Q.2   **a. State the different phases in an operations research study.**   **(6)**

Answer:
The phases in an OR study consists of the following steps:
1. Definition of the problem.
2. Construction of the model.
3. Solution of the model.
4. Validation of the model.
5. Implementation of the final result.

1 Definition of the problem
The first and the most important requirement is that the root problem should be identified and understood. The problem should be identified properly, this indicates three major aspects: (1) a description of the goal or the objective of the study, (2) an identification of the decision alternative to the system, and (3) a recognition of the limitations, restrictions and requirements of the system.

2 Construction of the model
Depending on the definition of the problem, the operations researchteam should decide on the most suitable model for representing the system. Such a model should specify quantitative expressions for the objective and the constraints of the problem in terms of its decision variables. A model gives a perspective picture of the whole problem and helps tackling it in a well organized manner. If the resulting model fits into one of the common mathematical models, a convenient solution may be obtained by using mathematical techniques. If the mathematical relationships of the model are too complex to allow analytic solutions, a simulation model may be more appropriate. There are various types of models which can be constructed under different conditions.

3 Solution of the model
Once an appropriate model has been formulated, the next stage in the analysis calls for its solution and the interpretation of the solutionin the context of the given problem. A solution to a model implies determination of a specific set of decision variables that would yield an Optimum solution. An Optimum solution is one which maximize or minimize the performance of any measure in a model subject to the conditions and constraints imposed on the model.

4 Validation the model
A model is a good representative of a system, then the Optimal solution must improve the system's performance. A common method for testing the validity of a model is to compare its performance with some past data available for the actual system. The model will be valid if under similar conditions of inputs, it can reproduce the past performance of the system. The problem here is that there is no assurance that future performance will continue to duplicate past behaviour. Also, since the model is based on careful examination of past data, the comparison should always reveal favorable results. In some instances this problem may be overcome by using data from trial runs of the system. It must be noted that such a validation method is not appropriate for nonexistent systems, since data will not be available for comparison.

5 Implementation of the final result

The optimal solution obtained from a model should be applied practice to improve the performance of the system and the validity of the solution should be verified under changing conditions. It involves the translation of these results into detailed operating instructions issued in an understandable form to the individuals who will administer and operate the recommended system. The interaction between the operations research team and the operating personnel will reach its peak in this phase.

     b. **Rolls of paper having a fixed length and width of 180 cm. are being manufactured by a paper mill. These rolls have to be cut to satisfy the following demand:**   **(10)**

Width:	80 cm.	45 cm.	27 cm.
No. of Rolls:	200	120	130

     Obtain the linear programming formulation of the problem to determine the cutting pattern, so that the demand is satisfied and wastage of paper is a minimum.

Answer:

Mathematical Formulation

Various alternatives for the number of rolls are given blow:

Feasible patterns of cutting	No. of rolls cut	Wastage per roll (cm)	Rolls obtained from each mother roll of width		
			80 cm.	45 cm.	27 cm.
80 + 80	x_1	20	2	—	—
80 + 45 + 45	x_2	10	1	2	—
80 + 45 + 27 + 27	x_3	1	1	1	2
80 + 27 + 27 + 27	x_4	19	1	—	3
45 + 45 + 45 + 45	x_5	0	—	4	—
45 + 45 + 45 + 27	x_6	18	—	3	1
45 + 45 + 27 + 27 + 27	x_7	9	—	2	3
45 + 27 + 27 + 27 + 27 + 27	x_8	0	—	1	5
27 + 27 + 27 + 27 + 27 + 27	x_9	18	—	—	6

Thus, the linear programming problem is:

Minimize $z = 20x_1 + 10x_2 + x_3 + 19x_4 + 18x_6 + 9x_7 + 18x_9$ subject to the constraints:

$$2x_1 + x_2 + x_3 + x_4 = 200 \qquad \text{(80 cm. rolls)}$$

$$2x_2 + x_3 + 4x_5 + 3x_6 + 2x_7 + x_8 = 120 \qquad \text{(45 cm. rolls)}$$

$$2x_3 + 3x_4 + x_6 + 3x_7 + 5x_8 + 6x_9 = 130 \qquad \text{(27 cm. rolls)}$$

$$x_j \geq 0 ; \quad j = 1, 2, 3, ..., 9.$$

Q.3   a. **Give the standard form of a linear programming problem.**   **(4)**

Answer:

Standard form of LPP must have following three characteristics:

