

# CS711: Introduction to Game Theory and Mechanism Design

1. **Objectives:** This course is an introduction to game theory and mechanism design. The goal is to equip students with a general purpose tool to analyze strategic behavior in multi-agent interaction. Though primarily a topic of economic flavor, it has significant applications in the decision process of a multi-agent environment like sponsored advertisements, crowdsourcing, social media, internet-based trade, and several settings of social choice and welfare. This course is a backend of such applications and discusses the mathematical details of analyzing and designing strategic interactions.
2. **Departments which may be interested:** CSE, MTH, EE, IME, ECO
3. **Pre-requisites:** Familiarity with formal mathematical reasoning, probability theory, calculus, basics of computational complexity, and (soft constraint) familiarity with computer programming.

## 4. Course Contents:

A tentative list of topics are as follows.

- **Non-cooperative game theory**
  - Quantitative models of strategic interaction: rationality, intelligence, common knowledge
  - Complete information simultaneous move games – normal form representation
    - Ideas of equilibria: domination of strategies, Nash equilibrium
    - Existence results for mixed and pure Nash equilibrium
    - Correlated equilibrium.
  - Complete information sequential move games – extensive form representation
    - Perfect and imperfect information extensive form games
    - Equilibria concepts – subgame perfect equilibrium, perfect Bayesian equilibrium, analogies with pure and mixed Nash equilibrium
  - Incomplete information games
    - Bayesian games
    - Equilibria concepts tied to the belief system
    - Nash and Bayesian equilibria in incomplete information games
- **Introduction to mechanism design**
  - Incomplete information to player types
  - Social welfare function, Arrow's impossibility result
  - Social choice function, Gibbard-Satterthwaite result
  - Domain restriction
  - Single-peaked preferences
  - Task allocation domain
  - Quasi-linear preferences
- **Some real world applications of mechanism design**

5. **Evaluation Components & Policies:** One midterm and one endterm exam (weightage 35% each) and two assignments (weightage 15% each).
6. **Lecture schedule & venue:** Monday, Thursday 14.00-15.15 hrs, RM 101.
7. **Course webpage:** <https://swaprava.wordpress.com/cs711>
8. **Teacher:** Swaprava Nath. **Office hours:** via email: [swaprava@cse.iitk.ac.in](mailto:swaprava@cse.iitk.ac.in) with subject including [CS711]
9. **Teaching assistant:** Garima Shakya, [garima@cse.iitk.ac.in](mailto:garima@cse.iitk.ac.in), mail to have her office hours – better to post on Piazza (information available on course homepage).
10. **Course Policies:**

Attendance for this course is mandatory. If any student has any medical/personal/professional reasons to miss the class, (s)he must be ready to produce documentary evidence for the same. The leave request for personal/professional reasons must be filed through the academic course management system (e.g., OARS or pingala), medical leave must have the health center certificate. In summary, if a student is in campus and in good health, (s)he must attend the classes. **Any leave without the reasons mentioned above may attract a penalty of 10% of the total course score.**

Honesty practices according to the policy laid down by the CSE department will be followed. For details, see: <https://www.cse.iitk.ac.in/pages/AntiCheatingPolicy.html>

#### 11. **Books & References:**

No specific one. The following books could be helpful.

1. **“Game Theory”** — Michael Maschler, Eilon Solan, Shmuel Zamir (few copies of this book are available in the library)
2. **“Multiagent Systems”** — Y. Shoham and K. Leyton Brown, Cambridge University Press, online copy available
3. **“Game Theory and Mechanism Design”** — Y. Narahari, World Scientific and IISc Press – Indian edition available