitude of the velocity.

7. Prove that $\vec{A} \cdot (\vec{A} \times \vec{C}) = 0$.

8. The components of a force acting on a plane are $F_x = y$, $F_y = x$. Prove the force is conservative.

9. Given, $\vec{A}=2x^2z\,\hat{i}-xy^2z\,\hat{j}+3yz^2\hat{k}$. Evaluate $\vec{\nabla}\cdot\vec{A}$.

10. If $\vec{F}=3xy\,\hat{i}$ - $y^2\,\hat{j}$, evaluate $\int \vec{F}.d\vec{r}$ along a curve C, $y = 2x^2$, from $(0, 0)$ to $(1, 2)$.

11. If two matrices X and Y are hermitian, prove that $X+iY$ and $X-iY$ are hermitian.

12. If S and A are unitary matrices, prove that TAS is a unitary matrix where T is the inverse of S.

13. If x is an eigenvector of a hermitian matrix H and y is any vector orthogonal to x, show that Hy is orthogonal to x.

14. If A and B are two non-commuting hermitian matrices with $[A, B] = iC$ then prove that C is hermitian.

15. Prove that a unitary matrix commutes with its hermitian conjugate.

INTERNAL EXAMINATION -2021

PHSA - SEM 1- CC2

20 MARKS

Answer ***any ten*** from the following questions.

1. State Newton's first law of motions.

2. Define inertial frame of reference.

3. Define Centre of Mass. Show that its position is unique for a system of particles.

4. Explain stable and unstable equilibrium with respect to potential energy curves.

5. Show that in a central force field angular momentum of a particle about the centre of the force is conserved.

6. Prove that for a particle moving under the influence of a central force field the path is planar.

7. Prove that for a particle moving under the influence of a central force field the areal velocity is constant.

8. What is conservative force field?

9. For what kind of a rigid body will the angular momentum and angular velocity always be parallel?

10. Let S' be a reference frame which is rotating with respect to a frame S with an angular velocity $\vec{\omega}$. Prove that for an arbitrary vector $\vec{A}$

$$\frac{d\vec{A}}{dt} = \frac{d'\vec{A}}{dt} + \vec{\omega} \times \vec{A}$$

Where $\frac{d}{dt}$ and $\frac{d'}{dt}$ refers to a time derivatives with respect to S and S' respectively.

11. Assuming that a rigid reference frame fixed at the centre of the earth is inertial, set up the equations of motion with respect to a frame fixed on the surface of the earth for a particle of mass m moving under the gravitational force of the earth and the other forces $\vec{F}_{other}$.

12. What is moment of inertia tensor?

13. A rigid body is rotating with an angular velocity $\vec{\omega}$, about an axis through the origin O and having direction cosines $\left(\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}\right)$. Calculate the moment of inertia of the said body about the axis.

14. For a fluid at rest in a non-conservative force field, show that Pascal's law is not valid.

15. State the equation of continuity for the motion of an ideal fluid.