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**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**  
**FIRST SEMESTER 2022-2023**  
**Comprehensive Examination**  
**Part-A & B (Closed Book)**

Course No. : BITS F314	Maximum Marks : 40
Course Title : Game Theory & Its Applications	Duration (Max) : 90 Minutes
Date : 21/Dec/2022	Weightage : 20%

***Instructions:***

1. Write your *Name* and *ID Number* clearly in the answer sheet.
2. There are two parts, Part-A & B. Part A carries a total of 10 questions and Part B carries 6 questions.
3. Answer to Part A (MCQ Type) to be given in the appropriate box given in this page only in Capital Letters as, A, B, C, or D. There will be no negative marking.
4. Part B contains six short answer-type questions. You will be given one supplementary answer book to write your answers to Part B.
5. Answer the questions once only. No rewriting is allowed and will not be evaluated.
6. At the end, submit both the question paper and the answer sheet.
7. Calculator is allowed; however, exchange of calculator is not permitted.
8. All the questions are compulsory. Use of pencil is not allowed.

PART-A										
Question	1	2	3	4	5	6	7	8	9	10
Answer										

**Part A**  
**Multiple Choice Questions (1 Mark Each)**

**Q1:** In a non-cooperative setup, each player in a prisoners' dilemma game has a dominant strategy that leaves \_\_\_\_\_ than if they could cooperate.

- A) them both worse off
- B) them both better off
- C) the first player to confess is better off and the other player is worse off
- D) the first player to confess is worse off and the other player is better off

**Q2:** Your game theory professor has decided that your class will not be graded on a curve but on an absolute scale. Therefore, every student in the class can get an "A." Your grade will not depend in any way on your classmates' performance. Based on this information, you decide that you should study game theory for three hours each day, regardless of what your classmates do. In the language of game theory, your decision to study three hours each day is:

- A) a dominant strategy
- B) a minimax strategy
- C) a maximin strategy
- D) a Prisoner's dilemma

**Q3:** Consider the following statements to answer this question:

- I) *If mixed strategies are allowed, every game has at least one Nash equilibrium.*
- II) *The maximin strategy is optimal in the game of "matching pennies."*

- A) both I and II are true.
- B) I is true, and II is false.
- C) I is false, and II is true.
- D) Both I and II are false.

**Q4:** A Nash equilibrium occurs if all players in a game play their best strategies

- A) before their competitors do.
- B) given what their competitors do.
- C) without knowing what their competitors do.
- D) only if their competitors are unaware of their strategies.

**Q5:** Consider the following game between two biscuit sellers:

		Britannia	
		Offer discount	No Discount
Parle	Offer discount	20,10	30,0
	No Discount	12,16	20,4

Which of the following is true about the game given above?

- A) Britannia's dominant strategy is to offer a discount.
- B) Britannia's dominant strategy is not to offer a discount.
- C) Parle's dominant strategy is to offer a discount.
- D) Both Britannia and Parle offer a discount as a dominant strategy.

**Q6:** To deter a potential entrant, an existing firm in a market may threaten to sharply increase production so that the entrant will be left with a small share of the market. The firm can make this threat credible by limiting its options, and possible actions of this type include:

- A) signing long-term sales contracts that commit the firm to high levels of output.
- B) building a very large factory that could potentially produce enough output to meet most of the market demand.
- C) signing long-term purchase contracts for large amounts of production inputs.
- D) all of the above

**Q7:** When cost and demand are stable over time in an industry, repetition of Prisoners' Dilemma situations

- A) can yield cooperative outcomes because firms can explicitly collude to set prices.
- B) can yield cooperative outcomes even when firms do not explicitly collude to set prices.
- C) cooperative or non-cooperative outcomes may occur, but cooperation is harder than when the market is unstable.
- D) will tend to yield non-cooperative outcomes.

**Q8:** For infinitely repeated games in which the players follow a tit-for-tat strategy, which one of the following outcomes is NOT possible?

