LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRDSEMESTER – APRIL 2017

MT 3102- MATHEMATICS FOR PHYSICS

Date: 24-04-2017 Dept. No. Max. : 100 Marks
01:00-04:00

Part A

*Answer **ALL** the questions* ***(10 x 2 =20)***

1. If $xy = ae^x + be^{-x}$ prove that $x\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - xy = 0$
2. Find the slope of the curve $r = a(1-\cos\theta)$ at $\theta = \frac{\pi}{2}$.
3. Prove that $A = \begin{bmatrix} cos\theta & sin\theta \\ -sin\theta & cos\theta \end{bmatrix}$ is orthogonal.
4. Find the Laplace transform of the exponential function e^{-at}.
5. Prove that $log\frac{n+1}{n-1} = \frac{2n}{n^2+1} + \frac{1}{3}\left(\frac{2n}{n^2+1}\right)^3 + \cdots$
6. Find the value of $L^{-1}\left[\frac{1}{(s+a)^2}\right]$.
7. Write down the expansion for $\tan n\theta$.
8. If $sin^2\theta + cos^2\theta = 1$, Show that $\cos h^2 x - sinh^2 x = 1$.
9. If a Possion variate X is such that $P(X=1) = 2P(X=2)$. Find the mean.
10. Define Normal distribution.

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. Sum to infinity of the series $\frac{1}{2.3} + \frac{1}{4.5} + \frac{1}{6.7} + \cdots$
13. Verify Cayley-Hamilton theorem for 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. Using the theorem on transforms of derivatives obtain $L(t \cos at)$.
17. Find the maximum and minimum value of the function $2x^3 - 3x^2 - 36x + 10$.
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. (a) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 4 & -20 & -10 \\ -2 & 10 & 4 \\ 6 & -30 & -13 \end{bmatrix}$

(b) Prove that $1+\frac{2^4}{2!}+\frac{3^4}{3!}+\frac{4^4}{4!}+.........\infty = 15e$. (10+10)

20.(a) If $y = \sin\left(m\sin^{-1}x\right)$ then prove that $\left(1-x^2\right)y_2 - xy_1 + m^2y = 0$ and hence prove that $\left(1-x^2\right)y_{n+2} - (2n+1)xy_{n+1} + \left(m^2+n^2\right)y_n = 0$. (10+10)

(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

21. (a) Solve the equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} - 3y = \sin t$ gives that $y = \frac{dy}{dt} = 0$ when t = 0.

(b) Find $L^{-1}\left(\frac{1}{(s+1)\left(s^2+2s+2\right)}\right)$ (15 + 5)

22. (a) Prove that $\frac{\sin 7\theta}{\sin\theta} = 64\cos^6\theta - 80\cos^4\theta + 24\cos^2\theta - 1$. (10+10)

(b) Find the angle of intersection of the cardioids $r = a\,(1+\cos\theta)$ *and* $r = b\,(1-\cos\theta)$.

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