1. Objective function should be of maximization type

2. All the constraints should of equality type
3. All the decision variables should be nonnegative

   b. Solve the following LPP using Simplex method: (12)
$$\text{Min } Z = x_1 - 3x_2 + 2x_3$$
$$\text{Subject to:} \quad 3x_1 - x_2 + 2x_3 \le 7$$
$$-2x_1 + 4x_2 \le 12$$
$$-4x_1 + 3x_2 + 8x_3 \le 10$$
$$x_1, x_2, x_3 \ge 0.$$

Answer:

Solution. By introducing slack variables $x_6 \ge 0$, $x_7 \ge 0$ and $x_8 \ge 0$, and converting the objective function into maximization form, the given L.P.P. becomes:

Maximize $z^* = -1 \cdot x_2 + 3x_3 - 2x_5 + 0 \cdot x_6 + 0 \cdot x_7 + 0 \cdot x_8$ subject to the constraints:

$$3x_2 - x_3 + 2 \cdot x_5 + x_6 = 7, \quad -2x_2 + 4x_3 + 0 \cdot x_5 + x_7 = 12$$
$$-4x_2 + 3x_3 + 8 \cdot x_5 + x_8 = 10; \quad x_2, x_3, x_5, x_6, x_7, x_8 \ge 0.$$

The iterative simplex tables are as follows:

Initial Iteration. Introduce y_2 and drop y_5.

c_B	y_B	x_B	y_1 (−1)	y_2 (3)	y_3 (−2)	y_4 (0)	y_5 (0)	y_6 (0)
0	y_4	7	3	−1	2	1	0	0
0	y_5	12	−2	4*	0	0	1	0
0	y_6	10	−4	3	8	0	0	1
z		0	1	−3	2	0	0	0

First Iteration. Introduce y_1 and drop y_4.

c_B	y_B	x_B	y_1	y_2	y_3	y_4	y_5	y_6
0	y_4	10	5/2*	0	2	1	1/4	0
0	y_2	3	−1/2	1	0	0	1/4	0
0	y_6	1	−5/2	0	8	0	−3/4	1
z		9	−1/2	0	2	0	3/4	0

Final Iteration. Optimum Solution.

c_B	y_B	x_B	y_1	y_2	y_3	y_4	y_5	y_6
−1	y_1	4	1	0	4/5	2/5	1/10	0
3	y_2	5	0	1	2/5	1/5	3/10	10
0	y_6	11	0	0	10	2/5	−1/2	1
z		11	0	0	12/5	1/5	8/10	0

Now since all $z_j - c_j \ge 0$, an optimal basic feasible solution has been attained. Thus the solution o the given L.P.P. is

Minimize $z = -$ Maximize $(-z^*) = -11$; $x_2 = 4$, $x_3 = 5$, $x_5 = 0$.

Q.4   Find the initial basic feasible solution for the following transportation problem using Vogel's approximation method. Further optimize the solution by MODI's method to minimize the total cost of transpiration.   (6+10)

Origins / Destinations	D_1	D_2	D_3	D_4	D_5	D_6	Available
O_1	1	2	1	4	5	2	30
O_2	3	3	2	1	4	3	50
O_3	4	2	5	9	6	2	75
O_4	3	1	7	3	4	6	20
Requirements	20	40	30	10	50	25	

Answer:

Solution. Using Vogel's Approximation method, an initial basic feasible is given in table *15.60*:

Table 15.60

Using *MODI* method, the iterative transportation tables are:

Initial Iteration. Introduce cell (4, 5) and drop cell (4, 2). See table *15.61.*

Final Iteration. Optimum Solution. See table *15.62*:

The optimum solution is

$x_{11} = 20$, $x_{13} = 10$, $x_{23} = 20$, $x_{24} = 10$, $x_{25} = 20$, $x_{32} = 40$, $x_{35} = 10$, $x_{36} = 25$ and $x_{45} = 20.$

The minimum transportation cost is

$20 \times 1 + 10 \times 1 + 20 \times 2 + 10 \times 1 + 20 \times 4 + 40 \times 2 + 10 \times 6 + 25 \times 2 + 20 \times 4 = 430.$

						u_i
20 1	(-3) **10** 2	 1	(-4) 4	(-2) 5	(-3) 2	-1
(-1) 3	(-3) **20** 3	 2	**10** 1	**20** 4	(-3) 3	0
(0) **20** 4	+θ 2	(-1) 5	(-6) 9	**30** -θ 6	**25** 2	2
(0) **20** 3	-θ 1	(-4) 7	(-1) 3	(1) θ 4	(-5) 6	1
v_j 2	0	2	1	4	0	

Table 15.61

						u_i
20 1	(-3) **10** 2	 1	(-4) 4	(-2) 5	(-3) 2	-1
(-1) 3	(-3) **20** 3	 2	**10** 1	**20** 4	(-3) 3	0
(0) **40** 4	 2	(-1) 5	(-6) **10** 9	 6	**25** 2	2
(-1) 3	(-1) 1	(-5) 7	(-2) **20** 3	 4	(-6) 6	0
v_j 2	0	2	1	4	0	

Table 15.62

Q.5   **a. Distinguish between total float and free float.**   **(4)**

Answer:

The Total Float and Free Float of an activity may not always be the same number of days. They can be different based on its predecessor and/or successor activity relationships. By definition:

Total Float (TF) = the maximum amount of time an activity can be delayed from its early start without delaying the ***entire project***.

