**Department of Economics**
**University of Delhi**
**M.A. Economics: Semesters II and IV, 2015**

**005: Markets, Institutions and Economic Growth**

Maximum Marks: 70. Time: $2\frac{1}{2}$ hours

**Instructions**

**1. There are two sections, answer both**

**2. Each section must be answered in a separate answer book**

**3. Write Section A/ Section B on the front page of answer books**

## Section A

Attempt as many as you wish and all answers will be graded.
However, the maximum that you can score in Section A is 35.

**1**. A crime is observed by a group of $n$ people. Each person would like the crime to be reported but prefers someone else to take the responsibility. Each person gets a utility $v$ if the crime is reported, while the whistle-blower incurs a cost $c$. Suppose that $v > c > 0$.

($a$) Find all pure strategy Nash equilibrium of this game.
($b$) A symmetric Nash equilibrium is an equilibrium where all players play the same strategy. Find all symmetric mixed strategy Nash equilibrium of the above game.
($c$) Find the probability of crime reporting (that is at least one person reports the crime) at the symmetric mixed strategy Nash equilibrium.
($d$) How does probability of crime reporting change with $n$ and $c$? Provide economic interpretation of your findings. $[3 + 3 + 3 + 4]$

**2**. Suppose you have a coupon to see one movie over the next three Saturdays. The schedule at the local cinema is as follows:
Week 1: A trash movie which gives you utility $u_1 = 22$
Week 2: A mediocre movie which gives you utility $u_2 = 35$
Week 3: A great movie which gives you utility $u_3 = 50$.
You can watch at most one of these three movies and the utility from seeing the movie is experienced immediately. That is, if you choose to watch a movie in Week $T$ then at Week $T$ you receive utility $u_T$, otherwise you receive utility 0. Future

utilities are discounted as follows. At any period $k$, utility at $(k+t)$ (that is, a $t$ period gap, where $t \geq 1$) is discounted by $\beta\delta^t$. Suppose that $\beta = \frac{3}{4}$ and $\delta = \frac{4}{5}$.

($a$) If you are taking a decision in Week 1, what is your optimal choice of movie?
($b$) Model this choice problem as an extensive form game, where in each week $T$, you can choose between two actions: watch week $T$ movie or wait for the next period. The game ends as soon as you choose to watch a movie or at the end of Week 3. Find SPNE of this game.
($c$) Now suppose that at the start of the game, you have an additional choice of selecting at most one movie for which the coupon won't be valid. Will you exercise your choice? If so, which week will you choose?
($d$) Using this example, explain why one may prefer to invest in fixed deposit (which can be liquidated only at the end of a fixed term) than savings deposit (which is fully liquid). Assume that rate of return is the same in fixed and savings deposits. $[3+3+3+4]$

**3**. A worker and a firm are negotiating over wage $w$. They use infinite period alternating offer bargaining, where the worker makes offer on odd dates $t = 1, 3, 5, \ldots$ and the firm on even dates $t = 2, 4, 6 \ldots$. If the game continues to date $\infty$, then the game ends with zero payoffs for both players. If the worker accepts a contract at date $t$ for wage $w$, then her payoff is $w\delta^{t-1}$ and firm's payoff is $(\Pi - w)\delta^{t-1}$.

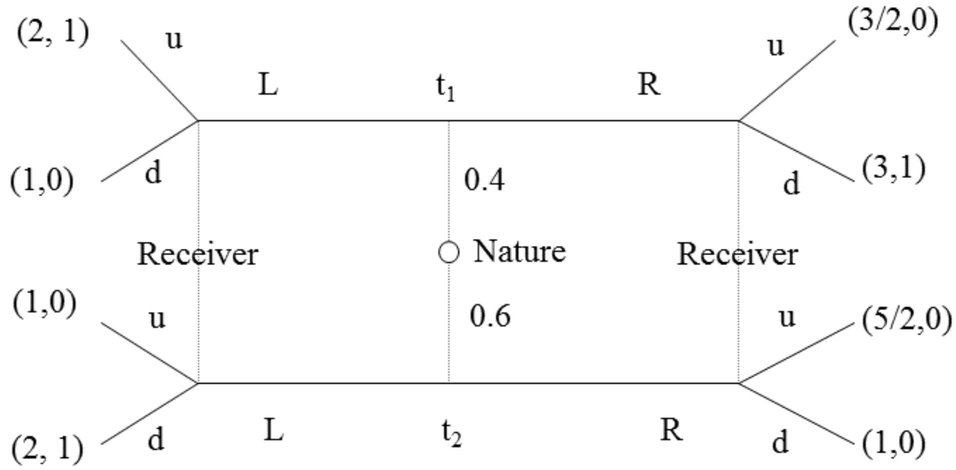
($a$) Find SPNE of the above game.
($b$) Now suppose that the worker has an outside option to go back to her village and work as a farmer. She can earn $R$ from farming. This option can only be exercised on even dates, when the worker is responding to firm's offer. That is when firm makes an offer $w$, then worker can choose one of the following three actions
- accepts the offer (game ends)
- rejects the offer and continue the negotiation process by making a counter offer in the next period
- rejects the offer and take up farming (game ends). In such case the firm's payoff is 0.

