There are four questions, answer all, and you can score 40 marks. The value at the end of the question within the bracket represents the max marks. You are allowed to use EXCEL/LINGO.

Q1. Two technicians are attending to six operating machines in a workshop. Each machine breaks down according to Poisson distribution with a mean of 2 per hour. The repair time is exponentially distributed with a mean of 15 minutes. [9=3+3+3]
(a) Find the expected number of machines in the systems and in the queue.
(b) Find the expected waiting time of a machine in the system and queue.
(c) Find the probability that the two repairmen are idle and that one is idle.

Q2. Suppose a client has Rs. 100000 to invest and as an initial strategy would like to invest in two stocks only, Indian Oil and A1 Properties. Formulate a multi-objective optimization problem (MOOP) with the help of the following information. [20=5+5+5+5]

Stocks	Price/Share	Annual Return/Share	Risk Index/Share
Indian Oil	25	12%	0.5
A1 Properties	50	10%	0.25

Solve the MOOP (1) using the weighted-sum (WS) method, and (2) using the ϵ-constraint(EC) method. Find at least four different solutions using each of these methods and summarize the solutions(you can use EXCEL/LINGO).
(a) What is your preferred solution among the obtained ones and why?
(b) Which method (WS/EC) do you prefer to solve this MOOP and why?

Q3. Assume that the following quantity discount schedule is applicable. If annual demand is 120 units, the ordering cost is Rs. 1000 per order, and the annual holding cost rate is 25%, what order quantity would you recommend? [6]

Order Size	Discount (%)	Unit Cost (Rs.)
0 to 59	0	1500
60 and more	5	1425

Q4. Consider the demand, holding cost, and ordering cost data as in Problem Q3. Assume back ordering is allowed with a cost of Rs. 1200 per unit per year. [5=1.5+1+1+1.5]
(a) Find the new EOQ
(b) Maximum Inventory
(c) Cycle Time and
(d) Total cost.