KATHMANDU UNIVERSITY
End Semester Examination [C]
November/December, 2023

Marks Scored:

Level : B.Sc.
Year : II

Course : MATH 211
Semester : II

Exam Roll No.:

Time: 30 mins.

F. M. : 20

Registration No.:

Date 28 NOV 2023

SECTION "A"

[10Q. × 1 = 10 marks]

Fill in the blank space(s) by the most appropriate word(s) or symbol(s).

1. The position of the moving point at time t is given by $x = at^2$, $y = 2at$, the magnitude of its velocity at time t is _____.

2. If $p^2 = ar$, the law of force is _____.

3. The expression for the velocity in central orbit is _____.

4. An apse is a point on the central orbit at which _____.

5. The magnitude of the resultant acceleration of a particle moving in a plane curve at time t is _____.

6. The period of a simple harmonic motion is _____.

7. A system of coplanar forces will be in equilibrium if algebraic sum of the moments of all the forces about any three non-collinear points will be _____.

8. The position of the center of gravity of a semi-circular arc subtending an angle 2π at the centre is_____.

9. The intrinsic equation of catenary is _____.

10 If T be the tension at any point P of a catenary and T_0 that at the lowest point, $T^2 - T_0^2 =$ _____.

SECTION "B"

[10Q. × 1=10 marks]

Fill in the blank space(s), DO NOT TICK, by selecting the most appropriate answers from among the given ones.

11. The resultant of two unlike parallel forces 10 kg and 18 kg act along a line at a distance 4 metres from the line of action of the smaller force. The distance between the lines of action of the two forces is _____.

[$\frac{16}{9}\,m$; $12\,m$; $\frac{15}{9}\,m$; $\frac{1}{9}\,m$]

12. If a particle moves along a circle of radius r with center at pole, then its radial acceleration is _____.
[$r^2\dot{\theta}$; $\ddot{r} - r\dot{\theta}^2$; $\ddot{r} + r\dot{\theta}^2$ $-r\dot{\theta}^2$]

13. The normal component of acceleration of a particle moving in a plane curve is _____.
[$\frac{v^2}{\rho}$; 0; $\ddot{r} - r\dot{\theta}^2$; $r\dot{\theta}^2$]

14. If $\frac{a}{r} = e^{n\theta}$, the law of force is _____.
[$P \propto 1/r^3$; $P \propto 1/r^2$; $P \propto r^3$; $P \propto 1/r$]

15. In a S.H.M of amplitude and period unity, then $\int_0^1 v^2 dt =$ _____.
[μ; π^2; $2\pi^2$; μ^2]

16. A system of coplanar forces acting at different points of a rigid body keeps it in equilibrium if _____.
[$\sum X = 0, \sum Y = 0, G = 0$; $\sum X = 0, \sum Y = 0, G \neq 0$;
$\sum X \neq 0, \sum Y \neq 0, G = 0$; $\sum X \neq 0, \sum Y \neq 0, G \neq 0$]

17. If a line CD drawn from the vertex C of a triangle ABC meets AB at D dividing it in the ratio $m:n$ in such a way that $\angle ACD, \angle BCD$ and $\angle CDB$ are α, β and θ respectively, then $(m+n)\cot\theta =$_____.

[$m\cot\beta - n\cot\alpha$; $m\cot\alpha - n\cot\alpha$; $m\cot\alpha - n\cot\beta$; $m\cot\beta - n\cot\beta$]

18. If G_1 be the algebraic sums of the moments of forces of the given system about the point(a, b), then _____.
[$G_1 = G - aR_y$; $G_1 = G + R_x - R_y$;
$G_1 = G + bR_x - aR_y$; $G_1 = G - bR_x$]

19. Let y_1 and y_2 be the heights of any two points on a catenary above the x-axis and T_1 and T_2 the tensions at these points. Then $T_1 - T_2 =$_____.
[$w(y_1 - y_2)$; $w(y_1^2 - y_2^2)$; $w(y_1^2 + y_2^2)$; $w(y_1 + y_2)$]

