LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **PHYSICS**

THIRD SEMESTER – **NOVEMBER 2024**

MT 3100 – ALLIED MATHEMATICS FOR PHYSICS

Date: 22-11-2024 Dept. No. Max. : 100 Marks

Time: 01:00 pm-04:00 pm

SECTION A

Answer ANY FOUR of the following **4 × 10 = 40 Marks**

1. Find $L^{-1}\left\{\frac{1}{s(s-1)(s-2)}\right\}$.
2. If $x+iy=\tan(A+iB)$, prove that $x^2+y^2+2x\cot 2A=1$.
3. Find the slope of the tangent with the initial line for the cardioid $r=a(1-\cos\theta)$ at $\theta=\frac{\pi}{6}$.
4. Expand $\cos^4\theta\sin^3\theta$ in terms of sines of multiples of θ.
5. Expand $\frac{\sin 6\theta}{\sin\theta}$ in terms of $\cos\theta$.
6. Show that $\frac{2\cdot 3}{3!}+\frac{3\cdot 5}{4!}+\frac{4\cdot 7}{5!}+\frac{5\cdot 9}{6!}+\cdots=2e-\frac{7}{2}$.
7. Verify Cayley-Hamilton theorem for $\begin{pmatrix}2 & -1 & 1\\ -1 & 2 & -1\\ 1 & -1 & 2\end{pmatrix}$.
8. Find the mean and standard deviation for the following data giving the age distribution of people.

Years under	10	20	30	40	50	60
No. of people	15	32	51	78	97	100

SECTION B

Answer ANY THREE of the following **3 × 20 = 60 Marks**

9. Write down the formula to find the angle between two curves in polar coordinates. Hence find the angle of intersection of the cardioids $r=a(1+\cos\theta)$ and $r=b(1-\cos\theta)$.
10. Find the sum to infinity of the series $1+\frac{3}{4}+\frac{3\cdot 5}{4\cdot 8}+\frac{3\cdot 5\cdot 7}{4\cdot 8\cdot 12}+\cdots$.
11. By using Laplace transform, solve $(D^2+5D+6)x=e^{-t}$ given that $x(0)=7.5$ and $x'(0)=-18.5$.
12. Find the eigen values and eigen vectors of the matrix $\begin{pmatrix}3 & 10 & 5\\ -2 & -3 & -4\\ 3 & 5 & 7\end{pmatrix}$.
13. If ¿ $\left\{x+\sqrt{1+x^2}\right\}^m$, prove that $(1+x^2)y_{n+2}-(2n+1)xy_{n+1}+(n^2-m^2)y_n=0$.
14. Eight coins are tossed at a time, for 256 times. Number of heads observed at each

throw is recorded, and results are given below.

No of heads at a throw	0	1	2	3	4	5	6	7	8
Frequency	2	6	30	52	67	56	32	10	1

What are the theoretical values of mean and standard deviation?
Calculate also the mean and standard deviation of the observed frequencies.

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