Late Date – Early Date = Total Float

Free Float (FF) = the maximum amount of time an activity can be delayed without delaying the early start of any of its ***succeeding activities***.

     b. A project consists of eight activities with the following time estimates: **(12)**

Activity	Time	Activity	Time
1 − 2	4	5 − 6	4
1 − 3	1	5 − 7	8
2 − 4	1	6 − 8	1
3 − 4	1	7 − 8	2
3 − 5	6	8 − 10	5
4 − 9	5	9 − 10	7

(i) Construct PERT network.
(ii) Compute T_E, T_L for each event.
(iii) Find the critical path.

Answer:

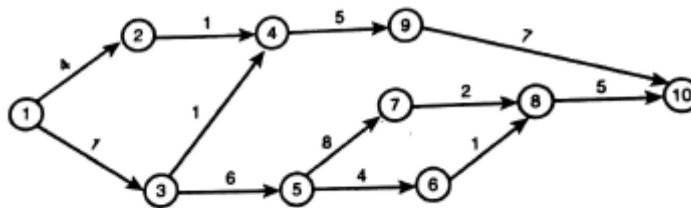*Solution.* Using given information, the resulting network is shown in Fig. 27.17

Fig. 27.17

To determine the minimum time of completion of the project (critical path), we compute ES_i and LF_j for each of the activity of the project. The critical path calculations are:

$$ES_1 = 0 \qquad ES_2 = ES_1 + t_{12} = 0 + 4 = 4 \qquad ES_3 = ES_1 + t_{13} = 0 + 1 = 1$$

$$ES_4 = \max_{i=2,3} \{ES_i + t_{i4}\} = \max. \{4 + 1, 1 + 1\} = 5 \qquad ES_5 = ES_3 + t_{35} = 1 + 6 = 7$$

$$ES_6 = ES_5 + t_{36} = 7 + 4 = 11 \qquad ES_7 = ES_5 + t_{57} = 7 + 8 = 15$$

$$ES_8 = \max_{i=6,7} \{ES_i + t_{i8}\} = \{11 + 1, 15 + 2\} = 17 \qquad ES_9 = ES_4 + t_{49} = 5 + 5 = 10$$

$$ES_{10} = \max_{i=8,9} \{ES_i + t_{i10}\} = \max. \{17 + 5, 10 + 7\} = 22$$

The values of LF_j are now obtained:

$$LF_{10} = LS_{10} = 22 \qquad LF_9 = 22 - 7 = 15 \qquad LF_8 = 22 - 5 = 17$$

$$LF_7 = LF_8 - t_{78} = 17 - 2 = 15$$
$$LF_6 = LF_8 - t_{98} = 17 - 1 = 16$$
$$LF_5 = \min_{j=6,7} \{LF_j - t_{5j}\} = \min. \{16 - 4, 15 - 8\} = 7 \qquad LF_4 = LF_9 - t_{49} = 15 - 5 = 10$$

$$LF_3 = \min_{j=4,5} \{LF_j - t_{3j}\} = \min. \{10 - 1, 7 - 6\} = 1 \qquad LF_2 = LF_4 - t_{24} = 10 - 1 = 9$$

$LF_1 = \min_{j=2,3}\{LF_j - t_{1j}\} = \min.\{9-4, 1-1\} = 0$

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For determining the critical nodes, all these calculations are displayed in the following table:

Activity	Normal time	Earliest time		Latest time		Total float
		Start	Finish	Start	Finish	
(1, 2)	4	0	4	5	9	5
(1, 3)	1	0	1	0	1	0
(2, 4)	1	4	5	9	10	5
(3, 4)	1	1	2	9	10	8
(3, 5)	6	1	7	1	7	0
(4, 9)	5	5	10	10	15	5
(5, 6)	4	7	11	12	16	5
(5, 7)	8	7	15	7	15	0
(6, 8)	1	11	12	16	17	5
(7, 8)	2	15	17	15	17	0
(8, 10)	5	17	22	19	22	0
(9, 10)	7	10	17	15	22	5

