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1 SEM TDC ECOH (CBCS) C 2

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(November)

ECONOMICS

(Core)

Paper : C-2

(Mathematical Methods for Economics—I)

Full Marks : 80

Pass Marks : 32

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Answer the following as directed : 1×8=8

(a) Define Cartesian products.

(b) What is $\frac{d}{dx}(3x^3)$?

(i) $3x^2$

(ii) $9x^2$

(iii) $9x^3$

(iv) $6x^2$

(Choose the correct option)

(2)

- (c) Define null set with an example from economics.
- (d) A function is said to be continuous at a point $x = a$, if
- (i) $\lim_{x \rightarrow a} f(x)$ exist
 - (ii) $\lim_{x \rightarrow a} f(x)$ exist and $\lim_{x \rightarrow a} f(x) = f(a)$
 - (iii) $\lim_{x \rightarrow a^-} f(x) = f(a)$
 - (iv) None of the above

(Choose the correct option)

- (e) If $n = 3$, the following polynomial function

$$f(x) = a_0 + a_1x + a_2x^2 + \dots + a_nx^n$$

will be known as

- (i) constant function
- (ii) linear function
- (iii) quadratic function
- (iv) cubic function

(Choose the correct option)

(3)

- (f) The correct relationship among average revenue (AR), marginal revenue (MR) and elasticity of demand is

(i) $e_d = \frac{AR}{AR - MR}$

(ii) $e_d = \frac{MR}{AR - MR}$

(iii) $e_d = \frac{AR}{MR - AR}$

(iv) $e_d = \frac{MR}{MR - AR}$

(Choose the correct option)

- (g) If $f(x) = \ln(x)$, then what is $f'(x)$?

(i) $1/x$

(ii) $\log(x^2)$

(iii) $x \log(x)$

(iv) x^2

(Choose the correct option)

- (h) State one property of a differentiable function.

2. Answer any four of the following questions :

$$4 \times 4 = 16$$

- (a) Prove the commutative and distributive properties of set operations with examples.

(b) Each of 30 persons eats rice or wheat, 26 of them eat rice, 14 eat both rice and wheat. Determine the number of persons who eat only wheat.

(c) From the given total cost (TC) function, find average cost (AC), average variable cost (AVC), average fixed cost (AFC) and marginal cost (MC)

$$TC = \frac{1}{4}Q^3 + 7Q^2 + 7Q + 137$$

(d) Find the elasticity of demand for the demand function $Q = 20 - 2P$, when $P = 5$.

(e) The total revenue (R) of a firm per day is a function of its daily sells (Q)

$$R = 68 + 10Q$$

The firm sells maximum 50 units of output per day. What are domain and range of the revenue function?

3. (a) (i) Define set. 2

(ii) Define the following with examples :
3×3=9

- (1) Equal sets
- (2) Power set
- (3) Disjoint set

Or

(b) (i) What do you mean by ordered pairs? Explain with examples. 4

(ii) Distinguish between relations and functions. 4

(iii) Distinguish between rational and irrational numbers. 3

4. (a) (i) Draw the graph of the following function : 4

$$y = |x| + 10$$

(ii) Write short notes on the following :
2×4=8

- (1) Constant function
- (2) Exponential function
- (3) Polynomial function
- (4) Logarithmic function

Or

(b) (i) Evaluate : 6

$$\lim_{y \rightarrow 7} \frac{y^2 - 4y - 21}{3y^2 - 17y - 28}$$

(ii) What are the conditions for continuity of a function? Explain with examples. 6

(6)

5. (a) The demand function for a product is given by

$$Q = 50 - 3P$$

- (i) Find the derivative of the demand function with respect to price P .
(ii) Calculate the price elasticity of demand when $P = 5$.
(iii) Find the marginal revenue of the firm selling this product for $P = 5$.
3+3+5=11

Or

- (b) The total cost function for a firm is given by

$$TC = 200 + 10Q + 0.5Q^2$$

- (i) Find the marginal cost (MC) function.
(ii) Find the average cost (AC) function.
(iii) Calculate the output level Q at which the marginal cost equals the average cost.
3+3+5=11

(7)

6. (a) (i) Evaluate :

$$\int \frac{x^2 + 1}{x^2 - 5x + 6} dx$$

- (ii) Discuss the properties of definite integrals.

Or

- (b) The demand and supply functions for a product are given by

$$Q_d = 100 - 5P$$

$$Q_s = 20 + 2P$$

- (i) Find the equilibrium price and quantity by setting $Q_d = Q_s$.
(ii) Calculate the consumer surplus and producer surplus at the equilibrium price using definite integrals.
5+6=11

7. (a) (i) Solve the following first-order linear differential equation :

$$\frac{dy}{dx} + 3y = 6$$

- (ii) If $AR = MR$ (i.e., $\frac{R}{q} = \frac{dR}{dq}$), then show that AR is constant.

Or

- (b) The rate of change of a firm's capital $K(t)$ with respect to time is proportional to the difference between the maximum capital K_{\max} and the current capital. This relationship is given by the differential equation

$$\frac{dK}{dt} = 0.1(K_{\max} - K)$$

- (i) Solve the differential equation to find the expression for $K(t)$, assuming $K(0) = 0$.

- (ii) If $K_{\max} = 100$, determine the capital after 10 years.

$$6+5=11$$
