STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted during the academic year 2019 – 2020 and thereafter)

SUBJECT CODE : 19MT/AC/MS35

B.C.A. DEGREE EXAMINATION, NOVEMBER 2022
THIRD SEMESTER

COURSE : ALLIED – CORE
PAPER : MATHEMATICS FOR COMPUTER SCIENCE - I
TIME : 3 HOURS **MAX. MARKS : 100**

SECTION – A **(10 X 2 = 20)**
ANSWER ANY TEN QUESTIONS

1. Define characteristic vector.
2. Find the eigen values of the matrix $B = \begin{pmatrix} 4 & 1 \\ 3 & 2 \end{pmatrix}$.
3. For the function $f(x) = e^x$ defined in $(0, \pi)$, find a_0.
4. Define even and odd function.
5. If $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$, then find $\nabla \times \vec{F}$.
6. Prove that the vector $\vec{F} = z\vec{i} + x\vec{j} + y\vec{k}$ is solenoidal.
7. Define adjacency matrix.
8. Prove that the sum of the degrees of the points of a graph G is twice the number of lines.
9. Write any two advantages of Linear Programming.
10. Define optimal solution.
11. State Cayley Hamilton theorem.
12. Write the mathematical formulation for LPP.

SECTION – B **(5 X 8 = 40)**
ANSWER ANY FIVE QUESTIONS

13. Verify Cayley-Hamilton theorem for $A = \begin{pmatrix} 1 & 0 & 3 \\ 2 & 1 & -1 \\ 1 & -1 & 1 \end{pmatrix}$.
14. Determine the eigen values and their corresponding eigen vectors of $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix}$.
15. Find the Fourier series for the function $f(x)$ if $f(x) = \begin{cases} x-1, & -\pi < x < 0 \\ x+1, & 0 < x < \pi \end{cases}$.
16. Show that the vector $2xy\vec{i} + (x^2 + 2yz)\vec{j} + (y^2 + 1)\vec{k}$ is irrotational.
17. In a graph G, prove that any $u - v$ walk contains a $u - v$ path.
18. A company makes two types of leather products A and B. A is of high quality and product B is of lower quality. The respective profits are Rs. 4 and Rs. 3 per product. Each product A requires twice as much time as product B and if all products were of type B, the company could make 1000 per day. The supply of leather is sufficient for only 800 products per day (Both A and B combined). Product A requires a special spare part and only 400 per day are available. There are only 700 special spare parts a day available for product B. Formulate this as Linear Programming Problem.

19. Use simplex method to solve the LPP

Maximize $Z = 4x_1 + 10x_2$

Subject to $2x_1 + x_2 \leq 50$

$2x_1 + 5x_2 \leq 100$

$2x_1 + 3x_2 \leq 90$

& $x_1, x_2 \geq 0$

SECTION – C (2 X 20 = 40)

ANSWER ANY TWO QUESTIONS

20. Diagonalize the matrix $A = \begin{pmatrix} 11 & -4 & -7 \\ 7 & -2 & -5 \\ 10 & -4 & -6 \end{pmatrix}$. (20)

21. (a) Determine the Fourier series expansion of $x + x^2$ in the interval $(-\pi, \pi)$.

(b) If $\vec{F} = 3xyz^2\vec{i} + 2xy^3\vec{j} - x^2yz\vec{k}$ and $f = 3x^2 - yz$, find (i) $\vec{F} \cdot \nabla f$ (ii) $\nabla \cdot \nabla f$ at the point $(1, -1, 1)$. (14+6)

22. (a) Show that in any group of two or more people, there are always two with exactly the same number of friends inside the group.

(b) Apply graphical method to solve the LPP

Maximize $Z = x_1 - 2x_2$

Subject to $-x_1 + x_2 \leq 1$

$6x_1 + 4x_2 \geq 24$

$0 \leq x_1 \leq 5$

$2 \leq x_2 \leq 4$

& $x_1, x_2 \geq 0$ (6+14)

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