Above table shows that the critical nodes are for the activities (1, 3), (3, 5), (5, 7), (7, 8) and , 10). The critical path comprises these activities:
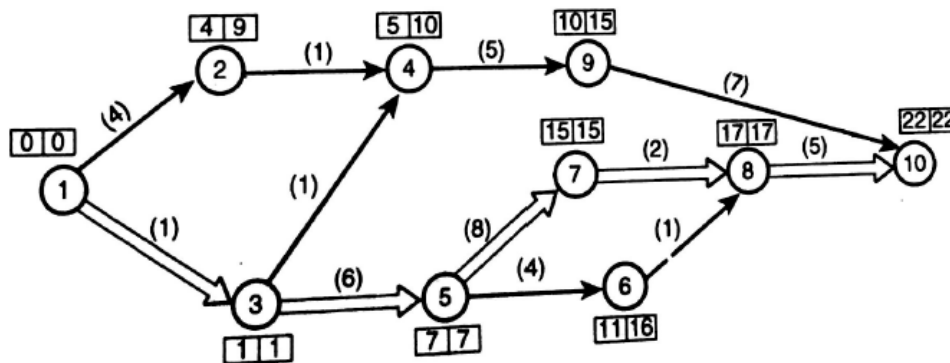
Fig 27.18

Q.6   a. Define saddle point in a two-player zero-sum game. Find out the saddle point for the given pay-off matrix: **(6)**

$$A = \begin{bmatrix} 3 & 4 & 1 & -2 \\ 2 & 5 & 2 & 4 \\ -5 & 2 & 1 & 0 \end{bmatrix}$$

Answer:

Saddle point:- In a two-person Zero-sum game a pay-off matrix $A = (a_{ij})$ is given then the matrix has a saddle point (i, j) if $\min_j \max_i a_{ij} = \max_i \min_j a_{ij}$.

For the given pay-off matrix the saddle point is calculated as:

Player II chooses j

	Strategy	1	2	3	4	Row min
Player I chooses i	1	3	4	1	−2	−2
	2	2	5	2	4	2	←
	3	−5	2	1	0	−5
	Col. max	3	5	2	4	

↑

By taking the maximum of the row minima we see that Player I is guaranteed not to get less than the amount 2 by choosing strategy 2, while, by considering the minimum of the column maxima, Player II is guaranteed not to lose more than 2 by choosing his strategy 3. The upshot is that they will settle on the (2,3) element which is worth 2 to Player I (-2 to Player II) and either player may be worse off if they deviate from the strategies indicated. The amount that they settle on, here 2, is known as the **value** of the game and the element (2,3) of the matrix is a **saddle point**.

b. **Customers arrive at one person barber shop according to Poisson process with a mean inter-arrival time of 20 minutes. Customers spend on an average of 15 minutes in the barber's chair.   (2×5)**
   (i) What is the probability that a new arrival need not to wait for the barber to be free?
   (ii) What is the expected number of customers in the barber shop?
   (iii) How much time can a customer expect to wait for his turn?
   (iv) How much time can a customer expect to append in the shop?
   (v) Management will put in another chair and hire another barber when a customer's average time in the shop exceeds 1.25 hours. How much must the average rate of arrivals increase to warrant a second barber?

Solution. Now,

$$\text{Arrival rate} = \frac{60}{20} = 3 \text{ / hr.} = \lambda$$

$$\text{Service rate} = \frac{60}{15} = 4 \text{ per hr.} = \mu$$

(i) The probability that a new arrival need not wait for the barber *i.e.,* the probability that here is no one in the system.

$$P_0 = 1 - \frac{\lambda}{\mu} = 1 - \frac{3}{4} = 1 / 4 = 0.25.$$

(ii) Expected number of customers in the barber shop (system length)

$$L_s = \frac{\lambda}{\mu - \lambda} = \frac{3}{4 - 3} = 3.$$

(iii) The time the customer expects to wait for this turn (Average time in the queue).

$$W_q = \frac{\lambda}{\mu(\mu - \lambda)} = \frac{3}{4(4 - 3)} = \frac{3}{4} \text{ hr.} = 45 \text{ minutes.}$$

(iv) The time customer expects to spend in the shop
= Average time in the queue system (waiting + service time)

$$= W_s = \frac{1}{\mu - \lambda} = \frac{1}{4 - 3} = 1 \text{ hr.} = 60 \text{ min.}$$

(v) Let customers average waiting time = 125 hours than

$$W_q = 125 \qquad \text{i.e.,} \qquad \frac{\lambda}{4(4 - \lambda)} = 125$$

i.e., $\lambda = 3.33 \text{ hours.}$

Q.7   a. Define management. What are the managerial functions?   (8)
Answer:

Management is *the process of designing and maintaining an environment in which individuals, working together in groups, efficiently accomplish selected aims.* This basic definition needs to be expanded:

1. As managers, people carry out the managerial functions of planning, organizing, staffing, leading, and controlling.
2. Management applies to any kind of organization.
3. It applies to managers at all organizational levels.
4. The aim of all managers is the same: to create a surplus.
5. Managing is concerned with productivity; this implies effectiveness and efficiency.