- A) The players cooperate until someone decides to not cooperate, and then the other players will not cooperate for some time.
- B) There can be dominant strategies.
- C) If the information about another player's action is limited, then some cooperative actions may be incorrectly interpreted as "not cooperating."
- D) All of the above are possible outcomes.

**Q9:** Which one of the following is true for output-choice models of oligopoly behavior?

- A) Both the Stackelberg and Cournot models can be constructed as sequential games.
- B) The Stackelberg model can be constructed as a sequential game but not Cournot.
- C) The Cournot, but not the Stackelberg, the model can be constructed as a sequential game.
- D) Neither the Cournot nor the Stackelberg model can be constructed as a sequential game, but other output-choice models can be.

**Q10:** Consider the Battle of the Sexes game as follows:

		Husband	
		Football Match	Movie
Wife	Football Match	2, 1	0, 0
	Movie	0, 0	1, 2

Suppose both players use maximin strategies for this game. Is there a clear equilibrium outcome to the game in this case?

- A) Yes, both players select to watch a football match
- B) Yes, both players select to watch a movie
- C) No, both players face the minimum payoff (0) under both actions.
- D) We do not have enough information to answer this question.

## Part B

### Short Answer Type Questions

**(Write your answer in the Supplementary Answer Book)**

**Q11:** Explain each of the following in brief:

- a) English Auction
- b) Dutch Auction
- c) Vickery Auction

[3M]

**Q12:** Two firms, A and B, are competing for business and the situation is whenever firm A gains, firm B loses. The following table shows the advertising strategies of both the firms and utilities to firm A for various market shares in percentages. Find optimal strategies for both the firms and the expected percentage of market share to firm A.

[5M]

		Firm B		
		Press	Radio	TV
Firm A	Press	60	75	40
	Radio	75	75	60
	TV	60	70	70

**Q13:** Consider the infinitely repeated, static game played between two competitors in the BITS Pilani. Both must decide whether to charge INR 30 or INR 50 for their product. The payoffs (in INR million) represent the firms' profits from each strategy profile.

		Looters	
		INR 30	INR 50
Mr. Idli	INR 30	60, 60	200, 30
	INR 50	30, 200	80, 80

Is the cartel stable at a discount rate of 20 percent? If the discount rate was reduced to 10 percent, what change would you observe? Also, calculate the discount rate at which both the competitors will be indifferent to violating the agreement to charge INR 50. **[5M]**

**Q14:** Two players Sony and Zee are bargaining over the price of a service contract. The highest price that Zee is willing to pay is INR 350. The lowest price that Sony is willing to accept is INR 150. Suppose that each player's discount factor is 0.05. For a subgame perfect equilibrium to exist, what price should Zee offer for the contract in the first round? What portion of the surplus will Sony receive? What portion of the surplus will Zee keep with himself? **[5M]**

**Q15:** A major factor that affects earnings in the smartphone industry is the timing of the release, which peaks around the festive period during October-November of each year in India. Suppose two companies Apple and Samsung are thinking to release new models of smartphones either during the festive period or later. If both are released during the festive period, they split the market and earn a total of INR 230. If one is released during the festive period and the other later then the former will earn INR 120 and later will earn INR 105. If both are released post-festive period both will earn INR 95. Now suppose that Apple made a contract with the distributors to release the apple model before Samsung and make this a sequential move game. Given this scenario, represent the game in an extensive form and find our SPNE. Also, find out the equilibrium outcomes when the extensive game is represented in a normal game. Is there a first-mover advantage for Apple? **[7M]**

**Q16:** Suppose there are two bidders, Shiva and Krishna, who are bidding for a vintage car. Both layers know how much the other bidder values the car. Krishna knows that Shiva is willing to pay up to INR 562, while Shiva knows that Krishna is willing to pay INR 442. We will assume that all bids must be in INR 50 increments and that there is a reservation price (opening bid) of INR 300. Given this information in a sealed-bid first-price auction, compute the payoff matrix and identify the Nash Equilibrium. **[5M]**

**\*\*\*\*\*All the Best\*\*\*\*\***