TDC (CBCS) Odd Semester Exam., 2020
held in March, 2021

ECONOMICS

(1st Semester)

Course No. : ECOHCC-102T

(Mathematical Methods in Economics—I)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

1. Answer any *ten* of the following questions : 2×10=20

(a) Define continuity of a function.

(b) Mention the truth table for $p \wedge q$.

(c) Express $0 \cdot 111 \cdots$ in the form of fraction.

(d) If $A = \{-1, 1\}$, then find $A \times A$.

(e) Define polynomial function with example.

(f) Write the first four terms of the sequence

$$a_n = n\frac{n^2+5}{4}$$

(g) What is the difference between a series and a sequence?

(h) Draw the graph of the function $y = 2x^2$ for the range $-2 < x < 2$.

(i) Find the first four derivatives for the function $y = 9x^3 - 9$.

(j) Obtain the differential dy when

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

(k) Given the total cost function

$$C = 15q - 6q^2 + q^3$$

derive the equation of MC curves.

(l) Write single-variable optimization conditions for $y = f(x)$.

(m) Why are convex functions important?

(n) Mention any two properties of a convex function.

(o) What is the local optimal solution?

(p) Find the value of x at which the function

$$f(x) = (x-4)^2$$

reaches an extremum. Describe the nature of this extremum.

(q) Define indefinite integrals.

(r) Mention any two rules of operation for definite integral.

(s) Evaluate :

$$\int ae^{4x}dx$$

(t) Given the marginal propensity to consume

$$C'(y) = 0 \cdot 7 + 0 \cdot 1y^2$$

find the consumption function $C(y)$.

SECTION—B

Answer *any* **five** questions

2. (a) If $A = \{7, 8, 9\}$, $B = \{0, 1, 8, 9\}$ and $C = \{4, 3, 7, 9\}$, then find—

(i) $A \times (B \cap C)$;

(ii) $(A \times B) \cap (A \times C)$;

(iii) $A \times (B \cup C)$;

(iv) $(A \times B) \cup (A \times C)$;

(v) $(A \cup B) - C$;

(vi) $(A \cup B) - C'$. 6

(b) A market research group conducted a survey of 1000 consumers and reported that 720 consumers like product *A* and 450 consumers like product *B*. What is the least number that must have liked both products? 4

3. (a) Evaluate : 3+3=6

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

(ii) $\lim_{x \to \infty} \frac{5+6x}{x^2}$

(b) Prove that the following function is continuous at $x=4$: 4

$$f(x) = 6+5x+4x^2+3x^3$$

4. (a) Solve : 6

$$\log(x) + \log(x+3) = \log(20-5x)$$

(b) Show that $f(x) = 3x+2$ and $g(x) = \frac{x-2}{3}$ are inverses of each other. 4

5. (a) Find the sum of the sequence

7, 77, 777, 7777, ··· to n terms 5

(b) Does the series $\sum_{n=1}^{\infty} \frac{n^3}{n^5+3}$ converge? Explain. 5

6. (a) Find $\frac{dy}{dx}$, when—

(i) $y = e^x x^n$;

(ii) $y = \log(ax^2+bx+c)$. 3+3=6

(b) The demand function is given by

$$q = 7-2p$$

Calculate e_d, when $p=1$ and $p=2$. 4

7. (a) Obtain the extrema for the function

$$C = q^3+2q^2-4q+4$$ 5

(b) The total cost (C) and total revenue (R) functions of a firm are given by

$$C = 5q^2+10 \text{ and } R = -2q^2+6q$$

Find the output level (q) at which profit of the firm is maximum. 5

8. (a) Discuss the geometric properties of a linear function. 4

(b) Given the price equation, $P = 100-2Q$, where Q is quantity demanded. Find—

(i) the marginal revenue (MR);

(ii) the price elasticity of demand, when $Q=10$;

(iii) the nature of the commodity. 6

9. *(a)* Explain local and global maxima with suitable graphical representation. 5

(b) Prove that a cubic function must have a point of inflexion. 5

10. Find the integral of the following : 3+3+4=10

(i) $\int (x+a)^3 dx$

(ii) $\int \frac{(a^x + b^x)^2}{a^x \cdot b^x} dx$

(iii) $\int_0^1 x(1-x)^n dx$

11. *(a)* The supply function of a firm is given by

$$p = q^2 + 2q + 1$$

Given that the equilibrium is reached at $q = 3$. Find producer surplus at the equilibrium quantity. 4

(b) Obtain the solution of the equation

$$y_{t+1} - 2y_t = 4$$

Given that $y_t = 4$, when $t = 0$. 6

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