

2022

COMMERCE

Paper : GE-4

(Business Mathematics)

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

(b) (i) What is sinking fund? A sinking fund is created for the redemption of debentures of ₹ 1,00,000 at the end of 25 years. How much money should be provided out of profits each year for the sinking fund, if the investment can earn interest @ 4% per annum?

[Given, $\log 1.04 = 0.0170$, antilog $0.425 = 2.661$] 2+6=8

(ii) At what rate percent will ₹ 6,000 amount to ₹ 7,500 in 4 years?

[Given, $\log 1.25 = 0.0969$, antilog $0.0242 = 1.057$] 6

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1. Choose the correct answer from the following : 1×6=6

- (a) Unit matrix is a
 - (i) diagonal matrix
 - (ii) scalar matrix
 - (iii) Both (i) and (ii)
 - (iv) None of the above

(b) If x denotes the volume of output, then $\frac{d}{dx}$ (TR) is equal to

- (i) MR
- (ii) AR
- (iii) 0
- (iv) None of the above

(2)

(c) If any two rows (or columns) in a determinant are identical, then the value of determinant will

- (i) remain same
- (ii) change by sign
- (iii) be zero
- (iv) None of the above

(d) $\int \frac{1}{x} dx$ is equal to

- (i) $a^x + c$
- (ii) $e^x + c$
- (iii) $0 + c$
- (iv) $\log x + c$

(e) If interest is compounded half-yearly, then the formula for finding amount is

- (i) $A = P \left(1 + \frac{r}{100} \right)^n$
- (ii) $A = P \left(1 + \frac{r}{2 \times 100} \right)^{2n}$
- (iii) $A = P \left(1 + \frac{r}{3 \times 100} \right)^{3n}$
- (iv) $A = P \left(1 + \frac{r}{4 \times 100} \right)^{4n}$

22KB/454

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(3)

(f) The graphical method is used to solve linear programming problem when the number of decision variables is

- (i) 6
- (ii) 2
- (iii) 4
- (iv) 5

2. Answer the following questions : $2 \times 5 = 10$

(a) Write two differences between a matrix and a determinant.

(b) If $y = x^3 - \frac{1}{x^2}$, then find $\frac{dy}{dx}$.

(c) Integrate $\int \frac{\log x}{x} dx$

(d) If $A = \begin{bmatrix} 1 & -3 & 2 \\ 0 & 3 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 5 & 6 \\ 1 & 1 & -2 \end{bmatrix}$

then find $2A - 3B$.

22KB/454

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(4)

(e) Find the interest on ₹ 730 from 15th March to 1st September (of the same year) @ 5% per annum.

3. Answer any six of the following questions :
 $5 \times 6 = 30$

(a) Solve the following system of simultaneous linear equations by Cramer's rule :

$$2x + 3y - z = 15$$

$$4y + 2z = 16$$

$$3x + 2y = 18$$

(b) Without expanding, prove that

$$\begin{vmatrix} bc & a & a^2 \\ ca & b & b^2 \\ ab & c & c^2 \end{vmatrix} = \begin{vmatrix} 1 & a^2 & a^3 \\ 1 & b^2 & b^3 \\ 1 & c^2 & c^3 \end{vmatrix}$$

(c) If $f(x) = x^2 - 3x + 2$, then find $f(A)$, where A is a matrix given by

$$\begin{bmatrix} 3 & 1 & 2 \\ 0 & 1 & 4 \\ -1 & 1 & 0 \end{bmatrix}$$

22KB/454

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(5)

(d) (i) The total cost function $C(x)$ of producing x items is given by

$$C(x) = \begin{cases} 1000 + 5x; & \text{when } 0 \leq x \leq 500 \\ 2000 + 4x; & \text{when } 500 < x \leq 2000 \end{cases}$$

Find the cost of producing

(1) 430 items and (2) 1200 items. 2

(ii) If

$$f(x) = \frac{ax + b}{bx + a}$$

then prove that $f(x) \cdot f\left(\frac{1}{x}\right) = 1$. 3

(e) Evaluate :

(i) $\lim_{x \rightarrow 2} \frac{x^2 - x - 2}{x^2 - 4}$

(ii) $\lim_{x \rightarrow 0} \frac{\sqrt{1+x} - \sqrt{1-x}}{x}$

(f) If

$$y = 2x + \frac{4}{x}$$

then prove that

$$x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} - y = 0$$

22KB/454

(Turn Over)

(6)

(g) Verify Euler's theorem for the function $f(x, y) = x^3 + 2x^2y + y^3$.

(h) Define objective function, feasible region and feasible solution associated with linear programming.

(i) A machine depreciated in value each year 10% of its previous value and at the end of fourth year its value was ₹ 1,31,220. Find the original value of the machine.

4. Answer any two of the following questions : $10 \times 2 = 20$

(a) Solve the following system of equations by using matrix inversion method :

$$3x + 4y + 5z = 18$$

$$2x - y + 8z = 13$$

$$5x - 2y + 7z = 20$$

(b) For a monopoly firm producing a certain article can sell x articles per week at p rupees each, where $5x = 375 - 3p$. The cost of production is $\left(500 + 13x + \frac{1}{5}x^2\right)$ rupees. Find how many articles the monopolist should produce for maximum profit. What is that maximum profit?

22KB/454

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(7)

(c) (i) If $u = 2(ax + by)^2 - (x^2 + y^2)$, then show that

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 4(a^2 + b^2) - 4$$

5

(ii) The marginal cost of producing x units of a product is given by $(25 + 30x - 9x^2)$ and the fixed cost is known to be 55. Find the total cost and average cost functions. 5

5. Answer any one of the following questions : 14

(a) (i) What is linear programming problem? What are the basic assumptions of linear programming problem? $2+5=7$

(ii) Solve the following LPP by graphical method : 7

$$\text{Maximize } Z = 3x + 4y$$

subject to

$$4x + 2y \leq 80$$

$$2x + 5y \leq 180$$

$$x \geq 0, y \geq 0$$

22KB/454

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