1B1N21078 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**First Semester B.Sc Degree Examination, November 2021**

**BMT1C01 – Mathematics – I**

(2019 Admission onwards)

Time: 2 hours Max. Marks : 60

**Section A**
**All questions can be attended**
**Each question carries 2 marks**

1. Find the slope of the tangent line to the graph of $f(x) = x^2 + 1$ at $x_0 = -1$.
2. Find $\lim_{x\to\infty} \frac{2x+1}{3x+1}$.
3. Find $\frac{d}{dx}(10x^3 - \frac{8}{x} + 5\sqrt{x})$.
4. Differentiate $g(x) = (9x^3 + 10)^{\frac{5}{3}}$.
5. Find the general antiderivative for the function $f(x) = x^4 + 6$.
6. Find $\int 4x^{\frac{3}{2}} dx$.
7. State whether the function $f(x) = x^4 + 3x^2 + 6$ is even, odd, or neither.
8. State Mean Value Theorem.
9. Evaluate $\lim_{x\to 0} \frac{cos\, x - 1}{x^2}$.
10. Prove that $\sum_{j=3}^{102}(j-2) = 5050$
11. Let $F(x) = \int_1^x \frac{1}{3+s^2+s^3} ds$. Find $F'(2)$.
12. Find the average value of $f(x) = x^2$ on $[0, 2]$.

(Ceiling: 20 Marks)

## Section B

**All questions can be attended**

**Each question carries 5 marks**

13. Use linear approximation to calculate $\frac{1}{(1.99)^2 + (1.99)^4}$.

14. Find the equation of the line tangent to the parametric curve given by the equation $x = t^2$, $y = t^3$ at $t = 5$.

15. If $y = (x^2 + 1)^{27}(x^4 + 3x + 1)^8$, find the rate of change of $y$ with respect to $x$.

16. Find the intervals on which $f(x) = x^3 - 2x + 6$ is increasing and decresing.

17. Suppose that $f$ is continuous on $[0, 3]$, that $f$ has no roots on the interval, and that $f(0) = 1$. Prove that $f(x) > 0$ for all $x$ in $[0, 3]$.

18. Find the area under the graph of $f(x) = 2x$ for $0 \leq x \leq 1$ using upper and lower sums.

19. Find the volume of the solid obtained by revolving the region under the graphs of $\sqrt{3 - x^2}$ and $5 + x$ on $[0, 1]$ about the $x$ axis.

**(Ceiling: 30 Marks)**

## Section C

**Answer any one question**

**Question carries 10 marks**

20. (a) Find the equation of the line tangent to the graph of the function $f(x) = \frac{(\sqrt{x} + 1)}{2(x + 1)}$ at $x = 1$.

    (b) Find $\int [\frac{2}{x^2} + 7x^2 - 3x + 2 - \frac{9}{\sqrt{x}}] dx$.

21. (a) Find the interval on which $f(x) = 3x^3 - 8x + 12$ is concave upward and downward. Also find local maxima, local minima and inflection points.

    (b) Find the area between the graphs of $y = x^3 + 1$ and $y = x^2 - 1$ between $x = -1$ and $x = 1$.

**(1×10 = 10 Marks)**

4B1N21091 (Pages : 3) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**First Semester B.Sc Physics Degree Examination, November 2021**

**BPH1B01 – Mechanics – I**

(2020 Admission onwards)

Time: 2 hours Max. Marks : 60

***The symbols used in this question papers have their usual meanings***

**Section A- Short Answer Type**

***( Answer all questions in two or three sentences, each correct answer carries a maximum of 2 marks)***

1. What is constraint force in Newtonian mechanics? Write the constraint equation for a block on a table which doesn't have vertical acceleration $a_v$.
2. Describe a conical pendulum.
3. What are normal forces? Explain its origin with a suitable example.
4. Describe the dynamics of a spring – block system.
5. Obtain an expression for center of mass of a system of particles.
6. Discuss non-conservative forces. Give examples.
7. Sketch and explain the energy diagram of a two atom system.
8. Explain the relation between force and potential energy?
9. What is angular momentum of a particle and what is its unit? How it differs from linear momentum?
10. Obtain expression for moment of inertia of a uniform thin stick of mass $M$ and length $L$, about a perpendicular axis through its midpoint.
11. State and explain the parallel axis theorem.
12. Explain conservative forces. Give examples

