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M.A./M.Sc. Semester II Examination, 2020 (CBCS)
Subject: Mathematics
Course: MMATG 207 (Operations Research)

Time: 2 Hours Full Marks: 40

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

[Notation and symbols have their usual meaning]

Answer any **four** questions. Only **first four** answers will be evaluated. 10×4 = 40

1 (a) The demand rate for an item in a company is 18000 units per year, and the company can produce the item at a rate of 3000 per month. The cost of one set-up is Rs 500.00 and the holding cost of one unit is Rs 0.15 per month. The shortage cost of one unit is Rs 20.00 per year. Determine the optimum manufacturing quantity and shortage level. Find also the manufacturing time and time between setups. [5]

(b) Find the optimal EOQ for a product having monthly demand 250 units, ordering cost Rs. 300 per order, holding cost Rs. 20% of unit purchase cost, and purchase cost Rs. 15 per unit for $0 \leq Q < 500$ and Rs. 14.50 per unit for $Q \geq 500$. [5]

2. Consider the following L.P.P.: [10]

$Max\ z = cx$

subject to $Ax \leq b, x \geq 0$, where $c, x^T \in \mathbb{R}^n, b^T \in \mathbb{R}^m$ and A in $m \times n$ real valued coefficient matrix. Determine the range of the discrete changes of the components a_{kj} of the coefficient matrix *A*, which does not belong to basis, so as to maintain the optimal feasible solution of the L.P.P.

3. (a) Solve the LPP by the revised simplex method [6]

$Max\ z = 3x_1 + 2x_2$

subject to $2x_1 + x_2 \leq 2, 3x_1 + 4x_2 \geq 12, x_1 \geq 0, x_2 \geq 0$.

(b) Write down the effect on optimal solution when a constraint is deleted from an LPP. [4]

4. (a) Derive a necessary and sufficient condition for finding maximum value of $f(x_1, x_2)$. [6]

(b) $Minimize\ F(x_1, x_2, x_3) = \frac{1}{2}(x_1^2 + x_2^2 + x_3^2)$ [4]

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subject to $x_1 - x_2 = 0$ and $x_1 + x_2 + x_3 = 1$.

5. (a) What do you mean by effective arrival rate of a queueing system with finite capacity? Calculate the expected number of units in the system and expected queue length for the queuing system (M/M/1):(∞/FCFS/∞). [4]

(b) In a railway yard, goods trains arrive at a rate 30 trains per day. Assume that the inter-arrival time follows an exponential distribution and the service time (the time take to hump a train) distribution is also exponential with an average of 36 min. Calculate the following: [6]

The average number of trains in the system.

The probability that the number of trains in the system exceeds 10.

Expected waiting time in the queue

Average number of trains in the queue.

6. (a) Describe the solution procedure of Branch and Bound method for solving all integer linear programming problem. [4]

(b) Solve the following mixed integer programming problem: [6]
Max $z = 7x_1 + 9x_2$
subject to $-x_1 + 3x_2 \leq 6$,
$7x_1 + x_2 \leq 35$, $x_1, x_2 \geq 0$ and x_1 is an integer