3 (Sem–4) ECO M 1

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ECONOMICS

(Major)

Paper : 4·1

(Mathematical Application in Economics)

Full Marks : 80

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer the following questions as directed :

$$1 \times 10 = 10$$

(a) Total cost $(C) = $ —— $ + $ total variable cost (VC).

(Fill in the blank)

(b) If $C = 100 + 2Q - 5Q^2$, where C is total cost and Q is output, what is the total fixed cost?

(c) State Euler's Theorem.

[P.T.O.

(d) Given the Cobb-Douglas production function $Q = AL^\beta K^\alpha$. What do α and β indicate?

(e) In a two-person zero-sum game, a saddle point always exists.

<div align="center">(Write True or False)</div>

(f) Obtain the total revenue function from the following marginal revenue function :

$$MR = 100 - 0 \cdot 5Q$$

where Q denotes quantity of output.

(g) Determine the marginal propensity to save from the consumption function

$$C(Y) = 50 + 0 \cdot 8Y^{\frac{1}{2}}$$

where C is consumption and Y is income.

(h) What is feasible solution?

(i) Who has written *The Theory of Games and Economic Behaviour* ?

(j) Define elasticity in terms of AR and MR.

2. Answer the following questions : $2 \times 5 = 10$

(a) Given the total cost function,

$$C = 2Q^2 + 5Q + 18$$

where Q is output level, find the output at which average cost is minimum.

(b) If the rate of investment is given by

$$I(t) = 3t\frac{1}{2}$$

find the time path of capital formation when $k(0) = 50$.

(c) Define pure strategy and mixed strategy.

(d) Find out equilibrium national income $(\overline{Y})$ and consumption $(\overline{C})$ from the following national income model :

$$Y = C + I$$
$$C = 50 + 0 \cdot 8Y$$
$$I = 100$$

where Y, C and I denote national income, consumption and investment.

(e) If $Q = \sqrt{2 + p}$ is a supply function, find the elasticity of supply with respect to price at $P = 2$.

3. Answer any *four* of the following questions : $5 \times 4 = 20$

(a) Show the relationship between marginal cost (MC) and average cost (AC) using the product rule of differentiation.

(b) Given two goods market models :

Market—I	Market—II
$D_1 = S_1$	$D_2 = S_2$
$D_1 = 25 - 2P_1 + P_2$	$D_2 = 20 + 2P_1 - 2P_2$
$S_1 = -5 + 4P_1$	$S_2 = -10 + 5P_2$

Obtain equilibrium prices P_1 and P_2.

(c) Give the general formulation of linear programming problem.

(d) In a perfectly competitive market, the total revenue and total cost of a firm are given by

$$TR = 12Q \text{ and } TC = 2 + 4Q + Q^2$$

Obtain profit maximizing output and total profit.

(e) Given the demand function, $P = 40 - 2Q^2$, find the consumer's surplus, if free goods, $P = 0$.

(f) The total cost function of a firm is given by

$$C = Q^3 - 12Q^2 + 36Q + 8$$

where C is total cost and Q is quantity of output. What is total fixed cost? Also, derive the average cost function and marginal cost function.

4. Answer the following questions : $10 \times 4 = 40$

(a) A firm has the total cost function $C = 7Q^2 + 5Q + 120$ and demand function $P = 180 - 0.5Q$. If a subsidy ₹ 5 per unit of output is paid by the government, find—

(i) the profit maximizing output and price;

(ii) the impact of subsidy on equilibrium output and price.

Or

Discuss the effect of increase in (i) specific sales tax and (ii) lump-sum tax on the output of a monopolist.

(b) Given the market model

$$D = a - bp, \qquad (a, b > 0)$$
$$S = -c + dp, \qquad (c, d > 0)$$
$$D = S = Q$$

where Q, D, S, P are quantity, demand, supply and price respectively and a, b, c, d are parameters.

(i) Find equilibrium price $(\bar{P})$ and equilibrium quantity $(\bar{Q})$.

(ii) Examine the effect of increase in the intercept and slope of demand curve on the equilibrium price and quantity.

Or

The sales revenue function of a firm is given by

$$R = 18L + 24M + 10ML - 5M^2 - 8L^2$$

where R, L and M denote revenue, labour and machine respectively. Determine the amount of machines and labour needed to maximize revenue of the firm.

(c) A monopolist discriminates prices in two markets of its product and his

average revenue (AR) and total cost (C) functions are given by

$$AR_1 = 60 - 4Q_1$$
$$AR_2 = 42 - 3Q_2$$

where Q_1 and Q_2 are the outputs of first and second markets and the total cost function is given by

$$C = 50 + 12Q, \text{ where } Q = Q_1 + Q_2$$

Find profit maximizing output, prices and maximum profit.

Or

(i) Define the term 'player' in the game theory. Solve the following game where the pay-off matrix of firm A is given below :

		Firm B	
Firm A	B_1	B_2	B_3
A_1	1	3	1
A_2	0	−4	−3
A_3	1	5	−1

(ii) In Domar growth model, the equilibrium condition requires that capacity creation should be equal to income generation and is given by

$$\frac{dI}{dt}\frac{1}{S} = p\frac{dK}{dt}$$

Find out the time path of investment.

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

Maximize $\pi = 4x_1 + 3x_2$

subject to

$$x_1 + x_2 \le 4$$
$$2x_1 + x_2 \le 6$$

and $x_1 \ge 0$ and $x_2 \ge 0$

Or

Write short notes on 'two-person zero-sum game' and 'non-zero-sum games'.

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