



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – PHYSICS

THIRD SEMESTER – APRIL 2018

MT 3102- MATHEMATICS FOR PHYSICS

Date: 05-05-2018
Time: 09:00-12:00

Dept. No.

Max. : 100 Marks

PART-A

Answer ALL the questions:

(10 x 2=20)

1. If $y = \frac{x+1}{x+2}$ find $\frac{d^2y}{dx^2}$.

2. Define an orthogonal matrix.

3. Show that the matrix $A = \begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{i}{\sqrt{2}} \\ -\frac{i}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \end{pmatrix}$ is unitary.

4. Write down the middle term of $\left(x - \frac{2}{x}\right)^{12}$.

5. Find the value of $L[\sinh 17t]$.

6. Prove that $\frac{a-x}{a} + \frac{1}{2}\left(\frac{a-x}{a}\right)^2 + \frac{1}{3}\left(\frac{a-x}{a}\right)^3 + \dots = \log a - \log x$.

7. Find the value of $L^{-1}\left[\frac{1}{s-3} + \frac{1}{s}\right]$.

8. Write down the expansion for $\sin n\theta$.

9. If $\sin^2\theta + \cos^2\theta = 1$, Show that $\cosh^2 x - \sinh^2 x = 1$.

10. If a Poisson variate X is such that $P(X=1) = 2P(X=2)$. Find the mean.

PART-B

Answer any FIVE questions:

(5 x 8=40)

11. Find the n^{th} differential coefficient of $\cos x \cos 2x \cos 3x$.

12. Find the sum to infinity of the series $1 + \left(\frac{3}{1.2}\right) + \left(\frac{5}{1.2.3}\right) + \left(\frac{7}{1.2.3.4}\right) + \dots \infty$.

13. Find the Eigen values and Eigen vectors of the matrix $A = \begin{pmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{pmatrix}$.

14. If $\sin(A + iB) = x + iy$, then

Prove that (i) $\frac{x^2}{\cosh^2 B} + \frac{y^2}{\sinh^2 B} = 1$ (ii) $\frac{x^2}{\sin^2 A} - \frac{y^2}{\cos^2 A} = 1$.

15. Find $L^{-1}\left[\frac{1}{s(s+1)(s+2)}\right]$.

16. Find (i) $L[\cosh t \cdot \sin 2t]$, (ii) $L[t \cdot e^{-t} \cdot \sin t]$.

17. Find the extreme values of the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$.

18. From a well-shuffled pack of 52 cards, one card is drawn at random. What is the probability that it will be (i) a jack (ii) a spade (iii) a clawer (iv) a heart?

PART - C

Answer any TWO questions:

(2 x 20=40)

19. Verify Cayley – Hamilton theorem for the matrix $A = \begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix}$.

20. (a) If $y = \sin(m \sin^{-1} x)$ then prove that $(1 - x^2)y_2 - xy_1 + m^2y = 0$ and hence

prove that $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} + (m^2 + n^2)y_n = 0$.

(b) Find the mean and standard deviation for the following table, giving the age distribution of 542 members.

Age in years	20-30	30-40	40-50	50-60	60-70	70-80	80-90
No. of members	3	61	132	153	140	51	2

(10+10)

21. (a) Solve the equation $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} - 5y = 5$ given that $y = 0, \frac{dy}{dt} = 2$ when $t = 0$.

(b) Find $L\left[\frac{1 - e^t}{t}\right]$. (15 + 5)

22. (a) Prove that $\frac{\sin 7\theta}{\sin \theta} = 64\cos^6\theta - 80\cos^4\theta + 24\cos^2\theta - 1$.

(b) Find the angle at which the radius vector cuts the curve $\frac{l}{r} = 1 + e \cos\theta$. (10+10)
