TDC Odd Semester Exam., 2020
held in July, 2021

ECONOMICS

(Honours)

(1st Semester)

Course No. : ECOH–103

Full Marks : 50
Pass Marks : 17

Time : 2 hours

The figures in the margin indicate full marks for the questions

Arts students will answer Option—A and Science students will answer Option—B

OPTION—A

(For Arts Students)

Course No. : ECOH–103 (A)

(Mathematics for Economics—I)

Answer **five** questions, selecting **one** from each Unit

UNIT—I

1. *(a)* Given $A=\{2, 5, 7, 9\}$, $B=\{5, 6, 7\}$ and $C=\{2, 7, 9\}$. Answer the following : 1×5=5

(i) Find power set of B.

(ii) Find all subsets of A.

(iii) Is $A \cap (B \cup C) = (A \cap B) \cup C$?

(iv) Find $B \times C$.

(v) Find $(A - B) \cup (B - A)$.

(b) If $X=\{a, b\}$ and $Y=\{x, y\}$, prove that

$$X \cdot Y \neq Y \cdot X$$ 3

(c) Show $(A \cup B)$ and $(A \cup B)'$ with the help of Venn diagram, where

$A=\{1, 2, 3, 4, 5\}$
$B=\{4, 5, 6, 7\}$
$U=\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$ 2

2. *(a)* Define function. Distinguish between domain and range of a function with example. 4

(b) In a class of 25 students of Economics and Statistics, 12 students have taken Economics. Out of these, 8 have taken Economics but not Statistics. Find the number of students who have taken Economics and Statistics and those who have taken Statistics but not Economics. 4

(c) Let $A = \{1, 2, 3\}$, $B = \{3, 4\}$ and $C = \{4, 5, 6\}$. Find the following : 2

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

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

UNIT—II

3. (a) Show that

$$\log_5 \sqrt{5\sqrt{5\sqrt{5 \cdots \infty}}} = 1$$ 2

(b) If $5\ {}^4P_r = 6\ {}^5P_{r-1}$, then find r. 2

(c) Prove that

$$\lim_{x \to 0} \frac{e^x - 1}{x} = 1$$ 3

(d) Find $\frac{dy}{dx}$, when $y = \log(5 - 2x + 3x^2)$. 3

4. (a) What is meant by continuity of a function? 2

(b) Find $\frac{dy}{dx}$ of the following functions : 2½×2=5

(i) $y = (2x^2 + 3)e^{-3x^2}$

(ii) $y = 4a^2 + 3ax^2 + x^3$

(c) Find out the maximum and minimum values of the following function : 3

$$y = x^3 - 6x^2 + 9x$$

UNIT—III

5. Evaluate the following : 3+3+4=10

(i) $\int (5x + 7)^8\, dx$

(ii) $\int \frac{1}{\sqrt{x+2}}\, dx$

(iii) $\int_{-1}^{3} (2x^2 + 5)\, dx$

6. Evaluate the following : 3+3+4=10

(i) $\int x^3 e^x\, dx$

(ii) $\int (2ax + b)(ax^2 + bx)^7\, dx$

(iii) $\int_1^2 (2x^3 - 1)^2 (6x^2)\, dx$

UNIT—IV

7. (a) Find the value of

$$\begin{vmatrix} b+c & a & a \\ b & c+a & b \\ c & c & a+b \end{vmatrix}$$ 3

(b) Find the inversion of the following matrix : 4

$$A = \begin{bmatrix} 5 & 1 & 1 \\ 0 & 2 & 2 \\ 3 & 1 & 4 \end{bmatrix}$$

(c) Find the rank of the following matrix : 3

$$A = \begin{bmatrix} 6 & 3 & 5 \\ -10 & 2 & 8 \\ 5 & 2 & 3 \end{bmatrix}$$

8. *(a)* If A and B both are square matrices and of the same order as follows

$$A = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 2 & 2 \end{bmatrix} \text{ and } B = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$$

then show that $AB \neq BA$. 3

(b) If

$$A = \begin{bmatrix} 1 & -1 \\ 2 & -1 \end{bmatrix}, B = \begin{bmatrix} a & 1 \\ b & -1 \end{bmatrix} \text{ and } (A+B)^2 = A^2 + B^2$$

find a and b. 4

(c) If

$$A = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}, B = \begin{bmatrix} 3 & 1 \\ 2 & 5 \end{bmatrix} \text{ and } C = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

then show that $(ABC)' = C'B'A'$. 3

UNIT—V

9. *(a)* Solve the following system of equations by matrix inversion : 5

$$\begin{aligned} 5x + y + z &= 1 \\ 2x + 2z + 2 &= 0 \\ 3x + y + 4z &= 4 \end{aligned}$$

