Astrophysical Game Theory Applications

Game Theory In Space Science · Practice Test · 10 Questions

1. In the context of the orbital debris 'tragedy of the commons', which specific equilibrium state is reached when multiple nations refuse to perform costly de-orbiting maneuvers?

A) Nash Equilibrium
B) Pareto Efficiency
C) Stackelberg Equilibrium
D) Bayesian Nash Equilibrium

2. The stability of the solar system can be modeled as a multi-player game where gravitational perturbations act as strategies. What theorem dictates that the system's long-term stability is not guaranteed for planetary bodies?

A) KAM Theorem
B) Poincaré-Bendixson Theorem
C) Ergodic Theorem
D) Fixed-point Theorem

3. When modeling competitive satellite constellation deployment, if one firm moves first to claim an optimal orbital shell, what type of game model best describes the sequential interaction?

A) Stackelberg Competition
B) Cournot Competition
C) Bertrand Competition
D) Zero-sum Game

4. Regarding the Fermi Paradox, if two civilizations reach a 'mutually assured destruction' standoff due to interstellar expansion, which game theory concept explains the failure to detect signals?

A) Grim Trigger Strategy
B) Minimax Regret
C) Tit-for-Tat
D) Cooperative Equilibrium

5. In the 'Interstellar Resource Allocation' game, where stars act as nodes, which mathematical property ensures that a stable coalition of energy-extracting civilizations is possible?

A) Core Non-emptiness
B) Strict Dominance
C) Zero-sum Payoff
D) Weak Nash Equilibrium

6. The transfer of mass between binary stars (Roche lobe overflow) can be viewed as a game between gravitational potential and stellar expansion. Which equilibrium occurs when mass transfer remains stable?

A) Walrasian Equilibrium
B) Correlated Equilibrium
C) Mixed-strategy Equilibrium
D) Symmetric Equilibrium

7. In calculating optimal trajectories for multi-spacecraft rendezvous in high-perturbation orbits, which game-theoretic framework accounts for uncertainty in gravitational anomalies?

A) Stochastic Differential Games
B) Non-cooperative Static Games
C) Cooperative Potential Games
D) Zero-sum Pure Games

8. Which game theory model best represents the 'Kessler Syndrome' where each actor's strategy to launch satellites inadvertently decreases the total utility of the Low Earth Orbit environment?

A) Prisoner's Dilemma
B) Battle of the Sexes
C) Chicken Game
D) Hawk-Dove Game

9. During a multi-target orbital insertion mission, if the fuel consumption is a shared cost, what mechanism prevents free-riding by individual spacecraft in the formation?

A) Vickrey-Clarke-Groves Mechanism
B) Nash Bargaining Solution
C) Shapley Value
D) Maximin Strategy

10. When modeling the formation of spiral galaxies, the interaction of dark matter halos can be viewed as an evolutionary game. What is the characteristic of the resultant stable density profile?

A) Evolutionary Stable Strategy (ESS)
B) Cooperative Pareto Optimum
C) Nash-Savage Equilibrium
D) Zero-sum Nash Point