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Part III — BUSINESS MATHEMATICS

(English Version)

Time Allowed : 3 Hours]

[Maximum Marks : 200

SECTION - A

N. B. : i) Answer all the 40 questions.

ii) Choose and write the correct answer from the four choices given. $40 \times 1 = 40$

1. The Adjoint of $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ is

a) $\begin{pmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}$

b) $\begin{pmatrix} \frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{3} \end{pmatrix}$

c) $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

d) $\begin{pmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{pmatrix}$

2. If $|A| = 0$ then $|\text{Adj } A|$ is

a) 0

b) 1

c) -1

d) ± 1 .

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3. The rank of an $n \times n$ matrix each of whose elements is 1, is

a) 1

b) 2

c) n d) n^2 .

4. For what value of k the matrix A , where $A = \begin{pmatrix} 2 & k \\ 3 & 5 \end{pmatrix}$ has no inverse ?

a) $\frac{3}{10}$ b) $\frac{10}{3}$

c) 3

d) 10.

5. A system of linear homogeneous equations has at least

a) one solution

b) two solutions

c) three solutions

d) four solutions.

6. Latus rectum of $y^2 = 4ax$ is

a) $2a$ b) $3a$ c) $4a$ d) a .

7. Focus of $y^2 = 16x$ is

a) $(2, 0)$ b) $(4, 0)$ c) $(8, 0)$ d) $(2, 4)$.

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8. The semi-major and semi-minor axes of $\frac{x^2}{16} + \frac{y^2}{25} = 1$ is

a) (4, 5)

b) (8, 10)

c) (5, 4)

d) (10, 8)

9. Eccentricity of the rectangular hyperbola is

a) 2

b) $\frac{1}{2}$

c) $\sqrt{2}$

d) $\frac{1}{\sqrt{2}}$

10. The average fixed cost of the function $c = 2x^3 - 3x^2 + 4x + 8$ is

a) $\frac{2}{x}$

b) $\frac{4}{x}$

c) $\frac{-3}{x}$

d) $\frac{8}{x}$

11. For the function $y = 3x + 2$ the average rate of change of y when x increases from 1.5 to 1.6 is

a) 1

b) 0.5

c) 0.6

d) 3

12. The slope of the normal to the curve $\sqrt{x} + \sqrt{y} = 5$ at (9, 4) is

a) $\frac{2}{3}$

b) $-\frac{2}{3}$

c) $\frac{3}{2}$

d) $-\frac{3}{2}$

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23. The solution of $x dx + y dy = 0$ is

a) $x^2 + y^2 = c$

b) $\frac{x}{y} = c$

c) $x^2 - y^2 = c$

d) $xy = c.$

24. The integrating factor of $x \frac{dy}{dx} - y = e^x$ is

a) $\log x$

b) e^{-x}

c) $\frac{1}{x}$

d) $\frac{-1}{x}.$

25. The particular integral of the differential equation $\frac{d^2y}{dx^2} - 5 \frac{dy}{dx} + 6y = e^{5x}$ is

a) $\frac{e^{5x}}{6}$

b) $\frac{x e^{5x}}{2!}$

c) $6 e^{5x}$

d) $\frac{e^{5x}}{25}.$

26. $E^2 f(x) =$

a) $f(x+h)$

b) $f(x+2h)$

c) $f(2h)$

d) $f(2x).$

27. When $h = 1$, $\Delta(x^2) =$

a) $2x$

b) $2x - 1$

c) $2x + 1$

d) $1.$

38. Most commonly used index number is

- a) diffusion index number b) price index number
c) value index number d) none of these.

39. Control charts in statistical quality consist of

- a) three control lines
b) upper and lower control limits
c) the level of process
d) all of these.

40. In a regression line of Y on X, the variable X is known as

- a) independent variable b) dependent variable
c) both (a) and (b) d) none of these.

SECTION - B

N. B. : Answer any ten out of fifteen questions given.

10 × 6 = 60

41. Given $A = \begin{pmatrix} 3 & 1 \\ 4 & 2 \end{pmatrix}$, $B = \begin{pmatrix} -1 & 0 \\ 2 & 1 \end{pmatrix}$. Verify that $\text{Adj}(AB) = (\text{Adj} B)(\text{Adj} A)$.

