1 SEM TDC ECOH (CBCS) C 2

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(March)

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. Choose the correct option : 1×8=8

(a) $A \cap A' = ?$

   (i) Ω (ii) ϕ

   (iii) A (iv) A'

(b) $B - A = ?$

   (i) $A \cup B$ (ii) $A \cap B$

   (iii) $A \cap B'$ (iv) $B \cap A'$

(2)

(c) If $n = 1$, the polynomial function $f(X) = a_0 + a_1 X + a_2 X^2 + \cdots + a_n X^n$ will take which one of the following forms?

   (i) Constant function

   (ii) Linear function

   (iii) Quadratic function

   (iv) Cubic function

(d) If the AR function is $AR = 10 - 0 \cdot 5Q$, the MR function is

   (i) $MR = -0 \cdot 5Q$

   (ii) $MR = 10 - Q$

   (iii) $MR = 10Q - 0 \cdot 5Q^2$

   (iv) None of the above

(e) The function

$$f(X) = \frac{X^2 + 3X - 4}{X - 1}$$

is not continuous at

   (i) 1

   (ii) 2

   (iii) 3

   (iv) None of the above

(f) $\dfrac{d}{dx}(2x+1)^8 = ?$

   (i) $8(2x+1)^7$

   (ii) $16(2x+1)^7$

   (iii) $(2x+1)^7$

   (iv) None of the above

(g) If the total cost function is

$$C = \dfrac{Q^2}{25} + 4Q + 50$$

identify the marginal cost function.

   (i) $MC = \dfrac{Q}{25}$

   (ii) $MC = \dfrac{2Q}{25} + 4$

   (iii) $MC = \dfrac{Q}{50} + 4$

   (iv) $MC = \dfrac{2Q}{25} + 4Q$

(h) $\int \dfrac{1}{6x^2}\, dx = ?$

   (i) $\dfrac{1}{6x} + c$ (ii) $-\dfrac{1}{6x} + c$

   (iii) $\dfrac{1}{12x} + c$ (iv) $12x^{-2}$

2. Answer any *four* of the following :   4×4=16

(a) Write short notes on constant and quadratic functions.

(b) Write on the mathematical derivation of the relationship between AC and MC.

(c) If the demand function is $P = (6-2x)^2$, for what value of x, the elasticity of demand will be unity?

(d) Evaluate :

$$\int \log x\, dx$$

(e) If the marginal propensity to save function $mps = 0\cdot6 + 0\cdot4Y^{-2}$, find the consumption function at income $(Y) = 200$, when $C = 0$.

3. (a) (i) Given the universal set

      Ω = all digits = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}

      Find the complement of the set (A')

      A = {0, 1, 3, 5, 7, 9}   2

  (ii) If A = {0, 2, 3, 4} and B = {3, 4, 5, 6}, find $A - B$ and $B - A$. Show the above difference of sets with the help of Venn diagram.   2+2+2=6

  (iii) Define the following with examples :   1×3=3

      Equal set; Equivalent set; Power set.

Or

(b)   (i) Draw the graph of $y = 2x^2 - x - 2$.   4

      (ii) A function is given by

$$f(x) = \frac{x^2 - x - 6}{x^2 - 9}$$

      Examine whether the function is continuous at $x = 3$ or not.   4

   (iii) Define the following with examples :   1×3=3

      Rational numbers; Real numbers; Complex numbers.

4. (a)   (i) If $A = \{1, 4, 5, 7\}$ and $B = \{4, 8, 9, 10\}$, then find $(A \cup B) \setminus (A \cap B)$.   3

      (ii) If $A = \{2, 3\}$ and $B = \{4, 5, 6\}$, then find $A \times B$ and $B \times A$.   4

     (iii) In a town, 60% of people speak Assamese, 50% speak Hindi, 45% speak English, 25% speak Assamese and Hindi, 30% speak Hindi and English, 12% speak English and Assamese and 10% speak all the three languages. What percentage of people does not speak at least one of the three languages?   4

Or

(b)   (i) State and prove De Morgan's rule of set operations.   2+6=8

      (ii) Evaluate :   3

$$\lim_{x \to 2} \frac{\sqrt{2-x} - \sqrt{2+x}}{x}$$

5. (a)   (i) Find $\frac{dy}{dx}$ of the following function :   3

$$6x^3 + 4x^2 y = 5x$$

      (ii) Given the production function $Q = 4L^{1/2}$ and price equation $P = 100 - 2Q$, find the marginal revenue product of labour (MRPL) at $L = 25$.   4

     (iii) The utility function of a consumer is given by $U = f(Q) = \alpha \, Q^{\beta}$, $\alpha > 0$; $0 < \beta < 1$. Does the above utility function exhibit the diminishing marginal utility?   4

Or

(b)   (i) The total cost function and the demand function of a firm are given as—

$$C = \tfrac{1}{3} Q^3 - 7Q^2 + 11Q + 50 \text{ and } Q = 100 - P$$

      Find the level of output at which the profit is maximum and the amount of profit at that level of output.   6+2=8

(7)

(ii) For a function $Y = f(x)$, state the conditions for maximization and minimization.   3

6. *(a)*   (i) Evaluate :   3

$$\int \frac{\ln x}{x}\, dx$$

(ii) If the marginal cost function is $MC = 20 + 2Q - 3Q^2$ and the total fixed cost (C) is 110, then find the average cost function.   3

(iii) The marginal revenue function of a firm is given by $MR = 40 - 2Q$. Find the price of product of the firm at $Q = 4$. What will be the change in price if the quantity of the product is increased to 10 units?   4+2=6

Or

(b)   (i) Given $MPC = 0 \cdot 5 \dfrac{1}{\sqrt{y}}$, derive the consumption function under the condition that aggregate consumption is 60 when income (y) is zero.   6

(ii) If the demand function is $Q = \sqrt{42 - \frac{3}{4} P}$, find the consumer's surplus when the market price $(P_0) = 8$.   6

(8)

7. *(a)*   (i) Solve the differential equation

$$2\frac{dy}{dx} + 4y = 12$$

with the initial condition $y(0) = 5$.   4

(ii) Given the demand and supply functions for a commodity

$$Q_d = 120 - 2P + 5\frac{dP}{dt} \text{ kg per week}$$

$$Q_s = -30 + 3P + 50\frac{dP}{dt} \text{ kg per week}$$

Find the time path of price for dynamic stability if the initial price is ₹ 40 per kg.   7

Or

(b)   (i) Write the homogeneous form of a standard linear differential equation.   1

(ii) Solve the differential equation :   3

$$\frac{dy}{dx} = 5$$

(iii) Analyze the following market model for stability :   7

$$Q_d = 14 - 3P$$
$$Q_s = -10 + 2P$$
$$\frac{dP}{dt} = 4(Q_d - Q_s)$$

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