(b) Use Cramer's rule to solve the following equations : 5

$$\begin{aligned} p_1 + p_2 + p_3 &= 6 \\ p_1 + 2p_2 + p_3 &= 8 \\ 2p_1 + p_2 + 3p_3 &= 13 \end{aligned}$$

10. *(a)* For what value of k, do equations

$$\begin{aligned} 2x - 3y + 7z &= 0 \\ 5x + 4y - 2z &= -3 \\ x - 13y + kz &= 9 \end{aligned}$$

have not a unique solution? 4

(b) Using Cramer's rule, solve the following market model : 6

$$\begin{aligned} Q_d &= 10 - 0{\cdot}4p \\ Q_s &= -3 + 0{\cdot}6p \\ Q_d &= Q_s \end{aligned}$$

OPTION—B

(For Science Students)

Course No. : ECOH–103 (B)

(Elements of Mathematical Economics—I)

Answer **five** questions, selecting **one** from each Unit

UNIT—I

1. *(a)* Define symmetric matrix. Give one example of symmetric matrix. 1+1=2

(b) Find the inverse of the following matrix : 5

$$A = \begin{bmatrix} 1 & 4 & 3 \\ 4 & 2 & 1 \\ 3 & 2 & 2 \end{bmatrix}$$

(c) Solve the following equations system by using Cramer's rule : 3

$$3x_1 + 2x_2 = 13$$
$$9x_1 - 3x_2 = 21$$

2. *(a)* Given the marginal cost function

$$\text{MC} = Q^2 - 4Q + 3$$

Find the level of output Q at which the average variable cost (AVC) will be minimum. 5

(b) Integrate : 2½×2=5

(i) $\int_0^1 x^3 \sqrt{1+3x^4}\, dx$

(ii) $\int_1^3 5xe^{x+2} dx$

UNIT—II

3. *(a)* What is Engel curve? Illustrate graphically the deviation of Engel curve. 2+5=7

(b) Suppose weekly income (m) of an individual increases from ₹ 5,000 to ₹ 6,000 and his weekly demand for petrol (Q) increases from 20 litres to 25 litres. Estimate income elasticity of demand. 3

4. Given the demand and supply functions :

$$Q_d = a - bP + \frac{\delta dP}{dt} (a,\ b > 0)$$

$$Q_s = c + dP (c,\ d > 0)$$

Obtain the time path of price P_t assuming that the rate of change of price over time is directly proportional to excess demand. Also indicate the restriction on the value of δ to ensure dynamic stability. 8+2=10

UNIT—III

5. *(a)* Suppose a short-run total cost function of output Q is

$$C = Q^3 - 3Q^2 + 15Q + 27$$

Find average cost (AC) and marginal cost (MC). 5

(b) Show that Cobb-Douglas production function exhibits constant returns to scale. 5

6. *(a)* State and illustrate the relationship between total product (TP), average product (AP) and marginal product (MP) with the help of a suitable diagram. 4

(b) Derive the expression of price elasticity of demand to show the relationship between AR, MR and elasticity. 6

UNIT—IV

7. *(a)* How would you determine the short-term equilibrium of a monopoly firm? 5

(b) Let the demand function of a firm under monopolistic competition is given by

$$P = 118 - 3Q + 4\sqrt{A}$$

where P is price, Q is quantity and A is advertisement expenditure.

If the total cost function is given by

$$C = 4Q^2 + 10Q + A$$

find the values of A and P that maximize the profit of the firm. 5

8. The total revenue R and total cost C functions of a perfectively competitive firm is given by

$$R = 26Q - 3Q^2$$
$$C = 2Q^2 - 4Q + 10$$

where Q stands for output produced. Find—

(a) profit maximizing output and corresponding profit, profit maximizing price and total revenue at that level of output;

(b) revenue maximizing output and corresponding profit, revenue maximizing price and total revenue at that level of output;

(c) whether or not the minimum profit constraint of $\pi \geq 30$ will prevent the attainment of the revenue maximizing output. 4+4+2=10

UNIT—V

9. What is Gini coefficient? State the relative merits and demerits and three limitations of Gini's coefficient as a measure of income inequality. 3+2+2+3=10

10. Write short notes on the following : 5×2=10

(a) Lorenz curve

(b) Pareto's law of income distribution

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