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P.O.-Bijni, Dist.-Chirang
(B.T.A.D) Assam

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) :

1×10=10

- (a) Determine the marginal propensity to save from the consumption function

$$C(Y) = 50 + 0.6Y$$

where C is consumption and Y is income.

- (b) A firm's marginal cost function is given by

$$MC = 100 - 10x + 0.1x^2$$

Obtain the total cost function of the firm under assumption that its fixed cost is 500.

- (c) Neither a lump sum, nor a profit tax will affect the optimum price-quantity combination for a monopolist.

(Write True or False)

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- (d) Given the Cobb-Douglas production function

$$Q = AK^{\alpha}L^{\beta}$$

What do α and β indicate?

- (e) A firm has the following total revenue (TR) and total cost (TC) functions :

$$TR = 100Q - 4Q^2$$

$$TC = 50 + 20Q$$

Find the profit function, if a subsidy is paid 3 per unit.

- (f) Rate of capital formation at time t = rate of net investment at time t .

(Write True or False)

- (g) The Domar growth model is based on the proposition that increase in income and increase in productive capacity should be equal to maintain steady and progressive growth of equilibrium.

(Write True or False)

- (h) What are the components of linear programming?

- (i) In game theory, when is a game said to be fair?

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

(Write True or False)

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

(a) Prove that as in the case of perfect competition, a firm's AR curve will coincide with its MR, when AR is constant.

(b) Find the elasticity of demand of the demand function

$$D = 24 - 4P, \text{ when } P = 3$$

where D and P represent demand and price.

(c) Find the equilibrium income (Y) from the national income model

$$Y = C + I_0 + G_0$$

$$C = 100 + 0.8Y$$

$$I_0 = 500$$

$$G_0 = 150$$

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

(d) Define primal and dual.

(e) If the net investment flow is given by

$$I(t) = 3t^{1/3}$$

what will be the capital formation in the time period of 5 years?

3. Answer any four of the following : 5×4=20

- (a) The marginal cost function of a firm is given by

$$MC = 6Q^2 - 24Q + 5$$

where Q is output. Find the level of output at which the average variable cost is minimum.

- (b) If the demand and supply laws are given by

$$P_d = 3x^2 - 20x + 5$$

$$P_s = 15 + 9x$$

find producer's surplus.

- (c) Given the production function

$$Q = 10K^{1/3}L^{2/3}$$

where Q , K and L denote output, capital and labour. Show that the total output will be exhausted, if factors K and L are paid according to their marginal productivity.

- (d) A firm has the following total cost and demand functions :

$$C = \frac{1}{3}Q^3 - 7Q^2 + 111Q + 50$$

$$Q = 100 - P$$

Find the profit maximizing level of output and maximum profit.

- (e) A monopolist uses one input x , which is purchased at a fixed price 5 to produce its output q . The demand and production functions of the monopolist are

$$P = 85 - 3q$$

$$q = 2\sqrt{x}$$

Determine the equilibrium price and output of the monopolist.

- (f) Give a general formulation of linear programming problem of cost minimization.

4. Answer the following questions : 10×4=40

- (a) In a competitive market with the demand, supply and equilibrium equations

$$Q_d = 18 - 2P$$

$$Q_s = -7 + 3P$$

$$Q_d = Q_s$$

if government imposes excise duty, find out the rate of excise duty which will maximize tax revenue of the government. Also find the equilibrium output and price after imposition of the excise duty.

6+2+2=10

Or

The demand and cost functions of a monopolist are given by

$$P = 100 - 3q + 4\sqrt{A}$$

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

where A is the level of advertisement of the monopolist. Find the value of A , q and P that maximize profit. 10

- (b) The production function of a commodity is given by

$$Q = 40L + 3L^2 - \frac{L^3}{3}$$

where Q is total output and L depicts the units of inputs.

- (i) Find the number of inputs required to give maximum output.
 (ii) Verify that when average product is maximum, it is equal to the marginal product. 4+6=10

Or

A firm has the demand curve $D = 200 - P$, where D and P are quantity and price respectively and the firm's average cost is $C = \frac{100}{Q} + Q$.

If government gives a subsidy of 2 per unit of output—

- (i) find profit maximizing price and quantity;
 (ii) would anything be produced in the absence of subsidy? 10

- (c) A firm under monopolistic competition produces its products in two different plants and the total cost functions of the two plants are given by

$$C_1 = 20 - 4Q_1 + 0.5Q_1^2$$

$$C_2 = 40 - 8Q_2 + 2Q_2^2$$

where Q_1 and Q_2 are the outputs produced in the two plants. If the average revenue (AR) function of the firm is given by $AR = 40 - Q$, where $Q = Q_1 + Q_2$, find the profit maximizing output, price and maximum profit.

$$6+2+2=10$$

Or

- (i) Find the range of values of p and q that will render the entry (2, 2) a saddle point for the following pay-off matrix :

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Player A	Player B		
	B_1	B_2	B_3
A_1	2	4	5
A_2	10	7	q
A_3	4	p	6

- (ii) Given the following pay-off matrix. Find the optimal strategies and value of the game :

Player A	Player B		
	B_1	B_2	B_3
A_1	-1	2	-2
A_2	6	4	6

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

$$\text{Minimize } C = 6x + 24y$$

subject to

$$x + 2y \geq 3$$

$$x + 4y \geq 4$$

$$x, y \geq 0$$

Or

Explain how a two-person zero sum game with a pay-off matrix of order $m \times n$ can be expressed as linear programming of activities.
