INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

GAME THEORY								
VI Semester: IT								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AITD14	Elective	L	T	P	C	CIA	SEE	Total
		3	0	0	3	40	60	100
Contact Classes: 48	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 48		
Prerequisite: Probability and Statistics								

I. COURSE OVERVIEW:

Game theory teaches us to think strategically: it is a method of analysis used to study, and guide, decision-making in environments where there is mutual interdependence. Information economics helps us to analyze situations in which one agent has greater information than another agent with which it interacts. This course surveys and develops concepts and techniques of game theory and mechanism design. Includes applications to issues of business strategy, including advertising and pricing decisions, negotiation and bargaining situations, entry deterrence games, etc.

II. COURSES OBJECTIVES:

The students will try to learn

I. The fundamental principles of rational decision-making in strategic environments using mathematical frameworks of Game Theory.

II. The 2-player strategic game formulation including payoff structures and optimal play using concepts of minimax, domination, and saddle point analysis employed in classical models from John von Neumann.

III. The equilibrium behavior in non-cooperative, cooperative, and repeated games through solution frameworks such as Nash Equilibrium and duopoly modeling.

IV. The combinatorial, graph-based games, and incentive-compatible system construction using strategic agent modeling and social preference aggregation studied in Mechanism Design.

III. COURSE OUTCOMES:

At the end of the course students should be able to

CO1 Formulate strategic games by identifying players, strategies, payoffs, and classify them as cooperative or non-cooperative models.

CO2 Compute optimal decisions in 2-player zero-sum games using minimax reasoning and verify dominance properties (weak/strong) and saddle point existence.

CO3 Derive and interpret pure and mixed strategy equilibria for canonical games including Prisoner’s Dilemma and Stag Hunt.

CO4 Analyze multi-equilibrium scenarios, best-response functions, and duopoly behavior using Stackelberg Duopoly Model.

CO5 Determine winning/losing positions and prove correctness in combinatorial and graph games using Sprague–Grundy Theorem.

CO6 Construct incentive-compatible mechanisms for strategic agents, model voting/social choice functions, and reason about existence and ranking systems under unrestricted preferences.

IV. COURSE CONTENT:

MODULE I: INTRODUCTION (10)

Introduction making rational choices: Basics of Games strategy, Mathematical basics, Game theory Rational Choice Basic solution, concepts-non-cooperative versus cooperative games, Applications of Game theory.

MODULE II: STRATEGIC GAMES (10)

Basic computational issues, finding equilibrium and learning in games, Typical application areas for game theory Strategic Games, 2 Player Strategy Games, payoffs, Minimax, Weak and Strong Domination, Saddle Points.

MODULE III: NASH EQUILIBRIUM (10)

Nash Equilibrium, mixed strategy equilibrium, prisoner's dilemma, stag hunt, matching pennies, BOS, multi NE, stacker's model of duopoly.

Cooperative and competitive games, extensive games with perfect information, repeated games, super modular game and potential games, strict and non-strict NE, best response functions for NE.

MODULE IV: COMBINATORIAL AND GRAPH GAMES (09)

Combinatorial games, winning and losing positions, subtraction game, 3-Pile and K-Pile games, proof of correctness, variations of K-Pile games, graph games, construction, proof of finiteness, SG theorem for sum of games.

MODULE V: MECHANISM DESIGN (09)

Aggregating preferences social choice formal model voting existence of social functions ranking systems protocols for strategic agents: mechanism design mechanism design with unrestricted preferences.

IV. TEXT BOOKS:

1. M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.

VI. REFERENCE BOOKS:

1. N. Nisan, T. Rough garden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press, 2007.
2. A.Dixit and S. Skeath, Games of Strategy, Second Edition. W Norton & Co Inc, 2004.
3. YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2008.
4. M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013

VII. ELECTRONICS RESOURCES:

1. https://www. nptel.ac.in/content/syllabus_pdf/109103021.pdf
2. https://www.geeksforgeeks.org/game-theory/
3. https://www.javatpoint.com/automata-and-game-theory

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech-talk topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. PowerPoint presentation
11. 11.E-Learning Readiness Videos (ELRV)