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**47C–N (MMEA)**

**[ 21 HRKP1S(N)–22A ]**

**MA 1st Semester (New) Exam., 2021 (W)**

# ECONOMICS

**( Mathematical Methods for Economic Analysis )**

[ PGEC S1 03 ]

*Full Marks* : 70/80

*Time* : 3 hours

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

**Note :** *(a)* Learners admitted in 2020 and 2021 are to answer *70* Marks (Question Nos. **1** to **4**).

*(b)* Learners admitted in and before 2019 are to answer all the questions (Question Nos. **1** to **5**), i.e., for *80* Marks.

**1.** Answer any *five* questions : 2×5=10

*(a)* Mention the conditions for minimisation in case of two explanatory variables.

*(b)* Given $MC = 5 + 3Q^2$. Find the total cost if the fixed cost is 50.

*(c)* If $y = \log(5 - 2x + 3x^2)$, then find $\frac{dy}{dx}$.

*(d)* Distinguish between an indefinite integral and a definite integral.

*(e)* Find the rank of the following matrix :

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

*(f)* Given the total cost function

$$TC = 1000 + 100Q - 10Q^2 + \frac{1}{3}Q^3$$

Find the slope of MC function.

**2.** Answer any *four* questions : 3×4=12

*(a)* Given the supply function $Q = 100 + 7P$. Find the elasticity of supply when $P = 2$.

*(b)* Given $Y = 2x_1^2 + x_1x_2 + 3x_2^2$. Show that $f_{12} = f_{21}$.

*(c)* Find the relative extrema of the function $Y = 20X - 2X^2$.

*(d)* Explain the notions of global maxima and local minima with the help of suitable diagrams.

*(e)* If $A = \begin{bmatrix} 2 & 1 \\ 4 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 4 \\ 2 & 6 \end{bmatrix}$, then show that $(A + B)' = A' + B'$.

**3.** Answer any *four* questions : 6×4=24

*(a)* The average revenue (AR) and total cost (TC) functions are AR = 4 and $TC = Q^2 - 6Q + 10$. Find *(i)* profit maximising output and *(ii)* maximum profit. 4+2

*(b)* The annual growth rate of population of India is 1·77 percent. The population in 2011 is 1210854977. What will be the population in 2021?

*(c)* If

$$Y = C + I + G$$
$$C = \alpha + \beta(Y - T) \quad (\alpha > 0;\ 0 < \beta < 1)$$
$$T = \gamma + \delta Y \quad (\gamma > 0;\ 0 < \delta < 1)$$

then find $\bar{Y}$. Also show that $\frac{\delta \bar{Y}}{\delta I} > 0$.

*(d)* Find the producer's surplus for the following supply function :

$$Q = -5 + \frac{4}{5}P, \text{ where price} = 15$$

*(e)* Given the demand function of a commodity $Q_1$ as $Q_1 = 50 - 2p_1 + 3p_2 + 0 \cdot 2Y$. Find *(i)* own price elasticity of demand, *(ii)* cross price elasticity of demand and *(iii)* income price elasticity of demand when $Y = 500$ and $p_1 = 2$ and $p_2 = 5$. 2+2+2

**4.** Answer any *three* questions : 8×3=24

*(a)* Establish the relationship between AC and MC with the help of quotient rule of differentiation.

*(b)* A monopolist firm produces two products $Q_1$ and $Q_2$ jointly. The total cost function is given by

$$TC = Q_1^2 + \frac{1}{2}Q_2^2 + Q_1Q_2 + 10$$

His average revenue functions are given by

$$P_1 = 40 - 2Q_1$$
$$P_2 = 34 - 3Q_2$$

Find profit maximising output levels $Q_1$ and $Q_2$.

*(c)* Show that indifference curve slopes downward and convex to the origin with the help of differentiation.

*(d)* Given the market model :

$$D = 50 - 2P$$
$$S = -10 + 30$$
$$D = S$$

Find the equilibrium price and output using matrix algebra.

**The following question is *NOT* for the learners admitted in 2020 and 2021 batches :**

**5.** Answer any *one* question : 10

*(a)* A consumer has the utility function $U = 18xy + 9y$ and his budget constraint is given by $6x + 3y = 15$. What will the optimum combination of $x$ and $y$ that will maximise the utility of the consumer subject to satisfaction of budget constraint.

*(b)* The demand functions of a monopoly in two different markets are given by

$$P_1 = 180 - 15Q_1$$
$$P_2 = 280 - 20Q_2$$

and total cost function is $C = 150 + 120Q$ where $Q = Q_1 + Q_2$. Given these what will be

*(i)* profit maximising outputs of $Q_1$ and $Q_2$;

*(ii)* equilibrium prices in both markets, i.e., $P_1$ and $P_2$

*(iii)* maximum profit?

Also show that price will be lower in the market where elasticity of demand is higher. 2+2+2+4=10

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