

3/ECO-201 Syllabus-2023

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(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.

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(Turn Over)

- (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 $\{X: 1 \leq X \leq 10\}$, 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

(3)

- (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) : $3 \times 3 = 9$

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

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

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

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

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

(4)

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

$$2+3+1=6$$

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

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

5. (a) Differentiate the following functions (any three) :

$$3 \times 3 = 9$$

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

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

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

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

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

- (b) For the function

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

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

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

$$2+2+2=6$$

(5)

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

- (b) Find the total differential of the function

$$u = \frac{x^2 + y^2}{x + y} \quad 5$$

- (c) If the demand function is $q = \frac{15}{p+2}$, 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

$$Y = x^3 - 2x^2 + x + 10 \quad 3+3=6$$

- (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

(6)

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

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

UNIT—IV

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

(b) Integrate the following (any *three*) : $3 \times 3 = 9$

(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 $C'(q) = 1.052 - 0.004q$. Find the total and average cost curves if $C(0) = 16.8$. 4

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

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

(8)

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.

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