MID-SEMESTER EXAMINATION

INDUSTRIAL ENGINEERING & OPERATIONS RESEARCH (ME324)

ME, IIT Guwahati **4-03-2022, 2 – 4 PM** **Total Marks: 40**

Note: Answer all **four** questions. Show your calculations in support of your answer.

Q1. A project is composed of activities whose time estimates are listed in the following table. Activities are identified by their beginning (i) and ending (j) node numbers.

Activity	Estimated durations (Days)		
i–j	Optimistic (t_o)	Most likely (t_m)	Pessimistic (t_o)
1–2	1	4	7
1–3	5	11	17
2–4	4	7	28
2–3	1	2.5	7
3–4	1	4	7

(i) Draw the project network and determine the critical path? What is the expected project length? **(2+3+1)**

(ii) What is the probability that the project will be completed **(2+2)**

(a) At least 3 days earlier than the expected time?

(b) No more than 3 days later than the expected time?

Z	0.5	0.67	1	1.34
p	0.1915	0.2486	0.3413	0.41

Q2. ABC shipping company has three warehouses in Mumbai, Chennai, and Kochi, where the stocks of a particular commodity are available to the extent of 300, 300, and 500 tonnes, respectively. Three customers in Trivandrum, Mysore, and Bangalore, whose monthly requirements for the item are 240, 480, and 380 tonnes, respectively, will be serviced through these three warehouses. The shipping cost (in Rs.) per tonne is provided in the table below.

Warehouse	Customer		
	Trivandrum	Mysore	Bangalore
Mumbai	100	200	50
Chennai	160	60	200
Kochi	180	120	90

(i) Find an initial feasible solution using **Vogel's approximation method** to find out how much of the item should be supplied by each warehouse to each customer while minimizing the total shipping costs? **(5)**

(ii) Find out the **optimal solution** to the present problem. **(5)**

Q3. An LPP problem is modelled using the following objective function: $Max.\ z = x_1 + x_2$. The objective function is subjected to three constraints of $\geq$ types and the decision variables are non-negative. The following is the simplex tableau in i-th iteration of Phase – I of Two Phase simplex method.

Basic	x_1	x_2	S_1	S_2	S_3	R_1	R_2	R_3	Solution
r	7/2	0	-1	0	¼	0	-1	-5/4	6
R_1	7/2	0	-1	0	¼	1	0	-1/4	6
x_2	¼	1	0	0	-1/8	0	0	1/8	3
R_3	-5	0	0	1	-1	0	-1	1	0

Here, r is the objective function of Phase-I, S_1, S_2, and S_3 are the slack variables for constraint-1, constraint-2, and constraint-3, respectively. R_1, R_2, and R_3 are the artificial variables for constraint-1, constraint-2, and constraint-3, respectively. Find the optimal solution using the steps of Two Phase simplex method. Perform your calculations in fraction. **(10)**

Q4. The optimal simplex tableau for a maximization problems having two $\leq$ type constraints and non-negative decision variables is given below.

Basic	x_1	x_2	S_1	S_2	Solution
z	0	0	1	9/8	64
x_1	1	0	¾	-3/32	3
x_2	0	1	-1/2	3/16	4

The following constraint is now added to the given problem: $2x_1 + 5x_2 \leq 20$. What is the new optimal solution if any? Perform your calculations in fraction. **(10)**