42. Solve using matrices the equations $2x - y = 3$, $5x + y = 4$.

43. Find the equation of the ellipse whose foci are $(4, 0)$ and $(-4, 0)$ and $e = \frac{1}{3}$.

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44. The demand for a given commodity is $q = -60p + 480$ ($0 < p < 7$), where p is the price. Find the elasticity of demand and marginal revenue when $p = 6$.
45. A metal cylinder when heated, expands in such a way that its radius r increases at the rate of 0.2 cm per minute and its height h increases at a rate of 0.15 cm per minute retaining its shape. Determine the rate of change of volume of the cylinder when its radius is 10 cm and its height is 25 cm.
46. Calculate the EOQ in units and total variable cost for the following items assuming an ordering cost of Rs. 5 and a holding cost of 10%.
- Annual demand = 392 units.
- One unit price = Rs. 8.60
47. For the marginal cost function $MC = 5 - 6x + 3x^2$, x is the output. If the cost of producing 10 items is Rs. 850, find the total cost and average cost functions.
48. Solve : $(1 - e^x) \sec^2 y \, dy + 3e^x \tan y \, dx = 0$.
49. Solve : $\frac{dy}{dx} + y \cos x = \frac{1}{2} \sin 2x$.
50. If $f(0) = 5$, $f(1) = 6$, $f(3) = 50$ and $f(4) = 105$. find $f(2)$ by Lagrange's formula.
51. Fit a straight line $y = ax + b$ to the following data by the method of least squares :

$x:$	0	1	3	6	8
$y:$	1	3	2	5	4

52. It is stated that 2% of razor blades supplied by a manufacturer are defective. A random sample of 200 blades is drawn from a lot. Find the probability that 3 or more blades are defective ($e^{-4} = 0.01832$).
53. Out of 1000 TV viewers, 320 watched a particular programme. Find 95% confidence limits for TV viewers who watched this programme.
54. Find trend values to the following data by the method of semi-average :

Year :	1980	1981	1982	1983	1984	1985	1986
Sales :	102	105	114	110	108	116	112

55. Calculate Fisher's Index numbers from the following data :

Commodity	Price		Quantity	
	Base year	Current year	Base year	Current year
A	6	10	40	50
B	2	2	90	120
C	4	6	70	60
D	10	12	40	25

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SECTION - C

N. B. : Answer any ten questions.

 $10 \times 10 = 100$

56. Show that the equations

$$2x - y + z = 7$$

$$3x + y - 5z = 13$$

$$x + y + z = 0$$

are consistent and have unique solution.

57. The data below are about an economy of two industries P and Q . The values are in millions of rupees.

Producer	User		Final Demand	Total Output
	P	Q		
P	14	6	8	28
Q	7	18	11	36

Determine the outputs if the final demand changes to 20 for P and 30 for Q .

58. Find the equation to the asymptotes of the hyperbola

$$3x^2 - 5xy - 2y^2 + 17x + y + 14 = 0.$$

59. At what points on the circle $x^2 + y^2 - 2x - 4y + 1 = 0$, the tangent is parallel to (i) x -axis (ii) y -axis ?

60. Investigate the maxima and minima of the function $2x^3 - 9x^2 + 12x + 15$:

61. The demand for a commodity A is $q_1 = 240 - p_1^2 + 6p_2 - p_1 p_2$.

Find the partial elasticity $\frac{Eq_1}{Ep_1}$ and $\frac{Eq_1}{Ep_2}$ when $p_1 = 5$ and $p_2 = 4$.

62. Evaluate $\int_0^{\pi} x \sin^2 x \, dx$.

63. In a perfect competition the demand and supply curves of a commodity are given by $P_d = 40 - x^2$ and $P_s = 3x^2 + 8x + 8$. Find the consumer's surplus and producer's surplus at the market equilibrium price.

64. Solve : $(D^2 - 13D + 12)y = e^{-2x} + 5e^x$.

65. From the following data calculate the value of $e^{1.75}$.

$x :$	1.7	1.8	1.9	2.0	2.1
$e^x :$	5.474	6.050	6.686	7.389	8.166

66. A random variable X has the following probability distribution :

Values of X

$x :$	0	1	2	3	4	5	6	7	8
$p(x) :$	a	$3a$	$5a$	$7a$	$9a$	$11a$	$13a$	$15a$	$17a$

- Determine the value of a
- Find $P(X < 3)$, $P(X > 3)$ and $P(0 < X < 5)$.

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67. In a sample of 1000 candidates the mean of certain test is 45 and standard deviation is 15. Assuming the normality of the distribution, find the following :

- i) How many candidates score between 40 and 60 ?
- ii) How many candidates score above 50 ?
- iii) How many candidates score below 30 ?

Use :

Z :	0.33	1
Area :	0.1293	0.3413

68. A sample of five measurements of the diameter of a sphere were recorded by a scientist as 6.33, 6.37, 6.36, 6.32 and 6.37 mm.

Determine the point estimate of

i) mean

ii) variance.

69. Solve the following, using graphical method :

Minimize

$$Z = 3x_1 + 2x_2$$

subject to constraints $5x_1 + x_2 \geq 10$

$$2x_1 + 2x_2 \geq 12$$

$$x_1 + 4x_2 \geq 12$$

$$x_1, x_2 \geq 0.$$

70. From the data given below, calculate the Seasonal Indices :

Quarter	Year				
	1984	1985	1986	1987	1988
I	40	42	41	45	44
II	35	37	35	36	38
III	38	39	38	36	38
IV	40	38	40	41	42