Reg. No. : ⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜

K 4380

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Eighth Semester

Mechanical Engineering

ME 1018 — OPERATIONS RESEARCH

(Common to Eighth Semester Automobile Engineering, Metallurgical Engineering and Sixth Semester Mechatronics Engineering)

(Regulation 2004)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write down the standard form of a LP problem.

2. What do you understand by 'Degeneracy' in a LP problem?

3. State the necessary and sufficient condition for a transportation problem to have a feasible solution.

4. Distinguish between a transportation problem and assignment problem.

5. What do you mean by slack? Define critical path with reference to slack.

6. Distinguish between PERT and CPM.

7. What do you understand by 'present work factor' and 'compounded annual factor'?

8. What do you understand by 'no passing rule' in a sequencing problem?

9. Define 'Utilization factor'.

10. What do you mean by 'service discipline'?

11. (a) A firm produces three products. These products are processed on three different machines. The time required to manufacture one of each of three products and the daily capacity of the three machines are given below :

| Machine | Time per Unit (minutes) | | | Machine capacity |
	Product 1	Product 2	Product 3	Minutes / day
M1	2	3	2	440
M2	4	—	3	470
M3	2	5	—	430

It is required to determine the daily number of units to be manufactured for each product. The Profit per unit for product 1, 2 and 3 is Rs. 40/-. Rs 30/- and Rs. 30/- and Rs. 60/- respectively. It is assumed that all the amounts produced are consumed in the market. Formulate a LP model to maximize the daily profit. Also determine the optimum production schedule.

Or

(b) Maximize $Z = X_1 + 2X_2 + 3X_3 - X_4$

Subjected to $X_1 + 2X_2 + 3X_3 = 15$

$2X_1 + X_2 + 3X_3 = 20$

$X_1 + 2X_2 + X_3 + X_4 = 10$ and

$X_1, X_2, X_3, X_4 \geq 0$.

12. (a) A production control superintendent finds the following information on his desk : In departments A, B and C, the number of surplus palet is 18, 27 and 21 respectively. In department G, H, I and J, the number of pallets required 14, 12, 23 and 17 respectively. The time in minutes to move a pallet from one department to another is given below :

From \ To	G	H	I	J
A	13	25	12	21
B	18	23	14	9
C	23	15	12	16

What is the optimal distribution plan to minimize the moving time?

Or

(b) A company has one surplus truck in each of the cities *A*, *B*, *C*, *D* and *E* and one deficit truck in each of the cities 1, 2, 3, 4, 5 and 6. The distance between the cities in kilometers is shown in matrix below. Find the assignment of trucks from cities in surplus to cities in deficit so that the total distance covered by vehicles is minimum.

	1	2	3	4	5	6
A	12	10	15	22	18	8
B	10	18	25	15	16	12
C	11	10	3	8	5	9
D	6	14	10	13	13	12
E	8	12	11	7	13	10

13. (a) Tasks *A*, *B*, *C* .... *H*, *I* constitute a project. The precedence relationship are $A < D$; $A < E$; $B < F$; $D < F$; $C < G$; $C < H$; $F < I$; $G < I$;

Draw a network to represent the project and find the minimum time of completion of the project when time in days, of each task is as follows :

Task :	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*
Time :	8	10	8	10	16	17	18	14	9

Identify the critical path and determine total, free and independent floats.

Or

(b) Construct a PERT network from the following information and determine the critical path.

Activity	Immediate predecessor	T_o	T_m	T_p
A	--	1	2	3
B	*A*	2	4	6
C	*A*	2	6	10
D	*B*	6	8	10
E	*C*	4	6	8
F	*C*	6	10	14
G	*E*	8	10	12
H	*F*	12	14	16
I	*G*, *H*	4	8	12
J	*G*, *H*	10	12	14
K	*I*	2	4	6
L	*J*	6	10	14

(i) Assume that the schedule allows 40 days to complete the whole project, calculate the probability of completion by scheduled date.

(ii) The contractor wants a scheduled completion date that will give him 98% chance of attaining, how many days should be allowed in this schedule.

14. (a) The maintenance engineer for a large construction company is examining alternatives open to him for the replacement of hydraulic hoses on the firm's 100 front end loaders; each loader uses six hoses, which from historical maintenance record fail at this rate.

Month of use :	1	2	3	4	5
% requiring replacement by that month :	10	15	20	70	100

The maintenance engineer learns that in the field replacement costs Rs. 80/- per hose while it costs only Rs. 40/- per hose if all the hoses are replaced at regular intervals during routine maintenance and service. Evaluate the alternatives open to this engineer and recommend a course of action.

Or

(b) Find the sequence that minimizes that total elapsed time required to complete the following tasks. Each task is processed in any two of the machines A, B and C in any order.

		Task					
		1	2	3	4	5	6	7
	A	12	6	5	3	5	7	6
Machine	B	7	8	9	8	7	8	3
	C	3	4	11	5	2	8	4

15. (a) Ships arrive at a port at the rate of one in every 4 hours with exponential distribution of inter arrival times. The time a ship occupies a birth for unloading has exponential distribution with an average of 10 hours. If the average delay of ships waiting for berths is to be kept below 14 hours, how many berths should be provided at the port?

Or

(b) Customer arrives at a clinic at the rate of 8 per hour and the doctor can serve at the rate of 9 per hour. What is the probability that a customer does not join the queue and walks into the doctors room and what is the probability that there is no queue? Suppose there is a restriction of 10 people in the system, what is the probability an entering person forced to leave the queue without joining it? What is the change in the expected number in the system and expected waiting time in the queue?