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ECONOMICS

(Major)

Paper : 4.1

(**Mathematical Applications in Economics**)

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks
for the questions

1. Answer the following as directed : $1 \times 10 = 10$

   (a) Determine the marginal propensity to save (MPS) from the consumption function $C = 50 + 0 \cdot 6Y$, where C is consumption and Y is income.

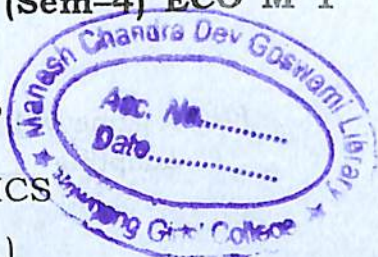   *(b)* Given the total cost function

   $$TC = 1000 + 2Q - 5Q^2$$

   Find the average fixed cost.

   (c) Both input-output and linear programming belong to the family of _____ models.

   (quadratic/linear/exponential)

   (*Choose the correct option*)

(d) A game with no saddle point is solved by adopting ____ strategies.

(mixed/pure/optimal)

(*Choose the correct option*)

(e) Given the marginal cost function $MC = 4 - 0.4Q$ and total fixed cost being 100. Find total cost when output $Q = 10$.

(f) What does the word 'person' imply in a two-person zero-sum game?

(g) What is saddle point?

(h) What is feasible region?

(i) Linear programming problems are always stated in linear relations.

(Write True or False)

(j) Given the demand function

$$D = \frac{a}{P}$$

where D is demand, P is price and a is constant. Obtain the price elasticity of demand.

2. Answer the following questions : 2×5=10

(a) Find the equilibrium income (Y) and consumption (C) from the following national income model :

$$Y = C + I_0 + G_0$$
$$C = 150 + 0.7Y$$
$$I_0 = 200$$
$$G_0 = 150$$

where Y, C, I_0 and G_0 denote national income, consumption, investment and government expenditure.

(b) The production function of a firm is given by

$$Q = 3L^{1/4} K^{1/2}$$

Calculate the level of output (Q) when it employs 81 units of labour (L) and 49 units of capital (K).

(c) What is Nash equilibrium?

(d) In a college canteen, four items are sold. Vector $Q = \{q_1\ q_2\ q_3\ q_4\}$ represents quantities sold of the four items and vector $P = \{P_1\ P_2\ P_3\ P_4\}$ represents the respective prices of the items. Find QP' and mention what the results represent.

(e) Given the total cost function

$$TC = Q^3 - 6Q^2 + 2Q + 50$$

Obtain the output at which the average variable cost is minimum.

3. Answer any *four* of the following questions :

5×4=20

(a) By using product rule of differentiation, prove that

$$MR = AR\left(1 - \frac{1}{ed}\right)$$

where MR, AR and ed represent marginal revenue, average revenue and price elasticity of demand respectively.

(b) For the total cost function

$$TC = \frac{3}{Q^2} - 10Q + 20$$

Find the average cost (AC) and marginal cost (MC) functions.

(c) If $I(t) = 2$ crores of rupees per year, what will be the capital formation in the period of 4 years and also in the 4th year.

(Continued)

(d) In the market model

$$D = a - bP(a, \ b > 0)$$
$$S = -c + dP(c, \ d > 0)$$
$$D = S$$

where D, S and P denote demand, supply and price respectively. Analyze the effect of increase in the slope of the demand curve on equilibrium price.

(e) Formulate a linear programming problem for maximization of a function.

(f) Given the marginal propensity to consume

$$MPC = C'(Y) = 0 \cdot 8 + 0 \cdot 1 Y^{-1/2}$$

and the information that $C = Y$, when $Y = 100$. Find the consumption function $C(Y)$.

4. Answer the following questions :

10×4=40

(a) Given the demand function $P = 40 - 2Q^2$. Find the consumer's surplus if (i) economic goods $Q = \frac{5}{2}$ and (ii) free goods $P = 0$.

5+5=10

Or

Derive mathematically Domar's model of growth.

10

(Turn Over)

(b) The total cost function of a firm is given by $TC = Q^3 - 12Q^2 + 36Q + 8$, where Q is quantity of output.

(i) What is the total fixed cost of production?

(ii) Derive the average cost function.

(iii) Derive the marginal cost function.

(iv) Find the output at which the marginal cost is minimum.

$$1+2+2+5=10$$

Or

A firm's average revenue is given by $P = 105 - 2Q$ and total cost of production by $TC = 200 + 5Q + 3Q^2$, where Q is quantity of output.

(i) Write out the total revenue function in terms of Q.

(ii) Formulate the profit function in terms of Q.

(iii) Find the profit maximizing output.

(iv) What is the maximum profit?

$$1+1+6+2=10$$

(c) Given the competitive market model

$$D = 20 - 3P$$
$$S = -10 + 2P$$
$$D = S$$

If the government imposes sales tax of rate t per unit of output, find the rate of tax (t) which will maximize the tax revenue. 10

Or

A monopolist produces two products Q_1 and Q_2 jointly. His total cost function is given by

$$TC = 2Q_1^2 + \frac{1}{2}Q_2^2 + Q_1Q_2 + 25$$

and his average revenue functions are given by

$$P_1 = 32 - 3Q_1 \text{ and } P_2 = 13 - 2d_2$$

Find the profit maximizing output level of Q_1 and Q_2, and also the maximum profit. 10

(d) Solve the following linear programming problem by graphical method : 10

Maximize $\pi = 40x_1 + 30x_2$

subject to

$$x_1 \leq 16$$
$$x_2 \leq 8$$
$$x_1 + x_2 \leq 24$$
$$x_1, x_2 \geq 0$$

(8)

(i) Find the saddle point and value of the game for the following games :

		Player B		
		B_1	B_2	B_3
	A_1	15	0	-2
Player A	A_2	0	-15	-1
	A_3	1	2	0

(ii) Define the following :

(1) Two-person zero-sum game

(2) Pay-off matrix   5+5=10

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