20. The center of gravity of the solid of revolution of the curve $y = f(x)$ lying between the ordinates $x = a$ and $x = b$ about x-axis is _____.
[$\bar{x} = \frac{\int_a^b xy\,ds}{\int_a^b y\,ds}, \bar{y} = 0$; $\bar{x} = \frac{\int_a^b xy^2 ds}{\int_a^b x\,ds}, \bar{y} = 0$;
$\bar{x} = 0, \bar{y} = \frac{\int_a^b xy\,ds}{\int_a^b x\,ds}$; $\bar{x} = 0, \bar{y} = 0$]

KATHMANDU UNIVERSITY
End Semester Examination [C]
November/December, 2023

28 NOV 2023

Level : B.Sc.
Year : II
Time : 2 hrs. 30 mins.

Course : MATH 211
Semester : I
F. M. : 55

SECTION "C"
[3Q. × 7 = 21 marks]

1. Find the expressions of radial and transverse components of velocity and acceleration of a particle moving in a plane curve. The velocities of a particle along and perpendicular to a radius vector from a fixed origin are λr^2 and $\mu\theta^2$. Find the equation to the path. [5+2]

OR

Establish the relationship between angular and linear velocities. A point moves in a plane curve so that its tangential acceleration is constant and the magnitudes of the tangential velocity and the normal acceleration are in a constant ratio. Show that the intrinsic equation of the path is of the form $s = A\psi^2 + B\psi + C$. [2+5]

2. Define Centre of Gravity. Explain the process of finding the center of gravity of an area enclosed between the two curves $y_1 = f_1(x)$ and $y_2 = f_2(x)$ and the ordinates $x = a$ and $x = b$. Also, find that the centre of gravity of the area bounded by the parabola $y^2 = 4ax$, axis of x and the latus rectum. [1+3+3]

3. Define sag and span of a common catenary. Derive equation of Common Catenary in Cartesian form. Show that for a common catenary $y + s = ce^{x/c}$, where the symbols have their usual meanings. [1+3+3]

SECTION "D"
[6Q. × 4 = 24 marks]

4. A particle moving in a straight line with simple harmonic motion has velocities v_1 and v_2 when its distance from the centre are p and q respectively. Find the period and the frequency of S.H.M.

5. If the law of force be the inverse distance, find the time of descent to the centre.

OR

Define Hodograph. A bead moves on the arc of a smooth vertical circle starting from rest at the highest point. Show that the equation to the hodograph is $r = \lambda \sin\frac{\theta}{2}$.

6. If the velocity at any point in a central orbit varies inversely as the distance of the point from the centre of the force, prove that the orbit is an equiangular spiral.

7. What is the system of Coplanar forces? Find the resultant of the system of coplanar forces acting at different points of rigid body.

OR

Define S.H.M. Discuss the motion of a particle moving under the action of force which varies as its distance from a fixed point in the line and is always away from fixed point.

8. A uniform chain of length ℓ is suspended from two fixed points P and Q in the same horizontal line. If the tension at P is n times that at the lowest point, show that the span PQ is

$$\frac{1}{\sqrt{n^2-1}} \ln\left(n+\sqrt{n^2-1}\right).$$

9. Three forces A, B and C act along the lines $x = 0, y = 0$ and $x\cos\theta + y\sin\theta = 1$, axes being rectangular. Find the magnitude and the equation of line of action of their resultant.

SECTION "E"

[5Q. × 2 = 10 marks]

10. Prove that the radius vector at an apse is either maximum or minimum.

11. Show that catenary behaves approximately as a parabola for very small values of x.

12. Prove that the angular acceleration of the direction of motion of a point moving in a plane is $\frac{v}{\rho}\frac{dv}{ds} - \frac{v^2}{\rho^2}\frac{d\rho}{ds}$.

13. Find the centre of gravity of a plane area bounded by a curve $y = f(x)$, the axis of x and $x = a$ and $x = b$.

14. Write down the geometrical interpretation of Simple Harmonic Motion.