Class : 11

Register Number

UNIT TEST -3, NOVEMBER - 2024

BUSINESS MATHEMATICS AND STATISTICS

Time Allowed : 1.30 Hours] [Max. Marks : 45

PART - I

1. Answer all the questions by choosing the correct answer from the given 4 alternatives 10 x 1 = 10
2. Write question number, correct option and corresponding answer
3. Each question carries 1 mark

1. If the demand function is said to be elastic, then

(a) $|\eta_d| > 1$ (b) $|\eta_d| = 1$ (c) $|\eta_d| < 1$ (d) $|\eta_d| = 0$

2. For the cost function $C = \frac{1}{25}e^{5x}$, the marginal cost is

(a) $\frac{1}{25}$ (b) $\frac{1}{5}e^{5x}$ (c) $\frac{1}{125}e^{5x}$ (d) $25e^{5x}$

3. Profit P(x) is maximum when

(a) MR = MC (b) MR = 0 (c) MC = AC (d) TR = AC

4. If $u = e^{x^2}$, then $\frac{\partial u}{\partial x}$ is equal to

(a) $2xe^{x^2}$ (b) e^{x^2} (c) $2e^{x^2}$ (d) 0

5. The demand function is always

(a) Increasing function (b) Decreasing function (c) Non-decreasing function (d) Undefined function

6. What is the amount realised on selling 8% stock of 200 shares of face value ₹ 100 at ₹ 50 .

(a) ₹ 16,000 (b) ₹ 10,000 (c) ₹ 7,000 (d) ₹ 9,000

7. A person brought 100 shares of 9% stock of face value ₹100 at a discount of 10%, then the stock purchased is

(a) ₹ 9000 (b) ₹ 6000 (c) ₹ 5000 (d) ₹ 4000

8. The annual income on 500 shares of face value ₹100 at 15% is

(a) ₹ 7,500 (b) ₹ 5,000 (c) ₹ 8,000 (d) ₹ 8,500

9. A invested some money in 10% stock at ₹96. If B wants to invest in an equally good 12% stock, he must purchase a stock worth of

(a) ₹ 80 (b) ₹ 115.20 (c) ₹ 120 (d) ₹ 125.40

10. Example of contingent annuity is

(a) Installments of payment for a plot of land (b) An endowment fund to give scholarships to a student

(c) Personal loan from a bank (d) All the above

PART - II

1. Answer any 4 questions 4 x 2 = 8
2. Each question carries 2 marks
3. Question number 16 is compulsory

11. Find the equilibrium price and equilibrium quantity for the following functions. Demand: $x = 100 - 2p$ and supply: $x = 3p - 50$

12. If $z = (ax + b)(cy + d)$, then find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$.

13. A person pays ₹ 64,000 per annum for 12 years at the rate of 10% per year. Find the amount of an ordinary annuity $[(1.1)^{12} = 3.3184]$.

14. What is the amount of perpetual annuity of ₹50 at 5% compound interest per year?

15. If the dividend received from 10% of ₹ 25 shares is ₹2000. Find the number of shares.

16. The chairman of a society wishes to award a gold medal to a student getting highest marks in Business Mathematics and Statistics. If this medal costs to ₹ 9,000 every year and the rate of compound interest is 15%, then what amount is to be deposited now.

PART – III

1. Answer any 4 questions 4 x 3 = 12
2. Each question carries 3 marks
3. Question number 22 is compulsory

17. $\bar{C} = 0.05x^2 + 16 + \frac{100}{x}$ is the manufacturer's average cost function. What is the marginal cost when 50 units are produced and interpret your result.

18. A manufacturer has to supply 12,000 units of a product per year to his customer. The ordering cost (C_3) is ₹100 per order and carrying cost is ₹0.80 per item per month. Assuming there is no shortage cost and the replacement is instantaneous, determine the

(i) economic order quantity (ii) time between orders (iii) number of orders per year

19. Let $u = x^2y^3\cos\left(\frac{x}{y}\right)$. By using Euler's theorem show that $x \cdot \frac{\partial u}{\partial x} + y \cdot \frac{\partial u}{\partial y} = 5u$.

20. A bank pays 8% per annum interest compounded quarterly. Find the equal deposits to be made at the end of each quarter for 10 years to have ₹ 30,200 ? $[(1.02)^{40} = 2.2080]$.

21. If the dividend received from 9% of ₹20 shares is ₹1,620, then find the number of shares.

22. If the production of a firm is given by $P = 4LK - L^2 + K^2, L > 0, K > 0$, Prove that $L\frac{\partial P}{\partial L} + K\frac{\partial P}{\partial K} = 2P$.

PART – IV

1. Answer all the questions 3 x 5 = 15
2. Each question carries 5 marks

23. a) A firm produces x tonnes of output at a total cost of $C(x) = \frac{1}{10}x^3 - 4x^2 - 20x + 7$. Find the

(i) average cost function
(ii) average variable cost function
(iii) average fixed cost function
(iv) marginal cost function and
(v) marginal average cost function.

