LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

THIRD SEMESTER – **APRIL 2016**

MT 3102 – MATHEMATICS FOR PHYSICS

Date: 06-05-2016   Dept. No.   Max. : 100 Marks

Time: 09:00-12:00

Section A

Answer ALL questions: (10 × 2 = 20)

1. Find the 5th differential coefficient of e^{5x}.
2. At any point of the curve $y = b\sin\frac{x}{a}$, find the length of the subnormal.
3. Find the rank of the matrix $\begin{pmatrix} 1 & -1 & 0 \\ 2 & 0 & 1 \\ 1 & 1 & 1 \end{pmatrix}$.
4. Find the coefficient of x^n in the series $1 + \frac{a+bx}{1!} + \frac{(a+bx)^2}{2!} + \cdots + \frac{(a+bx)^n}{n!} + \cdots$.
5. Find the Laplace transform of $\cos t$.
6. Find $L^{-1}\left(\frac{1}{s+a}\right)$.
7. Prove that $\cosh^2 x - \sinh^2 x = 1$.
8. Write the expansion of $\sin n\theta$ in terms of θ.
9. What is the chance that a leap year selected at random will contain 53 Sundays?
10. If the mean and variance of Binomial distribution is 2 and 2/3. Find $P(X \geq 1)$.

Section B

Answer any FIVE questions: (5 × 8 = 40)

11. Find the maxima and minima of $2x^3 - 3x^2 - 36x + 10$.
12. Find the angle of intersection of the cardioids $r = a(1 + \cos\theta)$ and $r = b(1 - \cos\theta)$.
13. Show that if $x > 0$, $gx = \frac{x-1}{x+1} + \frac{1}{2}\frac{x^2-1}{(x+1)^2} + \frac{1}{3}\frac{x^3-1}{(x+1)^3} + \cdots$.
14. Verify Cayley Hamilton theorem for the matrix $\begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix}$.
15. Find $L^{-1}\left(\frac{1}{s(s+1)(s+2)}\right)$.
16. Expand $\frac{\cos 7\theta}{\cos\theta}$ in terms of $\cos\theta$.
17. A car hire firm has two cars, which it hires out day by day. The number of demands for a car on each day is distributed as a Poisson distribution with mean 1.5. Calculate the proportion of days on which (i) neither car is used (ii) the proportion of days on which some demand is refused.

18. Calculate the mean and standard deviation for the following data.

Years under	10	20	30	40	50	60
No. of members	8	15	60	45	35	90

Answer any TWO questions: $(2 \times 20 = 40)$

19. a) If $y = sin(m sin^{-1} x)$, prove that $(1 - x^2)y_2 - xy_1 + m^2 y = 0$ and
    $(1 - x^2)y_{n+2} - (2n+1)xy_{n+1} + (m^2 - n^2)y_n = 0$.
    (b) Find the sum of the series $1 + \frac{3}{4} + \frac{3.5}{4.8} + \frac{3.5.7}{4.8.12} + \cdots$. $(12 + 8)$

20. a) Find the characteristic roots and characteristic vectors of the matrix $A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix}$.

    b) Evaluate $L\left(\frac{e^{-3t} - e^{4t}}{t}\right)$. $(14 + 6)$

21. a) Solve the equation $\frac{d^2 y}{dt^2} + 2\frac{dy}{dt} - 3y = sint$ given that $y = \frac{dy}{dt} = 0$ when $t = 0$.
    b) Separate the real and imaginary parts of $cos(x + iy)$. $(15 + 5)$

22. a) Expand $sin^5\theta cos^2\theta$ in a series of sines of multiplies of θ.

    b) Four cards are drawn at random from a pack of 52 cards. Find the probability that
           (i)   They are a king, a queen, a jack and an ace.
           (ii)   Two are kings and two are queens.
           (iii)   Two are black and two are red.
           (iv)   Two cards of hearts and two cards of diamonds. $(10 + 10)$

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