Reg. No.



MANIPAL (A constituent unit of MAHE, Manipal)

# VI SEMESTER B. TECH (MECHANICAL ENGG.) END SEMESTER EXAMINATIONS, APRIL 2019

## SUBJECT: OPERATIONS RESEARCH [MME 4026]

### **REVISED CREDIT SYSTEM**

#### Time: 3 Hours

MAX. MARKS: 50

#### Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitably assumed.
- Use of statistical table is permitted
- **1A.** A firm produces an alloy having the following specifications:

(5)

- i) Specific gravity  $\leq 0.98$
- ii) Chromium ≥ 8%
- iii) Melting point  $\ge 450^{\circ}C$

Raw materials A, B and C having the properties shown in the table can be used to make the alloy.

Property	Properties of raw material					
roperty	Α	В	C			
Specific gravity	0.92	0.97	1.04			
Chromium	7%	13%	16%			
Melting point	440 <sup>0</sup> C	490 <sup>0</sup> C	480 <sup>0</sup> C			

Cost of the various raw materials per ton are: ₹90 for A, ₹280 for B and ₹40 for C. Formulate the linear programing model to find the proportions in which A, B and C can be used to obtain an alloy of desired properties keeping the cost of the raw materials is minimum.

**1B.** Solve the game for the pay-off given below.

		Player B			
		b <sub>1</sub> b <sub>2</sub> b			
ayer A	<b>a</b> 1	1	-1	-1	
	a <sub>2</sub>	-1	-1	3	
Ъľ	a <sub>3</sub>	-1	2	-1	

(5)

Evaluate the following:

- Value of the game
- Strategies of the players
- **2A.** Solve the linear programming problem given below:

Max. Z =  $20x_1 + 30x_2 + 5x_3$ S.t,  $4x_1 + 3x_2 + x_3 \le 40$  $2x_1 + 5x_2 \le 28$  $8x_1 + 2x_2 \le 36$  $x_1, x_2, x_3 \ge 0$ 

2B. A small project consists of seven activities for which relevant data are given (5) below:

Activity	Immediate	Duration (da	
Activity	Predecessor	ys)	
A	-	4	
В	-	7	
С	-	6	
D	A,B	5	
E	A,B	7	
F	C,D,E	6	
G	C,D,E	5	

Draw the network and compute the following:

- Total float
- Free float
- Independent float.
- **3A.** Write the dual of the following LPP:

 $Max \ Z = 3x_1 + 4x_2 + 7x_3$ 

S.t., 
$$x_1 + x_2 + x_3 \le 10$$
  
 $4x_1 - x_2 - x_3 \ge 15$   
 $x_1 + x_2 + x_3 = 7$ 

 $x_1, x_2 \ge 0 \& x_3$  is unrestricted in sign.

3B. A machine operator processes four types of items on his machine each week (5) and must choose a sequence for them. The set-up cost in ₹ '000s for every change varies as per following table:

(5)

(5)

		То			
		Α	В	С	D
	Α	-	4	7	3
E	В	4	-	6	3
Fro	С	7	6	-	7
	D	3	3	7	-

How should the operator sequence the machine? Also compute the total setup cost.

**4A.** Food bags have to be lifted by three different types of aircraft from airports **(5)** and dropped at five flood affected villages. The amount spent in lakhs of rupees per trip in transporting the food, their supply and demand are given in the table below. What will be the minimum total cost incurred in delivering the food packets by the aircrafts?

Village Airport	V1	V2	V3	V4	V5	Supply
A1	10	8	6	9	12	50
A2	5	3	8	4	10	90
A3	7	9	6	10	4	60
Demand	100	80	70	40	20	

4B. Suggest optimal assignment for four sales representatives to different sales (5) territories where estimated monthly sales (in lakhs rupees) to be made by each of them are given below:

Sales	Sales territories				
representatives	W	X	Y	Z	
A	20	25	22	18	
В	25	24	19	21	
C	18	20	22	20	
D	25	20	17	22	

What will be the total maximum sales per month?

5A. A bakery keeps stock of a popular brand of cake. Daily demand based on (5) past experience is given below:

Daily demand	0	15	25	35	45	50
Probability	0.01	0.15	0.2	0.5	0.12	0.02

- Using the following random nos.: 48, 78, 09, 51, 56, 77, 15, 14, 68, 09 simulate the demand for the next 10 days.
- What will be the average unsold quantities for those 10 days if the owner decides to keep a stock of 35 on the daily basis?
- **5B.** The following project description provides time estimates of various activities **(5)** as follows:

Activities	Activity	Time e	estimates (w	veeks)
	, country -	Τo	Т <sub>р</sub>	T <sub>m</sub>
A	1—2	6	12	9
В	1—3	3	9	6
С	2—4	1	4	3
D	3—5	4	8	6
E	4—5	5	15	10
F	5—6	5	9	7

Find:

- The expected project length and standard deviation of project completion time.
- > What is the probability of completing the project in 26 weeks?
- The time in which management can be 95% confident of completing project.