(OR)

b) Find the stationary values and stationary points for the function: $f(x) = 2x^3 + 9x^2 + 12x + 1$.

24. a) A dealer has to supply his customer with 400 units of a product per every week. The dealer gets the product from the manufacturer at a cost of ₹50 per unit. The cost of ordering from the manufacturers in ₹ 75 per order. The cost of holding inventory is 7.5% per year of the product cost. Find (i) EOQ and (ii) Total optimum cost.

(OR)

b) The age of the girl is 2 years. Her father wants to get ₹20,00,000 when his ward becomes 22 years. He opens an account with a bank at 10% rate of compound interest. What amount should he deposit at the end of every month in this recurring account? $[(1.0083)^{240} = 6.194]$.

25. a) Which is better investment? 7% of ₹ 100 shares at ₹ 120 (or) 8% of ₹ 100 shares at ₹ 135 .

(OR)

b) Let $u = \log\frac{x^4+y^4}{x+y}$. By using Euler's theorem show that $x \cdot \frac{\partial u}{\partial x} + y \cdot \frac{\partial u}{\partial y} = 3$.

Unit test 2. Part-I 11th Business Maths

ANSWER KEY.

S.No	option	Answers:
1.	a	$\|rd\| > 1$
2.	b	$\frac{1}{5}e^{5x}$
3	a	MR = MC
4.	a	$2xe^{x^2}$
5.	b	Decreasing function
6.	b	₹10,000
7.	a	₹9000
8.	a	7500
9.	b	115.20
10.	b.	An endowment fund to give Scholorships to a student.

Part-II.

11. At equilibrium

Demand = Supply

$100 - 2p = 3p - 50$

$100 + 50 = 3p + 2p$

$150 = 5p$

$p = 30$

$x = 100 - 2p$

$= 100 - 2(30)$

$= 40$

price at equilibrium = 30

quantity at equilibrium = 40

12. $z = (ax+b)(cy+d)$ $\frac{\partial z}{\partial x}$ & $\frac{\partial z}{\partial y}$

$\frac{\partial z}{\partial x} = (a(1)+0)(cy+d)$

$= a(cy+d)$

$\frac{\partial z}{\partial y} = (c(1)+0)(ax+b)$

$= c(ax+b)$

13. $a = 64000$ $n = 12$ $i = 0.1$

$A = \frac{a}{i}[(1+i)^n - 1]$

$= \frac{64000}{0.1}[(1+0.1)^{12} - 1]$

$= 6,40,000[2.3184]$

$= ₹ 14,83,776$

$A = ₹\ 14,83,116$.

14. $a = 50$

$i = 5\% = 0.05$

$A = \frac{a}{i} = \frac{50}{0.05} = ₹1000$

15. No. of Shares be x

FV of x Shares $= 25x$

$\frac{10}{100} \times 25x = 2000$

$x = \frac{2000 \times 100}{25 \times 10} = 800$

$x = 80$.

16. $a = 9000$

$i = 0.15$

$P = \frac{a}{i}$

$= \frac{9000}{0.15} = ₹60,000$

Part - III

17. $TC = AC \times x$

$\bar{C} = \bar{C} \times x$

$= 0.05x^2 + 16x + 100$

$MC = \frac{dc}{dx} = 0.15x^2 + 16$

$x = 50$

$= 0.15(50)^2 + 16$

$= ₹$

18. $R = 12000$

$C_3 = 100$

$C_1 = 0.80 \times 12$

$= ₹9.6$

(i) EOQ $= \sqrt{\frac{2C_3R}{C_1}} = \sqrt{\frac{2 \times 100 \times 12000}{9.6}}$

$= 500$ units.

(ii) $\frac{\text{Demand}}{\text{EOQ}} = \frac{12000}{500} = 24$

(iii) $\frac{1}{\text{to}} = \frac{1}{24}$ year

$= \frac{12}{24}$ Month $= \frac{1}{2}$ Month

$= 15$ days.

19. $u = x^2y^3 \cos\left(\frac{x}{y}\right)$

P.T. $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 5u$

$u(x,y) = x^2y^3 \cos\left(\frac{x}{y}\right)$

$u(tx, ty) = t^2x^2 \cdot t^3y^3 \cdot \cos\left(\frac{tx}{ty}\right)$

$= t^5\left(x^2y^3 \cos\left(\frac{x}{y}\right)\right)$

$= t^5 u$

∴ It is a homogeneous function of degree 5

$n = 5$

$x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 5u$

hence proved.

20.