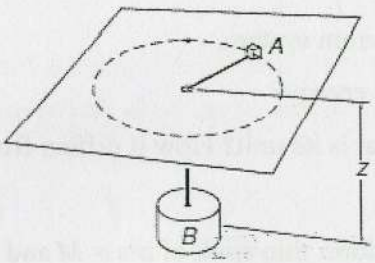
**(Ceiling-20)**

## Section B- Paragraph/ Problem Type

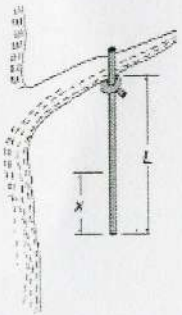
***( Answer all questions in a paragraph of about half a page to one page, each correct answer carries a maximum of 5 marks)***

13. Two astronauts on a spacewalk decide to play tug-of-war by pulling on either end of a rope. Astronaut A is stronger than astronaut B. Each astronaut pulls on the rope as hard as possible. Considering the rope to be of negligible mass show that the total force on the rope is zero and that each astronaut can pull with same force though astronaut A is stronger than B.

14 A horizontal frictionless table has a small hole in its center. Block $A$ on the table is connected to block $B$ hanging beneath by a string of negligible mass which passes through the hole. Initially, $B$ is held stationary and $A$ rotates at constant radius $r_0$ with steady angular velocity $\omega_0$. If $B$ is released at $t = 0$, what is its acceleration immediately afterward?




15 A uniform rope of mass $M$ and length $L$ hangs from the limb of a tree. Find the tension in the rope at distance $x$ from the bottom.



16 Show that for a conservative force the work depends only on the net displacement, not on the particular path followed.

17 A 5-kg mass moves under the influence of a force $F = (4t^2\,\hat{i} - 3t\,\hat{j})N$, where $t$ is the time in seconds (1 N = 1 newton), It starts at rest from the origin at $t = 0$.
Find (*a*) its velocity; (*b*) its position; and (*c*) $\mathbf{r} \times \mathbf{v}$, for any later time.

18 Obtain an expression for moment of inertia of a uniform thin disk of mass $M$ and radius $R$, around the axis of symmetry of the disk.

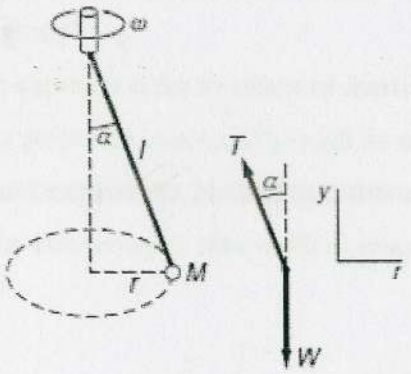
19 Show that the acceleration of the masses $m_1$ and $m_2$ suspended over a pulley of mass $m_p$ in an Atwood's machine is $a=(m_1-m_2)g/(m_1+m_2+m_{p/2})$

**(Ceiling- 30)**

## Section C- Essay Type

***Answer any one question. Answer carries 10 marks***

20 Mass $M$ is fixed to the end of a rod of length $l$ and negligible mass that is pivoted to swing from the end of a hub that rotates at constant angular frequency $\omega$, as shown in the drawing. The mass moves with steady speed in a circular path of constant radius. Find $\alpha$, the angle the rod makes with the vertical. Discuss cases of possible values of $\alpha$ with different $\omega$ values. Discuss stability and instability of the system with the help of a graph.




21 Show that angular momentum is conserved in motion under central forces. State, prove and explain law of equal areas in case of motion under central force.

**(1x10= 10 marks)**