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Reg. No. : ....

Name : ....

First Semester B.Sc. Degree Examination, November 2018
First Degree Programme under CBCSS
COMPLEMENTARY COURSE I FOR PHYSICS
MM 1131.1 : Mathematics – I : Calculus with Applications in Physics – 1
(2018 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – I

All the **first 10** questions are **compulsory**. They carry **1** mark **each**.

1. State chain rule of differentiation.
2. Write the formula for radius of curvature of y = f(x).
3. State Rolle's theorem.
4. State rule of integration by parts.
5. Write the formula for volume V enclosed by rotating the curve y = f(x) about the x-axis between x = a and x = b.
6. Find the sum to infinity of a geometric series having first term and common ration ½ .
7. What is an arithmetico-geometric series ?
8. State D'Alembert's ration test.
9. Define linearly independent vectors.
10. What is the unit vector in the direction of any vector a ?

P.T.O.

SECTION – II

Answer **any 8** questions from among the questions **11** to **22**. These questions carry **2** marks **each**.

11. Find the derivative with respect to x of $x^3 \sin x$.

12. Differentiate $\frac{\sin x}{x}$.

13. What are the three types of stationary points ?

14. Evaluate $\int x \sin x dx$.

15. Evaluate $\int_0^\infty \frac{x}{(x^2 + a^2)^2} dx$.

16. Find the mean value m of the function $f(x) = x^2$ between the limits $x = 2$ and $x = 4$.

17. Evaluate the sum $\sum_{n=1}^{N} \frac{1}{n(n+2)}$.

18. Test for convergence the series $\sum_{n=1}^{\infty} \frac{1}{(n!)^2}$.

19. Determine whether the series $\sum_{n=1}^{\infty} \left(\frac{1}{n}\right)^n$ is convergent.

20. Find a.b, where a = i + 2j + 3k and b = 2i + 3j + 4k.

21. Prove that for any three vectors a, b and c, $a \times (b \times c) + b \times (c \times a) + c \times (a \times b) = 0$.

22. Find the area of the parallelogram with sides a = i + 2j + 3k and b = 4i + 5j + 6k.

SECTION – III

Answer **any 6** questions from among the questions **23** to **31**. These questions carry **4** marks **each**.

23. Find positions and number of stationary points of $f(x) = 2x^3 - 3x^2 - 36x + 2$.

24. What semi-quantitative results can be deduced by applying Rolle's theorem to the following functions :

    a) sin x

    b) $x^2 - 3x + 2$.

25. Find the area of the ellipse with semi-axes a and b using its polar coordinates.

26. Find the length of the curve $y = x^{2/3}$ from $x = 0$ to $x = 2$.

27. Sum the series $S(x) = \frac{x^4}{3(0!)} + \frac{x^5}{4(1!)} + \frac{x^6}{5(2!)} + \dots$

28. Determine the range of values of x for which the power series $P(x) = 1 + 2x + 4x^2 + 8x^3 + \dots$ converges.

29. Four non-coplanar points A, B, C, D and positioned such that the line AD is perpendicular to BC and BD is perpendicular to AC. Show that CD is perpendicular to AB.

30. Find the volume of the parallelopiped with sides $a = i + 2j + 3k$, $b = 4i + 5j + 6k$ and $c = 7i + 8j + 10k$.

31. Find the direction of the line of intersection of two planes $x + 3y - z = 0$ and $2x - 2y + 4z = 0$.

SECTION – IV

Answer **any 2** questions from among the questions **32** to **35**. These questions carry **15** marks **each**.

32. a) State and prove Mean Value Theorem. **7**

b) Using Mean Value Theorem, determine the inequality satisfied by ln x and sin x for suitable ranges of the real variable x. **8**

33. Using integration by parts, find a relation between I_n and I_{n-1} where $I_n = \int_0^1 (1 - x^3)^n dx$ and n is any positive integer. Hence evaluate $I_2 = \int_0^1 (1 - x^3)^2 dx$. **15**

34. Expand $f(x) = \cos x$ as a Taylor series about $x = \pi/3$. **15**

35. The vertices of a triangle ABC have position vectors a, b and c relative to some origin O. Find the position vector of the centroid G of the triangle. **15**