Last Name (Please PRINT): .....

First Name (PRINT): .....

Your I.D. Number: .....

INSTRUCTIONS (please read!)

1. Please make sure that you have 8 pages, including this page. Complaints about missing pages will not be accepted.
2. Please answer all the questions. You are not allowed to use any course material. Calculators are permitted.
3. Maximum Time Allowed: 1 hour and 30 minutes.
4. Your grade depends on the arguments you develop for supporting your answers. Each answer must be justified by using a logical argument consisting of a model/graph. An answer with no justification will not be given any credit.
5. You must provide all the derivations leading you to a numerical solution. Please do *not* use any "formulas" developed in class. You need to drive them by yourself.
6. When you draw a graph, make sure that you label the axes with the appropriate notation.
7. Maximum Score: 100 Points
8. Budget your time. If you cannot answer a certain question, skip it and go to the next one.
9. Please always bear in mind that "somebody" has to read and understand your handwriting. Please make sure that your ink is 'visible' and that your sentences are properly organized and fit into the designated blank space. If you think that your handwriting is poor, please print each word!
10. Good Luck !

..... *Instructor's use only* .....

Question no.	Maximum	Actual Grade
1	30	
2	20	
3	15	
4	20	
5	15	

(1) Consider a system composed of two components labeled X and Y. There are two firms producing two different systems (different brands), at zero production cost. Firm A produces components X_A and Y_A, and firm B produces X_B and Y_B. In this market there are 100 consumers labeled AA, and 100 consumers labeled BB. The Utility function of a consumer i, j where $i, j = A, B$ is

$$U_{i,j} = \begin{cases} 10 - \left(p_i^X + p_j^Y\right) & \text{buys system } X_i Y_j \\ 10 - \left(p_j^X + p_j^Y\right) - 2 & \text{buys system } X_j Y_j \\ 10 - \left(p_i^X + p_i^Y\right) - 2 & \text{buys system } X_i Y_i \\ 10 - \left(p_j^X + p_i^Y\right) - 3 & \text{buys system } X_j Y_i \end{cases}$$

(1a) [10 pts.] Calculate the undercut-proof equilibrium prices and the profit of each firm assuming that the components produced by different firms are incompatible. *Hint:* First make sure that you know to define price-undercutting.

(1b) [5 pts.] Calculate the aggregate consumer surplus and social welfare.

(1c) [10 pts.] Calculate the undercut-proof equilibrium prices and firms' profit levels assuming that the components produced by different firms are compatible.

(1d) [5 pts.] Calculate the aggregate consumer surplus and social welfare.

(2) Consider a market for a popular software ACROPOP™. There are 100 (one-hundred) support-oriented (type-O) users, and 200 (two-hundred) support-independent (type-I) users, with utility functions given by

$$U^O \stackrel{\text{def}}{=} \begin{cases} 400+q-p & \text{buys the software} \\ q & \text{pirates (steals) the software} \\ 0 & \text{does not use this software,} \end{cases} \quad \text{and} \quad U^I \stackrel{\text{def}}{=} \begin{cases} q-p & \text{buys the software} \\ q & \text{pirates (steals) the software} \\ 0 & \text{does not use this software,} \end{cases}$$

where q denotes the number of users of this software (which includes the number of buyers and the number of pirates, if piracy takes place). Suppose that the software is costless to produce and costless to protect. Also, assume that ACROPOP™ provides support only to those consumers who buy the software.

(2a) [10 pts.] Suppose that ACROPOP™ is *not* protected, so piracy is an option for every consumer. Calculate the software seller's profit-maximizing price. Prove your answer.

(2b) [10 pts.] Suppose that ACROPOP™ is protected, so piracy is impossible. Calculate the software seller's profit-maximizing price. Prove your answer.

(3) Consider a monopoly cable-TV operator providing a service to 3 types of consumers by transmitting 2 channels: CNN and BBC. Assume that the monopoly's production (transmission) is costless and that no royalties are paid to the content providers . The Table below shows the valuation (maximum willingness to pay) of each consumer type for each channel, and the number of consumers of each type.

Consumer type	# consumers	CNN	BBC
1	1000	4	1
2	9000	5	5
3	1000	1	4

(3a) [10 pts.] Calculate the profit-maximizing prices assuming that the monopoly must sell each channel separately.

(3b) [5 pts.] Calculate the profit-maximizing price assuming that the monopoly sells all the channels in a single package.

(4) Consider two airline companies: airline α and airline β, who are the only airlines providing a service connecting city A with city B. Suppose that the frequency of flights provided by airline α and airline β are $f_\alpha = 6$ and $f_\beta = 3$, respectively. That is, airline α provides 6 flights per day, whereas airline β provides only 3 flights per day. There are η consumers who are oriented towards airline α, and η who are oriented towards airline β. Suppose now that passengers' utility functions are given by:

$$U_\alpha \stackrel{\text{def}}{=} \begin{cases} f_\alpha - p_\alpha & \text{flies } \alpha \\ f_\beta - 4 - p_\beta & \text{flies } \beta, \end{cases} \quad \text{and} \quad U_\beta \stackrel{\text{def}}{=} \begin{cases} f_\alpha - 4 - p_\alpha & \text{flies } \alpha \\ f_\beta - p_\beta & \text{flies } \beta. \end{cases}$$

Assume that the airline firms do not bear any type of cost. Answer the following questions.

(4a) [10 pts.] Calculate the UPE airfare charged by each airline and the associated profit levels assuming that there are no agreements between the two airline firms.

(4b) [10 pts.] Calculate the UPE airfares and the associated profit levels assuming that the two airline firms are engaged in a code-sharing agreement. Assume that airline α continues to maintain $f_\alpha = 6$ flights per day and airline β continues to maintain $f_\beta = 3$ flights per day even after the agreement is signed.

(5) Consider a program-type competition among 4 independent broadcasting channels: Channels A, B, C, and D. Each channel maximizes the number of viewers times 1¢ (which he receives as a revenue from advertising per viewer). Also assume that that each channel can broadcast only one program type: A talk-show, a news program, or a movie.

There are 3 types of TV viewers: There are 800 viewers who would like to watch only *talk-shows* (T). Similarly, there are 400 viewers who like to watch *news* programs (N) only. Finally, there are 200 viewers who watch *movies* (M) only.

(5a) [10 pts.] Calculate which program will be broadcasted by each channel in a Nash equilibrium. Prove your answer. *Remark*: You do NOT need to demonstrate all NE. You are being asked to prove an existence of one equilibrium).

(5b) [5 pts.] Suppose that the utility function of each viewer is given by

$$U = \begin{cases} 5 & \text{if she watches her favorite program} \\ 0 & \text{if she does not watch her favorite program} \end{cases}$$

Define a social welfare function and calculate the amount of social welfare in a Nash equilibrium you found in (5a). Explain whether social welfare is maximized at this equilibrium or whether there is a *market failure*. Prove your answer!

Scratch Paper

This page will NOT be read by the instructor !

THE END