When the worker makes an offer, the firm can either accept the offer (game ends) or reject the offer and the negotiation continues. Assume that $R < \Pi$.
Find SPNE of this game.
($c$) How does this SPNE change if the outside option of farming is available only till date 2? $[6+6+2]$

**Section B**

4 is compulsory. Answer either 5 or 6.

**4**. Find all pure strategy perfect Bayesian equilibria of the following signaling game. Do you think all of them are reasonable? Give reason. [9 + 3]




**5**. There are two players 1 and 2, playing a two period public good contribution game. The benefits from the public good per-period to each player is $b_1$ and $b_2$ respectively, which are common knowledge. For the provision of the public good only one player needs to contribute. Once a player contributes and the good is provided then both can derive the benefits. The public good lasts for only one period and contributions are required in each period to renew it.

The per-period cost of contribution for player 1 is private information which can take two values $\underline{c}$ (low type with probability $p$) and $\bar{c}$ (high type with probability $1-p$) for which following condition holds $\underline{c} < b_1 < \bar{c}$ . However, the cost of contribution for player 2 takes the value $c_2$ which is common knowledge and is lower than its benefit i.e. $c_2 < b_2$.

The game is played as per the following sequence:

First period: Only player 1 moves. He can choose to 'contribute'($C$) or 'Not to Contribute'($N$) towards the first period contribution of public good. If player 1 chooses $N$ then both gets 0 otherwise if player 1 chooses $C$ then both players get their benefits but only player 1 pays the cost. Note that the player 2 observes the player 1's action of either $C$ or $N$ but not its type (i.e. the private information regarding costs).

Second period: The game is played sequentially where player 2 moves first and chooses $C$ or $N$. Player 1 observes it and decides on $C$ or $N$. If at least one of

them contributes then both players get their benefits $b_i$ and those who contribute pay their respective costs. If no one contributes each gets 0.
Players discount their payoffs by $\delta$, which is common to both. In answering the questions below, you need to write strategies and beliefs precisely.

$(a)$ Find an equilibrium where different types of player 1 choose different actions in first period (separating equilibrium).
$(b)$ Find an equilibrium where different types player 1 choose the same action in first period (pooling equilibrium).
$(c)$ Find a hybrid equilibrium where low type of player 1 in first period chooses $C$ with probability $\alpha$ and $N$ with probability $(1-\alpha)$, and player 2 in second period randomizes between $C$ with probability $\beta$ and $N$ with probability $(1-\beta)$.
$[7+7+9]$

**6**. Consider the following principal-agent model. The owner of a firm (the principal) wishes to hire a manager (the agent) to run the firm. To generate profits the manager needs to put in effort and higher effort results in higher expected profit. Each effort level can result in two possible profit levels, $\pi_H = 36$ and $\pi_L = 0$ (the probability distribution is given below). The effort $(e)$ has a cost for manager, $g(e)$, and in compensation he is paid money wage $w$ which gives him payoff $v(w) = \sqrt{w}$. His utility function is $u(w, e) = \sqrt{w} - g(e)$. Finally, the manager's reservation utility $\bar{u} = 1$. Assume that principal is risk neutral. The above information is common to both parts $(a)$ and $(b)$ below.

$(a)$ Suppose, there are three discrete effort levels $e_1$, $e_2$ and $e_3$ having costs as, $g(e_1) = 1$, $g(e_2) = x(>0)$ and $g(e_3) = 3$ and the conditional profit distributions as, $f(\pi_H|e_1) = \frac{1}{3}, f(\pi_H|e_2) = \frac{1}{2}$ and $f(\pi_H|e_3) = \frac{2}{3}$.
$(i)$ If efforts are observable, what is the optimal contract? Specify the effort level principal wants to implement and the wage it offers as compensation.
$(ii)$ If efforts are not observable, for what value(s) of '$x$' it would be incentive compatible to implement $e_2$.

$(b)$ Now suppose that efforts can take only two values $e_1$ and $e_2$ with costs $g(e_1) = 1$, $g(e_2) = x(>0)$ and the conditional distributions are $f(\pi_H|e_1) = \frac{1}{3}$, $f(\pi_H|e_2) = \frac{2}{3}$.
$(i)$ Suppose the efforts are observable. What would be the condition(s) for implementing the effort level $e_2$?
$(ii)$ Suppose, the efforts are not observable. Which effort level the principal would prefer to implement when $x = 2.5$?
$(iii)$ How do you interpret the difference in results between $(b-i)$ and $(b-ii)$?
$[(6+5)+(5+5+2)]$