Answer all of the followings.
Properly write names of the methods (if any) that you are using. Show all the logical steps.
No partial marks will be provided. No explanation will be provided during exam.

$$[(5 \times 10) + (5 \times 2) = 60]$$

1. Inside IITP, there are only two kirana stores, ABC and XYZ. The total number of customers is equally divided between the two, because the price and quality of goods sold are equal. Both stores have good reputation in the fraternity, and they render equally good customer service. Assume that a gain of customers by ABC is a loss to XYZ, and vice-versa. Both stores plan to run annual pre-X-Mas sales during the 2nd week of December. Sales are advertised through a local newsletter (NL), and through facebook (FB) and whatsapp (WA). With the aid of an IITP student, ABC constructed the **game matrix** given below (numbers in the matrix represent a gain or loss of customers).

	Strategy of XYZ		
	FB	WA	NL
NL FB	30	40	-80
FB WA	0	15	-20
WA NL	90	20	50

(Strategy of ABC labels the rows)

Determine **optimal strategies** and the worth of such strategies for both ABC and XYZ.

2. Find the optimum **integer** solution to the following LPP.

$$\textbf{\textit{Maximize }} Z = x_1 + x_2$$
$$s.t. \quad 3x_1 + 2x_2 \leq 5,$$
$$x_2 \leq 2,$$
$$x_1, x_2 \geq 0 \text{ and are integers}$$

3. An airline company has drawn up a new flight schedule that involves 5 flights. To assist in allocating 5 pilots to the flights, it has asked them to state their preference scores by giving each flight a number out of 10. The higher the number, the greater the preference. A few of these flights are unsuitable to some pilots, owing to domestic reasons. There have been marked with 'X'.

	Flight				
	A1	A2	A3	A4	A5
P1	8	2	X	5	4
P2	10	9	2	8	4
P3	5	4	9	6	X
P4	3	6	2	8	7
P5	5	6	10	4	3

(Pilot labels the rows)

What should be the **allocation** of the pilots to flights in order to meet as many preferences as possible?

P.T.O.

4. Use **revised simplex** method to solve the following LPP.

$$Maximize \ Z = x_1 + 2x_2$$
$$s.t. \quad x_1 + x_2 \leq 3,$$
$$x_1 + 2x_2 \leq 5,$$
$$3x_1 + x_2 \leq 6$$
$$x_1, x_2 \geq 0$$

5. Suppose, you need to design a feed-forward neural network with backpropagation to learn the Boolean OR function.

Show the **computational steps** for a forward and backward propagation with a single set of input values/features.

Also check whether after the second forward propagation, the loss is decreasing.

You have to use *squared-error* loss, *softplus* activation function, *gradient descent with momentum* optimizer.

$$softplus(z) = \log_e(1 + e^z)$$

6. Write in brief and to-the-point.

    (a) Difference between linear regression and logistic regression.
    (b) Advantages of Nesterov accelerated gradient descent over gradient descent with momentum.
    (c) Advantages of ADAM over RMSPROP.
    (d) Advantages and disadvantages of MSE and MAE.
    (e) Advantages of *learning rate decay* over *fixed learning rate*.

------ All the best ------