

MSc DS (NEP) Semester-2 Examination

MDC-DTSC-124 (T)

Mathematical Science Concepts-II

Time : 2-00 Hours]

April-2024

[Max. Marks : 50]

Instructions: All questions are compulsory. Use of non-programmable scientific calculator is allowed.

Q.1 (a) Using Vertically and Crosswise Sutra, solve 12131×20412 (05)

(b) Find the first, second, third derivative of the function $x^5 \sin x$ using Urdhva Tiryag sutra and Meru Prastara. (05)

OR

(a) Using Vertically and Crosswise Sutra, solve the determinant D: (05)

$$D = \begin{vmatrix} 2 & 5 & 7 & 8 \\ 3 & 6 & 2 & 4 \\ 3 & 5 & 7 & 6 \\ 1 & 6 & 9 & 7 \end{vmatrix}$$

(b) Using Urdhva Tiryag sutra, solve the integral of $\int x \sin x \, dx$ (05)

Q.2 (a) The demand and supply functions for a commodity are $p_d = 56 - x^2$ and (05)

$p_s = 8 + \frac{x^2}{3}$. Find the consumer's surplus and producer's surplus at equilibrium price.

(b) Find the area of the region bounded by $y^2 = 4x$ and the line $x = 3$. (05)

OR

(a) A manufacturer produces x units per week at a total cost of Rs. $\frac{x^2}{2} - 800x - 400$. The demand law of the commodity is $p = 200 - \frac{x}{2}$. Find the profit function. How many units should be manufactured to get maximum profit? Also obtain the maximum profit. (05)

(b) Define: Integration by Parts Rule. Evaluate the following integrals: (05)

i. $\int (1+x) \log x \, dx$

ii. $\int \frac{\log x}{(x+1)^2} \, dx$

Q.3 (a) ABC Party Supply Store sells invitations, party favors, decorations, and food service items such as paper plates and napkins. When ABC buys its inventory, it pays 25 paisa per package for invitations and party favors. Decorations cost ABC 50 paisa each and food service items cost 20 paisa per package. ABC sells invitations for Rs. 2.50 per package and party favors for Rs. 1.50 per package. Decorations sell for Rs. 4.50 each and food service for Rs. 1.25 per package. (05)

During the month of May, ABC Party Supply Store sells 1258 invitations, 342 party favors, 2426 decorations, and 1354 food service items. Use vectors and dot products to calculate how much money ABC made in sales during the month of May. How much did the store make in profit?

(b) Express the following matrix as a sum of a symmetric and a skew-symmetric matrix (05)

$$\begin{bmatrix} -2 & 3 & -1 \\ 5 & 4 & -1 \\ 1 & -3 & 2 \end{bmatrix}$$

OR

(a) A particle is displaced from the point $(0, 1, -2)$ to the point $(-1, 3, 2)$ under the action (05) of applied forces $(1, 2, 3)$, $(-1, 2, 3)$ and $(-1, 2, -3)$ then find the work done.

(b) i. Prove that the angle subtended between $(1, 1, -1)$ and $(2, -2, 1)$ is $\sin^{-1}\left(\frac{2}{\sqrt{7}}\right)$. (05)
ii. Find the unit vector perpendicular to the plane containing the vectors $a = i - j + k$ and $b = 2i + 3j - k$.

Q.4 (a) Using 2014 as the origin obtain a straight-line trend equation by the method of least (05) squares.

Year	2010	2012	2013	2014	2015	2016	2019
Value	140	144	160	152	168	176	180

(b) Derive an iterative formula to find \sqrt{N} and hence find approximate value of $\sqrt{65}$, correct (05) up to three decimal places.

OR

(a) Determine the percentage of criminals under 35 years of age. (Using Lagrange's method) (05)

Age	Percentage of criminals
Under 25 years	52.0
Under 25 years	67.3
Under 25 years	84.1
Under 25 years	94.4

(b) Use Descartes' Rule of signs to determine the possible numbers of positive and negative (05) real zeros for $f(x) = -x^4 - 3x^3 + 6x^2 - 4x - 12$

Q.5 Attempt any TEN out of TWELVE: (Each carries 01 mark)

(10)

(1) Define: Average cost and Marginal cost

(2) $\frac{d}{dx}(\sin x \cdot \cos x) = \underline{\hspace{2cm}}$

A. $\cos^2 x + \sin^2 x$ C. $\sin x \cdot \cos x$
B. $-\cos x \cdot \sin x$ D. $\cos^2 x - \sin^2 x$

(3) $\int \frac{(\log x)^2}{x} dx = \underline{\hspace{2cm}}$

A. $\frac{(\log x)^2}{2} + c$ C. $\frac{-\log x}{2} + c$
B. $\frac{\log x}{2} + c$ D. $\frac{(\log x)^3}{3} + c$

(4) Find adjoint of the matrix A where $A = \begin{bmatrix} -2 & 5 \\ 2 & -3 \end{bmatrix}$

(5) Define: Direction Cosines of the vector

(6) Define: Curve Fitting

(7) Define: Descartes' Rule of Sign

(8) What is Correlation? State its types.

(9) For regression line $Y = 3.76 + 0.4 X$, what is the estimated value of Y for $X = 12$?

(10) What is the order of convergence of Newton-Raphson's iterative method.

(11) Give normal equations of a Geometric curve $y = ab^x$

(12) Prepare a table of divided differences of different orders.

Year (x)	1	2	7	8
Amount of Pension (y)	1	5	5	4

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