$A = 30,200$

$r = \frac{8\%}{4}$

$= 2\%$

$= 0.02$

$n = 10 \times 4$

$= 40$

$A = \frac{a}{i}\left[(1+i)^n - 1\right]$

$30,200 = \frac{a}{0.02}\left[(1.02)^{40} - 1\right]$

$604 = a(1.1080)$

$a = \frac{604}{1.1080} = ₹500.$

21.

Let No. of Shares be x

Dividend = No. of Shares × FV × Rate percentage.

$1620 = x \times 20 \times \frac{9}{100}$

$x = \frac{1620 \times 100}{20 \times 9}$

$x = 900$ Shares.

22. $p = 4Lk - L^2 + k^2$

P.T. $L\frac{\partial p}{\partial L} + k\frac{\partial p}{\partial k} = 2p$

$p(tL, tk) = 4tk \cdot tk - tL^2 + tk^2$

$p(tL, tk) = 4t^2Lk - t^2L^2 + t^2k^2$

$= t^2(4Lk - L^2 + k^2)$

$= t^2 p$

$\therefore p$ is a homogeneous function of degree 2

$L\frac{\partial p}{\partial L} + k\frac{\partial p}{\partial k} = 2p$

Hence proved

Part-IV.

23. a) $C(x) = \frac{1}{10}x^3 - 4x^2 - 20x + 7$

(i) AC

$\frac{C}{x} = \frac{1}{10}x^2 - 4x - 20 + \frac{7}{x}$

(ii) AVC

$\frac{C}{x} = \frac{1}{10}x^2 - 4x - 20$

(iii) AFC

$\frac{K}{x} = \frac{7}{x}$

(iv) MC

$\frac{dC}{dx} = \frac{3}{10}x^2 - 8x - 20$

(v) MAC

$\frac{d}{dx}(AC) = \frac{x}{5} - 4 - \frac{7}{x^2}$

23)

b) $f(x) = 2x^3 + 9x^2 + 12x + 7$

$f'(x) = 6x^2 + 18x + 12$

$= 6(x^2 + 3x + 2)$

$= 6(x+2)(x+1)$

$f'(x) = 0$

$6(x+2)(x+1) = 0$

$x+2 = 0 \quad / \quad x+1 = 0$

$x = -2 \qquad x = -1$

When $x = -2$

$f(-2) = 2(-2)^3 + 9(-2)^2 + 12(-2) + 7$

$= -3$

When $x = -1$

$f(-1) = 2(-1)^3 + 9(-1)^2 + 12(-1) + 7$

$= -4.$

Stationary points are $(-2, -3)$ $(-1, -4)$

$= \sqrt{8,33,333.33}$

$= 912.87$ per order.

(ii) T.O.C = purchasing cost + minimum annual cost

$= 400 \times 50 + \sqrt{2 \times 400 \times 7 \times 0.7211}$

$= 20000 + 65.75$

$= 20,065.75$ per week.

b) $A = 20,00,000$

$i = 0.1$

$n = 20 \quad k = 12.$

$A = \frac{a}{i/k}\left[\left(1 + \frac{i}{k}\right)^{nk} - 1\right]$

$= \frac{a}{\frac{0.1}{12}}\left[\left(1 + \frac{0.1}{12}\right)^{20 \times 12} - 1\right]$

$= 120a\left[(1.0083)^{240} - 1\right]$

$= 120a\,[5.194]$

$a = \frac{20.09000}{120 \times 5.194}$

$a = 3208.83$

$= 3209.$

24)

a) $R = 400$

$C_3 = 75$

$C_1 = 0.07211$

(i) EOQ

$q_0 = \sqrt{\frac{2C_3R}{C_1}}$

$= \sqrt{\frac{2 \times 400 \times 75}{0.7211}}$

25. a) Income from 7%.

$\frac{7}{120} \times (126 - 135).$

$= 7 \times 135$

$= 945$

Income from 8%.

$\frac{8}{135} \times (120 - 135) = 8 \times 120$

$= 2960$

$\therefore$ 8% of ₹ 100 Shares is better investment

25)

b) $u = \log \frac{x^4+y^4}{x+y}$

S.T. $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 3$.

$$e^u = \frac{x^4+y^4}{x+y} = f(x,y) \quad \text{---} (1)$$

$$f(tx,ty) = \frac{t^4x^4 + t^4y^4}{tx+ty}$$

$$= t^3\left(\frac{x^4+y^4}{x+y}\right)$$

$$= t^3 f(x,y)$$

$\therefore$ f is a homogeneous function of degree = 3

Using Euler's theorem

$$x\frac{\partial v}{\partial x} + y\frac{\partial v}{\partial y} = 3f$$

$$x\frac{\partial e^v}{\partial x} + y\frac{\partial e^v}{\partial y} = 3e^v$$

$$e^v x\frac{\partial v}{\partial x} + y\frac{\partial v}{\partial y} = 3e^v$$

$$x\frac{\partial v}{\partial x} + y\frac{\partial v}{\partial y} = 3$$

Hence proved. ——— x ———.