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**INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR**  
**Algorithmic Game Theory: Mid-Semester Examination 2022**

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**Date of Examination: 20 September 2022**

**Duration: 2 Hours**

**Full Marks: 60**

**Subject No: CS60025**

**Subject: Algorithmic Game Theory**

**Department/Center/School: COMPUTER SCIENCE AND ENGINEERING**

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1. Let  $\alpha_1$  and  $\alpha_2$  be respectively a correlated and coarse correlated equilibrium of a matrix game  $\mathcal{A}$  with  $m$  rows and  $n$  columns. Prove that  $u_1(\alpha_1)$  and  $u_1(\alpha_2)$  (the utility of the row player) are equal to the value of the game in mixed strategies.

**[15 Marks]**

2. Give an example of a strategic form game where there exists a CE which is not an MSNE and there exists a CCE which is not a CE.

**[15 Marks]**

3. (a) Give an example of a strategic-form game where the best-response dynamic never converges.
- (b) Give an example of a network congestion game where the best response dynamic takes an exponential (in the size of the input) number of iteration to converge to a PSNE.

**[5+10 Marks]**

4. Let  $d$  be the last digit of your roll number and  $n = 2d + 5$ . Consider the following strategic form game: We have  $n$  players. The strategy set of every player is  $\{1, 2, \dots, n\}$ . Every player  $i \in [n]$  is associated with an integer  $a_i \in \{1, 2, \dots, n^2\}$ . In a strategy profile  $(s_1, \dots, s_n) \in \{1, 2, \dots, n^2\}^n$ , the cost  $C_i(s_1, \dots, s_n)$  of player  $i \in [n]$  is  $|a_i - \text{med}(s_1, \dots, s_n)|$  where  $\text{med}(s_1, \dots, s_n)$  is the median of  $(s_1, \dots, s_n)$ . Find a WDSE for this game if it exists.

**[15 Marks]**

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Best of luck

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