Printed Pages : 8 TMA-013/MA-013

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 9974/9932 Roll No.

B. Tech.

(SEM. VI) EXAMINATION, 2006-07

PRINCIPLES OF OPERATIONS RESEARCH

Time : 3 Hours] *[Total Marks : 100*

Note : *(1) Attempt **all** questions.*

*(2) All questions carry **equal** marks.*

(3) The choice of questions is internal as indicated in each question.

(4) Graph papers will be provided on demand.

1 Attempt any **four** of the following : 5×4=20

(a) Solve the following **LPP** by graphical method :

Maximize $Z = 3x_1 + 4x_2$

Subject to $4x_1 + 2x_2 \leq 80$, $2x_1 + 5x_2 \leq 180$

and $x_1, x_2 \geq 0$

(b) Explain clearly the following terms used in **LPP** :

(1) Objective function

(2) Decision variables,

(3) Slack variables

(4) Surplus variables and

(5) Redundant constraints.

(c) Convert the following **LPP** to the standard form :

Maximize $Z = 5x_1 + 7x_2 + 9x_3$

Subject to
$$4x_1 - 6x_2 \leq 5$$
$$3x_1 + 2x_2 + 7x_3 \geq 12$$
$$4x_1 + 3x_3 \leq 2$$

and $x_1, x_2 \geq 0$

(d) Write the dual of the following **LPP** :

Minimize $Z = 3x_1 - 2x_2 + 6x_3$

Subject to
$$4x_1 + 5x_2 + 3x_1 \geq 7$$
$$3x_1 + x_2 + 6x_3 \geq 5$$
$$7x_1 - 2x_2 - 3x_3 \leq 10$$
$$x_1 - 2x_2 + 5x_3 \geq 3$$
$$4x_1 + 7x_2 - 9x_3 \geq 2$$

and $x_1, x_2, x_3 \geq 0$

(e) Solve the following **LPP** by simplex method :

Minimize : $Z = x_1 - 3x_2 + 3x_3$

Subject to
$$3x_1 - x_2 + 2x_3 \leq 7$$
$$2x_1 + 4x_2 \geq -12$$
$$-4x_1 + 3x_2 + 8x_3 \leq 10$$

and $x_1, x_2, x_3 \geq 0$

(f) Fill in the blanks so that the following statements are correct :

(1) A constraint which does not affect the solution of an **LPP**, is called _____

(2) Any solution to an **LPP** which satisfies the non-negativity condition is called _____

(3) The feasible solution of an **LPP** is _____ of the objective function.

(4) Iso-profit lines on a graph of an LPP would always be _____ to each other.

(5) A constraint $5x_1 + 3x_2 \leq 12$ on an **LPP** is replaced by the constraint $5x_1 + 3x_2 \leq 7$. This would make the **LPP** more restrictive in nature. The constraint $5x_1 + 3x_2 \leq 12$ now becomes _____.

Attempt any **four** of the following : **5×4=20**

(b) What is a transportation problem ? Give the mathematical formulation of the transportation problem.

(b) What is a trans-shipment problem ? Explain how it can be formulated and solved as a transportation problem ?

(c) Find the initial basic feasible solution for the following transportation problem by **VAM** :

Factory	Destination				*Supply*
	D_1	D_2	D_3	D_4	
F_1	11	13	17	14	250
F_2	16	18	14	10	300
F_3	21	24	13	10	400
Demand	200	225	275	250	950

(d) A company has five jobs to be done on five machines. Any job can be done on any machine. The cost of doing the jobs in different machines are given below :

Jobs	*Machines*				
	M_1	M_2	M_3	M_4	M_5
J_1	13	8	16	18	19
J_2	9	15	24	9	12
J_3	12	9	4	4	4
J_4	6	12	10	8	13
J_5	15	17	18	12	20

Assign the jobs for different machines so as to minimize the total cost ?

