Game Theory CSL426   **Instructor Name:**Dr. Anshul Agarwal
Summer 2022
Mid Term Examination
4/03/2022

This assignment contains 2 pages (including this cover page) and 4 questions.
Total number of marks is 25.
INSTRUCTIONS for ANSWER SHEETS:
1. The answers should be written ONLY in the below mentioned order.
2. Write your roll number on the top of every page.
3. Credits reserved for formal and succinct answers.
Any evidence of copying will attract a serious penalty.
Clearly state any assumptions that you have taken.
Be formal and succinct.
Best of luck!

1. **(6 Marks)** Consider a game consisting of a boy (B) and a girl (G). They can either watch cricket (C) or Harry Potter (H). If one watches cricket and the other watches Harry Potter, then their payoff is zero. If both watch cricket, then boy's payoff is ten and that of girl's is five. Similarly, if both watch Harry Potter, then boy's payoff is five and that of girl's is ten. Draw the game table, and find out the best responses of the agents and the Nash equilibrium outcome(s) if any. If there are multiple Nash equilibrium outcomes, then what is the preference of these outcomes for both the players? Is it a coordination game (justify)? Also, list down the pareto optimal outcome(s) if any. Now, assume (with respect to mixed strategy Nash equilibrium) that the boy watches cricket with probability p and Harry potter with probability 1-p; similarly, the girl watches cricket with probability q and Harry potter with probability 1-q. Find out the mixed strategy Nash equilibrium of this game.

2. **(6 Marks)** Assume a game which consists of two agents. The agents are supposed to divide an amount of ten rupees amongst themselves. They adopt the following process: each agent selects a non negative integer amount (at max ten). If the total sum of the amounts selected by both the agents is at max ten, then each agent receives the amount selected by her. If the total sum of the amounts selected by both the agents exceeds ten and the amounts of both the agents are different, then the agent who selected smaller amount receives that much amount and the other agent receives the remaining money. If the total sum of the amounts selected by both the agents exceeds ten and the amounts of both the agents are equal, then each agent receives five rupees. Determine the best response of each player and thus, find the Nash equilibrium.

3. **(7 Marks)** Assume a game which consists of three agents. Each agent selects an integer ranging from 1 to N. Let the average of these three integers (one integer selected by each agent) be denoted by α. If these three integers (one integer selected by each agent)

are different, then the agent whose selected integer is closest to two-thirds of α wins one rupee. If two or more of these integers are equal, then one rupee is divided equally amongst the agents whose integer is closest to two-thirds of α. Is there an outcome (n,n,n) where all the agents select same integer and is a Nash equilibrium? If $n \geq 2$, what happens if the agent selects a smaller integer? Is there any other Nash equilibrium outcome?

4. **(6 Marks)** Following are the game tables of two games.

P1 P2	Action A1	Action A2
Action A1	4,4	2,6
Action A2	6,2	-1,-1

Game table for game 1

P1 P2	Action A1	Action A2
Action A1	3,2	1,4
Action A2	4,-2	2,-1

Game table for game 2

Justify whether these games are similar or different in terms of the players' preferences, best responses and Nash Equilibrium outcome. Also, justify whether either of these games is similar to Prisoner's Dilemma in terms of players' preferences, best responses and Nash Equilibrium outcome.