INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

End-Spring Semester 2022-23

Date of Examination: _____ Session (FN/AN): ___ Duration: 3 hours
Full Marks: 50 Subject No.: HS50019 Subject: ECONOMIC MODELLING
Department/Center/School: HUMANITIES & SOCIAL SCIENCES
Specific charts, graph paper, log book etc., required: None
Special Instructions (if any): **Answer all. Clearly state any assumption made.**

1. There are N firms producing N brands of a quality differentiated commodity in a circular city. Every firm faces a constant marginal cost 2.5 and a fixed cost 0.5. Consumers are uniformly distributed and they incur a transportation cost of 8 for travelling unit distance. What will be the equilibrium value of N? How much of each brand will be produced? What would be the price? (3+3+3)

2. Consider a 0 to 1 continuum such that at every point there is a voter where the voter's location represent her/his ideology. In other words, the location x represents the distances (ideological) of the voter from the two extremities. There are 2 political candidates. If all the voters vote simultaneously, then what positions (on the continuum) will the two candidates take? (3)

3. Consider a 1 km road. At the left extreme resides 100 people and there is one coffee shop named "Café Del Mar". On the other extreme side resides 200 people and there is coffee shop named "Café Mariana". In between the two extremities there is no residential area. Each of the 300 people, living in this stretch, buys (and drinks) one cup of coffee every day. There is one bus that plies between the residential areas and one way trip costs 30 pesos. What will be the prices (assume it takes 10 pesos to prepare one cup of coffee for both the cafes) that the two coffee shops will charge per cup of coffee? (6)

4. Consider a two-firm industry producing two varieties of coffee – Arabica and Robusta. The ith firm faces the inverse demand function given by –

$$P_i = 30 - 2q_i + q_j; i, j = 1,2; i \neq j.$$

They know that they can't trust each other and form a cartel. What would be the equilibrium price (prices) if they compete in quantity? What would be the outcome if they compete in price? (5+5)

5. Consider an industry producing potentially N differentiated brands. The utility function of the representative consumer is given as –

$$u(q_1, q_2, \dots) = \sum_{i=1}^{N} q_i^{\alpha}; 0 < \alpha < 1$$

The consumer's income (I) is composed of the total wages (unit wage is normalized to 1) paid by the firms for his L units of labour plus the sum of their profits. Each brand is produced by a firm and all firms have the same cost structure –

$$TC_i(q_i) = \begin{cases} F + cq_i, & \text{if } q_i > 0 \\ 0, & \text{if } q_i = 0 \end{cases}$$

(i) Find the equilibrium price, quantity and number of firms. (3+3+3)

(ii) If we assume $\alpha = 0.5$, then, what will be the gain in utility of this representative individual if this economy (as described above) freely trades with an identical partner country? (5)

6. Consider an industry with two firms. Both of them can engage in research and development (R&D) by investing in a onetime investment of \$100 mn. The probability (p) that a firm will succeed in coming out with an innovation is 0.4. Let the profit be V if there is a sole innovator and ($V/2$) if both innovates. What will be the conditions for –

(i) Neither firm invests
(ii) Only one firm undertakes R&D
(iii) Both firms invest in R&D leading to market failure
(iv) Both firms invest and it is socially optimal

(2+2+2+2)