(e) Solve the following integer programming problem using branch and bound method :

Maximize $Z = 3x_1 + 2.5x_2$

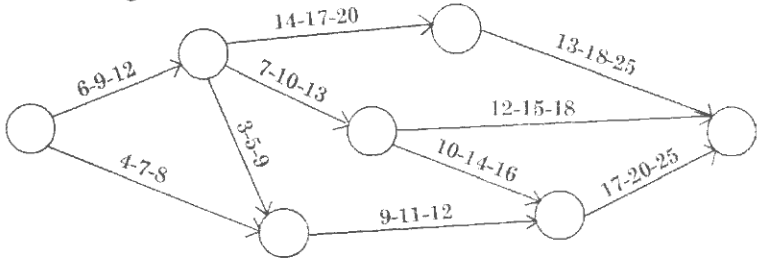
Subject to $x_1 + 2x_2 \geq 20$, $3x_1 + 2x_2 \geq 50$

and $x_1, x_2 \geq 0$ and both are integers.

(f) Give the various steps involved in Hungarian method to solve an assignment problem.

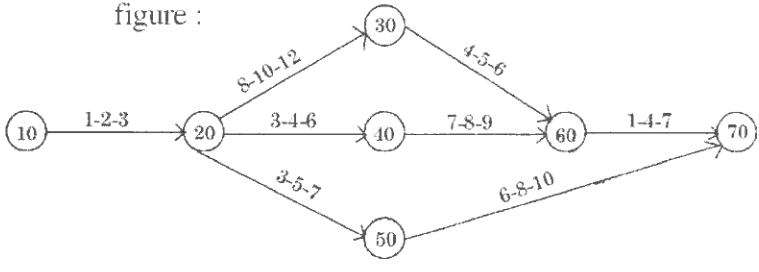
3 Attempt any **two** of the following : **10×2=20**

(a) Calculate the variance and expected activity time for the activities of the network shown in the following figure :



For each activity, the three estimates t_0, t_m and t_p are given along the arrows in the $t_0 - t_m - t_p$ order. Enter calculations in the tabular form.

(b) Consider **PERT** network given in the following figure :



Find the float of each activity and identify the critical path if the scheduled completion time for the project is **20** weeks. Also, identify the sub-critical path.

(c) There are five jobs, each of which has go through the two machines M_1 and M_2 in the order M_1M_2. Processing times are given in the following table :

	Processing times in hours for the job				
Machines	**1**	**2**	**3**	**4**	**5**
Machine - M_1	**5**	**1**	**9**	**3**	**10**
Machine - M_2	**2**	**6**	**7**	**8**	**4**

Determine a sequence of the five jobs that will minimize the total elapsed time **T**. Calculate the total idle time for the machines in this period.

4 Attempt any **two** of the following : **10×2=20**

(a) A manufacturer has to supply his customer with **600** units of his product per year. Shortages are not allowed and the storage cost amount to Re. **0.60** per unit per year. The set up cost per run is Rs. **80.** Find (i) The optimum run size, (ii) Optimum scheduling period and (ii) The minimum average yearly cost.

(b) A machine owner finds from his past records that the costs per year of maintanining (i.e. operations) a machine whose purchase price is Rs. 6000, are as given below :

Year	1	2	3	4	5	6	7	8
Operating Cost (in Rs.)	1000	1200	1400	1800	2300	2800	3400	4000
Resale Value (in Rs.)	3000	1500	750	375	200	200	200	200

Determine at what age, the replacement of the machine is due ?

(c) The following failure rates have been observed for a certain type of light bulbs :

Week	1	2	3	4	5
Percent failing by the end the week	10	25	50	80	100

There are 1000 bulbs in use and it costs Rs. 10 to replace an individual bulb which has burnt out. If all the bulbs were replaced simultaneously, it would cost Rs. 4 per bulb. It is proposed to replace all bulbs at fixed intervals of time, whether or not they have burnt out and to continue replacing burnt out bulbs as and when they fail. At what intervals, should all the bulbs be replaced ? At what group replacement price per bulb would a policy of strictly individual replacement become preferable to the adopted policy ?

5 Attempt any **two** of the following : **10×2=20**

(a) What do you understand by inventory ? Give the merits and demerits of inventory ? What is inventory control ? What are the main objectives of inventory control ?

(b) Use dynamic programming to solve the following LPP :

Maximize $Z = x_1 + 9x_2$

Subject to $2x_1 + x_2 \leq 25, \quad x_2 \leq 11$

and $x_1, \ x_2 \geq 0$

(c) State Bellman's principle of optimality in reference to dynamic programming problem. Give the basic characteristics of dynamic programming problem.