Examination: VII Sem. B.Tech (Mining Engineering) **Session: 2022-23**

Semester: Monsoon Semester **Max. Marks: 30**

Subject: Mine Systems Engineering MND 404 **Time: 2 Hrs.**

Q1. Answer the following: each subsection carries 2 marks ***(6 marks)***

i. List any 4 benefits of the First Mile connectivity project of CIL to mining logistics
ii. Name any 4 modes of coal transport from mines and rank them in order of magnitude of material transported
iii. List any 4 measures taken by the Indian railways to increase coal transportation

Q2. A linear programming problem consists of maximizing an objective function P involving three variables ***x, y, and z***. Slack variables ***s, t, u and v*** are introduced and simplex table is given below. Several iterations lead to the following tableau. ***(5 marks)***

P	***x***	***y***	***z***	***s***	***t***	***u***	***v***	***value***
1	0	−12	0	5	−3	0	0	37
0	1	−8	0	1	2	0	0	16
0	0	4	0	0	3	0	1	20
0	0	2	0	−3	2	1	0	14
0	0	1	1	2	5	0	0	8

a)

i. State the pivot for the next iteration is chosen from which column and why. State which value should be chosen and explain the reason of your choice. ***(1marks)***
ii. Perform the next iteration of the Simplex method ***(1marks)***

b) Explain why your new tableau solves the original problem ***(1marks)***

c) State the maximum value of ***P*** and values of ***x, y, and z*** that produce the maximum value ***(1marks)***

d) State the values of slack variables at the optimum point. Hence determine how many of the original inequalities still have some slack at the optimal solution. ***(1marks)***

Q3. *Prove* ***that e^x is a convex function*** *for all x ϵ Real Numbers* ***(4 marks)***

if $f(\theta x + (1-\theta)y) \leq \theta f(x) + (1-\theta)f(y), \ \forall x, y \in R^n, 0 < \theta < 1$

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Q4. Clearly show all steps and equations in solving the problem ***(5 marks)***

Question-4 (LP problem)

A small mining company that produces both copper and nickel owns two mines whose ores contain both minerals. The two mines have different costs and different production rates. Furthermore their products are different. Mine 1 produces 40 tons of copper per day and 15 tons of nickel per day. Mine 2 produces 20 tons of copper/day and 30 tons of nickel/day

The company has contracted to provide 100 tons per week of copper and 150 tons per week of nickel. Daily operating costs have been estimated as $3,000 and $9,000 for mines 1 and 2, respectively. The company policy states that neither mine can be in operation for more than 5 days per week for safety reasons.

The company is interested to identify number of days per week mines 1 and/or 2 should be operated so that the company meet its contract obligation at least total cost.

Answer the following questions based on the information provided.

a) Formulate the problem mathematically
b) Solve this linear optimization problem using graphical method (show the graph and lightly shade in the feasible region if there is one)

Q5.

A mining company has three mines (M1, M2 and M3) that supply coal to three power plants (P1, P2 and P3). The three mines produce **900, 1000 and 1200 te of coal per day respectively**. The power plant requirements from these three mines are **1200, 1000 and 900 te per day respectively**. The unit cost of transporting coal from the three mines to the three power plants in Rs. is given below **(5 Marks)**

		Power plants		
		P1	P2	P3
	M1	8	10	12
Mines	M2	12	13	12
	M3	14	10	11

Calculate the initial basic feasible solution, using Vogel's approximation method, what is the total transportation **cost in Rs**. Also **calculate the optimal solution using MODI method**. Clearly show all the steps involved for arriving at the solution, starting from whether the problem is balanced or not.

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Q6. A mining company has five machines that are used for four jobs. Each job can be assigned to one and only one machine. The cost of each job on each machine is given in the following Table. Find the assignment of machines for each job and total minimum cost using the Hungarian method. Show all iterations and steps involved in the solution.

(5 Marks)

		Machines				
		A	**B**	**C**	**D**	**E**
Job	**1**	5	7	11	6	7
	2	8	5	5	6	5
	3	6	7	10	7	3
	4	10	4	8	2	4