2025

(Nov–Dec)

FYUP : 3rd Semester Examination

MAJOR

ECONOMICS

(Mathematical Methods for Economics—I)

ECO–201

Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, taking at least **one** from each Unit

UNIT—I

1. *(a)* Given the following sets :

$u = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

$A = \{1, 2, 3, 4\}$;

$B = \{2, 4, 6, 8\}$;

$C = \{3, 4, 5, 6\}$

Prove the De Morgan's law of set operation. 5

(b) Differentiate between—

(i) equal set and equivalent set with example;

(ii) ordered pair (a, b) and set $\{a, b\}$ 3+2=5

(c) State the associative law of set theory. Verify the associative law for the following sets : 1+2+2=5

$A = \{a, c, d, e\}$, $B = \{b, d, e, f\}$, $C = \{c, d, f\}$

2. (a) What is a function? Illustrate with examples the fact that all functions are relations but all relations are not functions. 2+6=8

(b) If the domain of a function $Y = 5 + 2X$ is a set $\{X: 1 \le X \le 10\}$, find the range of the function and express it as a set. 3

(c) Assume that the direct tax system takes 25% of income Y, regardless of size and that an individual's consumption is 600 plus 80% of disposable income D, where D is income Y minus direct taxes. Express the relation $C = f(Y)$ and find C when $Y = 1000$. 4

3. (a) The total cost of producing a product is ₹ 124 if 3 units of labour and 2 units of capital are used. If 4 units of labour and 1 unit of capital are used, the cost incurred is ₹ 112. What is the cost per unit of labour and capital? 3

(Continued)

(b) Find the equation of the straight line which passes through the point (–5, 3) and whose intercept on the x-axis is 4 times its intercept on the y-axis. 4

(c) When the price of a certain commodity was ₹ 2 per unit, 10 units were supplied to the market. When the price increased to ₹ 4, the supplier supplied 40 units to the said market.

(i) Obtain the linear supply function.

(ii) Predict the supply on future price of ₹ 3.

(iii) Graph the supply function. 4+1+3=8

UNIT—II

4. (a) Evaluate the following (any *three*) : 3×3=9

(i) $\lim_{x \to 3} \frac{x^2 - 2x - 3}{x^2 + x - 12}$

(ii) $\lim_{x \to 0} \frac{\sqrt{4 - x} - 2}{x}$

(iii) $\lim_{x \to 0} \frac{e^x - 1}{x}$

(iv) $\lim_{x \to \infty} \frac{ax^2 - b}{bx^2}$

(v) $\lim_{x \to a} \frac{x^9 - a^9}{x^5 - a^5}$

(Turn Over)

(b) Discuss the continuity of a function $f(x)$ at $x = a$. At what values of x, the following functions are discontinuous? 2+3+1=6

(i) $f(x) = \dfrac{3x+5}{x^2-6x+8}$

(ii) $f(x) = \dfrac{x^2-3x+1}{3x+5}$

5. (a) Differentiate the following functions (any *three*) : 3×3=9

(i) $Y = \dfrac{ax^2 - bx + c}{x^{-4}}$

(ii) $Y = \log(x + \sqrt{1+x^2})$

(iii) $Y = (x+1)^x$

(iv) $Y = x^3 e^{-\frac{1}{2}x^2}$

(v) $x^3 - 3axy + y^3 = 0$

(b) For the function

$$z = 3x^2 + 6xy + y^2$$

find the first- and second-order partial derivatives. Also show that

$$\frac{\partial^2 z}{\partial x \partial y} = \frac{\partial^2 z}{\partial y \partial x}$$

2+2+2=6

(Continued)

6. (a) What do you understand by total differential of a function? 2

(b) Find the total differential of the function

$$u = \frac{x^2 + y^2}{x + y}$$

5

(c) If the demand function is $q = \dfrac{15}{p+2}$, find the price elasticity of demand at $p = ₹3$. Also interpret the result. 4+1=5

(d) If MR is ₹40 and the elasticity of demand with respect to price is ₹3, find AR. 3

UNIT—III

7. (a) What is optimization problem in economics? Give examples. 3

(b) Determine the maximum and minimum values of the function

$$Y = x^3 - 2x^2 + x + 10$$

3+3=6

(c) The total cost function of a cotton ginnery is given by

$$C = \frac{1}{5}x^2 + 6x + 100$$

where x represents output of cotton. Find the output of cotton for which average cost is minimum. 6

(Turn Over)

8. *(a)* The total cost function of a firm is given by $C = 50000 - 15Q + 5Q^2$ where Q is the output. Find—

(i) the average variable cost function;

(ii) the level of output at which the slope of the average variable cost curve is zero;

(iii) the minimum marginal cost. 1+3+4=8

(b) Given the demand function $P = \sqrt{12 - x}$, find the maximum total revenue. 7

9. *(a)* A monopolist is facing a linear demand function $4q = 100 - P$. His average cost function is given by

$$AC = \frac{50}{q} + 20$$

What level of output will maximize total profit and what are the corresponding values of price and profit? 5+2+2=9

(b) Find the points of inflexion of the curve

$$Y = x^4 - 6x^3 + 12x^2 + 10x$$ 6

UNIT—IV

10. *(a)* What is integration? How is it applicable in the field of economics? 1+5=6

(Continued)

(b) Integrate the following (any *three*) : 3×3=9

(i) $\int \left(x^2 + \sqrt{x} + \frac{1}{x^3} \right) dx$

(ii) $\int \frac{e^x}{a + be^x} dx$

(iii) $\int x^2 e^{2x} dx$

(iv) $\int \frac{2x + 3}{x^2 + 2x - 3} dx$

(v) $\int \log x \, dx$

11. *(a)* What is meant by definite integral? 3

(b) Evaluate : 4+4=8

(i) $\int_1^4 \left(\frac{8}{\sqrt{x}} - 12\sqrt{x^3} \right) dx$

(ii) $\int_1^2 x(x^2 + 2)^3 \, dx$

(c) The marginal cost curve for sales is $C'(q) = 1{\cdot}052 - 0{\cdot}004q$. Find the total and average cost curves if $C(0) = 16{\cdot}8$. 4

12. *(a)* If the marginal revenue function for q is given by

$$MR = \frac{6}{(q + 2)^2} - 5$$

(Turn Over)

show that the demand function is

$$P = \frac{3}{q+2} - 5$$

8

(b) If the demand function for a profit maximizing monopolist is $P = 45 - x^2$ and the marginal cost of production is $MC = 6 + \frac{x^2}{4}$, calculate the consumer's surplus. 7

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