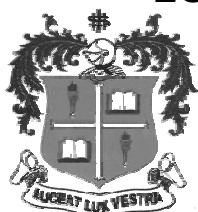# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – PHYSICS

THIRD SEMESTER – NOVEMBER 2013

MT 3102 - MATHEMATICS FOR PHYSICS

Date : 16/11/2013   Dept. No. [   ]   Max. : 100 Marks
Time : 9:00 - 12:00

SECTION A

ANSWER ALL QUESTIONS.   **(10 × 2 = 20)**

1. Find the 5th derivative of e^{4x}.
2. Find the polar subtangent for the curve $r = e^{\theta \cot \alpha}$.
3. Define symmetric matrix.
4. Write the expansion of $(1 - x)^{-p/q}$.
5. Find the laplace transform of $\cos at$.
6. Evalute $L^{-1}\left(\frac{1}{s+a}\right)$.
7. Show that $\cosh 2x = \cosh^2 x + \sinh^2 x$.
8. Write down the expansion of $\tan 5\theta$ in terms of $\tan \theta$.
9. What is the chance that a leap year selected at random will contain 53 Sundays?
10. If two dice are thrown, what is the probability that the sum is greater than 8?

SECTION B

ANSWER ANY FOUR QUESTIONS.   **(5 × 8 = 40)**

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

12. Prove that $\frac{1}{2n+1} + \frac{1}{3} \cdot \frac{1}{(2n+1)^3} + \frac{1}{5} \cdot \frac{1}{(2n+1)^5} + \cdots . = \frac{1}{2} \log\left(\frac{n+1}{n}\right)$.

13. Verify Cayley-Hamilton theorem for the matrix $\begin{pmatrix} 1 & 0 & 3 \\ 2 & 1 & -1 \\ 1 & 1 & 1 \end{pmatrix}$.

14. Find the Laplace transform of $f(t) = \begin{cases} e^{-t}, & 0 < t < 4 \\ 0, & t > 4 \end{cases}$.

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

16. Express $\sin^4\theta \cos^5\theta$ in a series of cosines of multiples of θ.

17. If $\sin(A + iB) = x + iy$, prove that

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

18. Ten coins are thrown simultaneously, find the probability of getting at least 7 heads.

SECTION C

ANSWER ANY TWO QUESTIONS.   **(2 × 20 = 40)**

19. (a) Find the maxima and minima of the function $2x^3 - 3x^2 - 36x + 10$.

    (b) If $y = \sin(m \sin^{-1} x)$, then prove that $(1 - x^2)y_{n+2} - (2n +1)x y_{n+1} + (m^2 - n^2)y_n = 0$.

                                                            (5 + 15)

20. Find the characteristic roots and associated characteristic vectors of the matrix $\begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$

21. (a) Find the sum to infinity of the series $1 + \frac{1+3}{2!} + \frac{1+3+3^2}{3!} + \cdots \infty$.

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

(8 + 12)

22. (a) Express $\cos4\theta$ in terms of $\sin\theta$.

(b) Calculate 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
Number of Members	3	61	132	153	140	51	2

(8 + 12)

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