STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted during the academic year 2023 – 24)

B. Sc. DEGREE EXAMINATION, NOVEMBER 2023
BRANCH III - PHYSICS
FIRST SEMESTER

COURSE	**:**	**ALLIED – CORE**
PAPER	**:**	**MATHEMATICS FOR PHYSICS – I**
SUBJECT CODE	**:**	**23MT/AC/MP15**
TIME	**:**	**3 HOURS**

MAX. MARKS : 100

Q. No.	SECTION A ($5 \times 2 = 10$) Answer ANY FIVE questions	CO	KL
1.	State Cayley Hamilton theorem.	1	1
2.	Find y_n if $y = \log(2x+1)$.	1	1
3.	Eliminate the arbitrary functions from the functions $z = f(x+2y)$.	1	1
4.	Write the formula of Fourier series with periodic function 2π.	1	1
5.	Show that $f(x) = x \sin x$ is an even function.	1	1
6.	What is the test of optimality in simplex method?	1	1

Q. No.	SECTION B ($10 \times 1 = 10$) Answer ALL questions	CO	KL
7.	Choose the matrix corresponding to the characteristic roots 1, 5. (a) $\begin{pmatrix} 3 & 3 \\ 2 & 2 \end{pmatrix}$ (b) $\begin{pmatrix} 3 & 2 \\ 2 & 3 \end{pmatrix}$ (c) $\begin{pmatrix} 1 & 3 \\ 2 & 1 \end{pmatrix}$ (d) $\begin{pmatrix} 3 & 3 \\ 0 & 2 \end{pmatrix}$	2	2
8.	Find the characteristics equation of the matrix $\begin{pmatrix} -1 & 3 \\ -1 & 4 \end{pmatrix}$ (a) $\lambda^2 - 3\lambda - 1 = 0$ (b) $\lambda^2 - 3\lambda + 2 = 0$ (c) $\lambda^2 + \lambda + 1 = 0$ (d) $\lambda^2 - \lambda - 2 = 0$.	2	2
9.	What is the nth derivative of e^{3x} ? (a) $3^n e^{3x}$ (b) $-3^n e^{-3x}$ (c) $(-1)^n 3^n e^{3x}$ (d) $(-1)^n e^{3x}$	2	2
10.	Choose a proper substitution to rationalise the given expression $\sqrt{\frac{5-x}{x-2}}$. (a) $2sin^2\theta + 5cos^2\theta$ (b) $5sin^2\theta + 2cos^2\theta$ (c) $2sin^2\theta - 5cos^2\theta$ (d) $5sin\theta + 2cos^2\theta$.	2	2
11.	Find the partial differential equation of $z = (x+a)(y+b)$ (a) $z = p$ (b) $z = q$ (c) $z = pq$ (d) $qz = p$	2	2
12.	Find the complete integral of $z = px + qy + pq$ (a) $z = ax + by$ (b) $z = ax + by + ab$ (c) $z = a(x+y) + a^2$ (d) $z = ax - by - ab$	2	2

13.	Find the Fourier series coefficient a_0 of $f(x) = \frac{\pi - x}{2}$ in $0 \le x \le 2\pi$. (a) 0 (b) π (c) $\frac{\pi}{2}$ (d) $\frac{\pi^2}{4}$	2	2
14.	Choose the formula to find sine series for $f(x)$ in (0, π). (a) $f(x) = \sum_{n=1}^{\infty} b_n \sin nx$ (b) $f(x) = \sum_{n=1}^{\infty} b_n \cos nx$ (c) $f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos nx$ (d) $f(x) = \sum_{n=1}^{\infty} a_n \cos nx$	2	2
15.	If the feasible solution is not a closed polygon then the problem has ________solution. (a) unbounded (b) optimal (c) degenerate (d) infinite	2	2
16.	If some decision variable is zero the solution is called __________ (a) non-degenerate (b) optimal (c) feasible (d) degenerate	2	2

Q. No.	**SECTION C** $(\mathbf{2 \times 15 = 30})$ **Answer ANY TWO questions**	**CO**	**KL**
17.	Verify Cayley Hamilton theorem for the matrix A = $\begin{pmatrix} 1 & 0 & 3 \\ 2 & 1 & -1 \\ 1 & -1 & 1 \end{pmatrix}$ and hence find its inverse.	3	3
18.	Compute the nth derivative of the following functions (a) $\frac{3}{(x+1)(2x-1)}$ (b) $cosx\ cos2x\ cos3x$ **(10+5)**	3	3
19.	Solve: (a) $p + q + pq = 0$ (b) $xp + yq = z$ **(10+5)**	3	3
20.	Make use of graphical method to solve the following LPP: Minimize $Z = 20x + 10y$ subject to the constraints $x + 2y \le 40$ $3x + y \le 30$ $4x + 3y \le 60$ $x, y \ge 0$.	3	3

Q. No.	**SECTION D** $(\mathbf{2 \times 15 = 30})$ **Answer ANY TWO questions**	**CO**	**KL**
21.	Evaluate the matrix $A^6 - 25A^2 + 122A$ where A is $\begin{pmatrix} 0 & 0 & 2 \\ 2 & 1 & 0 \\ -1 & -1 & 3 \end{pmatrix}$.	4	4
22.	Integrate: (a) $\int \frac{dx}{(x+1)\sqrt{x^2+x+1}}$ (b) $\int \sqrt{(x-3)(7-x)}dx$ **(5+10)**	4	4
23.	Examine the function $f(x) = x, 0 \le x \le \pi$ to express it in terms of cosine series.	4	4

24.	A farmer has 100 acre farm. He can sell all tomatoes, lettuce and radishes that he can raise. The price he can obtain is Re.1 per kg for tomatoes, Re.0.75 a heap for lettuce and Re.2 per kg for radishes. The average yield per acre is 2000 kgs for tomatoes, 3000 heaps for lettuce and 1000 kgs for radishes. Fertilizer is available at Re.0.50 per kg and the amount required per acre is 100kgs each for tomatoes and lettuce and 50 kgs for radishes. Labour for sowing, cultivation and harvesting per acre is 5 man-days for tomatoes and radishes and 6 man-days for lettuce. A total of 400 man-days of labour are available at Rs.20 per man-day. Formulate this problem as LP model to maximize the farmer's profit.	4	4

Q. No.	**SECTION E** $(\mathbf{2 \times 10 = 20})$ **Answer ANY TWO questions**	CO	KL
25.	Determine the eigen values and eigen vectors of the matrix $A = \begin{pmatrix} 2 & 2 & 0 \\ 2 & 1 & 1 \\ -7 & 2 & -3 \end{pmatrix}$.	5	5
26.	Prove that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2+a^2)y_n = 0$ if $y = e^{a\sin^{-1}x}$ using Leibnitz's theorem.	5	5
27.	Express $f(x) = \begin{cases} a & 0 < x < \pi \\ -a & \pi < x < 2\pi \end{cases}$ as a Fourier series.	5	5
28.	Solve the following LPP using simplex method: Maximize $Z = 3x_1 + 2x_2$ subject to the constraints $x_1 + x_2 \leq 4$ $x_1 - x_2 \leq 2$ $x_1, x_2 \geq 0$	5	5

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