   Here are some of the managers that made the cover story of *Fortune* magazine in the year 2000: Steve Jobs at Apple Computer Inc.; Bill Ford, Jr. at Ford Motor Company; Scott McNealy of Sun; Jack Welch of General Electric (GE); Cisco's John Chambers; and Bill Gates of Microsoft. Many of the 40 very rich people in America under the age of 40 are also managers.[1] One of the most powerful managers is George Bush, the President of the United States. The Governor of the State of California Arnold Schawarznegger is also a manager and in some ways, so is Pope John Paul II the head of the Roman Catholic Church, one of the largest global organization. But also those middle-level managers and the first-line supervisors make important contributions to the goal of their organizations.

   All manage **organizations** which we define as a group of people working together to create a surplus. In business organizations, this surplus is termed the profit. In nonprofit organizations, such as in charitable organizations, it may be satisfaction of needs. The universities also create a surplus through generation and dissemination of knowledge as well as providing service to the community or society.

Planning

Planning involves selecting missions and objectives and the actions to achieve them; it requires decision making, that is, choosing future courses of action from among alternatives. As Chapter 4 will show, there are various types of plans, ranging from overall purposes and objectives to the most detailed actions to be taken, such as ordering a special stainless steel bolt for an instrument or hiring and training workers for an assembly line. No real plan exists until a decision—a commitment of human or material resources or reputation—has been made. Before a decision is made, all that exists is a planning study, an analysis, or a proposal; there is no real plan. The various aspects of planning are discussed in Part 2 of this book.

Organizing

People working together in groups to achieve some goal must have roles to play, much like the parts actors fill in a drama, whether these roles are the ones they develop themselves, are accidental or haphazard, or are defined and structured by someone who wants to make sure that people contribute in a specific way to group effort. The concept of a "role" implies that what people do has a definite purpose or objective; they know how their job objective fits into group effort, and they have the necessary authority, tools, and information to accomplish the task.

   This can be seen in as simple a group effort as setting up camp on a fishing expedition. Everyone could do anything he or she wanted to do, but activity would almost certainly be more effective and certain tasks would be less likely to be left undone if one or two persons were given the job of gathering firewood, others the assignment of getting water, others the task of starting a fire, others the job of cooking, and so on.

Organizing, then, is that part of managing that involves establishing an intentional structure of roles for people to fill in an organization. It is intentional in the sense of making sure that all the tasks necessary to accomplish goals are assigned and, it is hoped, assigned to people who can do them best.

The purpose of an organization structure is to help in creating an environment for human performance. It is, then, a management tool and not an end in and of itself. Although the structure must define the tasks to be done, the roles so established must also be designed in the light of the abilities and motivations of the people available.

Staffing

Staffing involves filling, and keeping filled, the positions in the organization structure. This is done by identifying work-force requirements, inventorying the people available, and recruiting, selecting, placing, promoting, appraising, planning the careers of, compensating, and training or otherwise developing both candidates and current jobholders so that tasks are accomplished effectively and efficiently. This subject is dealt with in Part 4 of this book.

Leading

Leading is influencing people so that they will contribute to organization and group goals; it has to do predominantly with the interpersonal aspect of managing. All managers would agree that their most important problems arise from people—their desires and attitudes, their behavior as individuals and in groups—and that effective managers also need to be effective leaders. Since leadership implies followership and people tend to follow those who offer a means of satisfying their own needs, wishes, and desires, it is understandable that leading involves motivation, leadership styles and approaches, and communication. The essentials of these subjects are dealt with in Part 5 of this book.

Controlling

Controlling is measuring and correcting individual and organizational performance to ensure that events conform to plans. It involves measuring performance against goals and plans, showing where deviations from the standards exist, and helping to correct those deviations. In short, controlling facilitates the accomplishment of plans. Although planning must precede controlling, plans are not self-achieving. Plans guide managers in the use of resources to accomplish specific goals; then activities are checked to determine whether they conform to the plans.

b. Draw and explain line and staff organization. State its advantages and disadvantages also. (8)
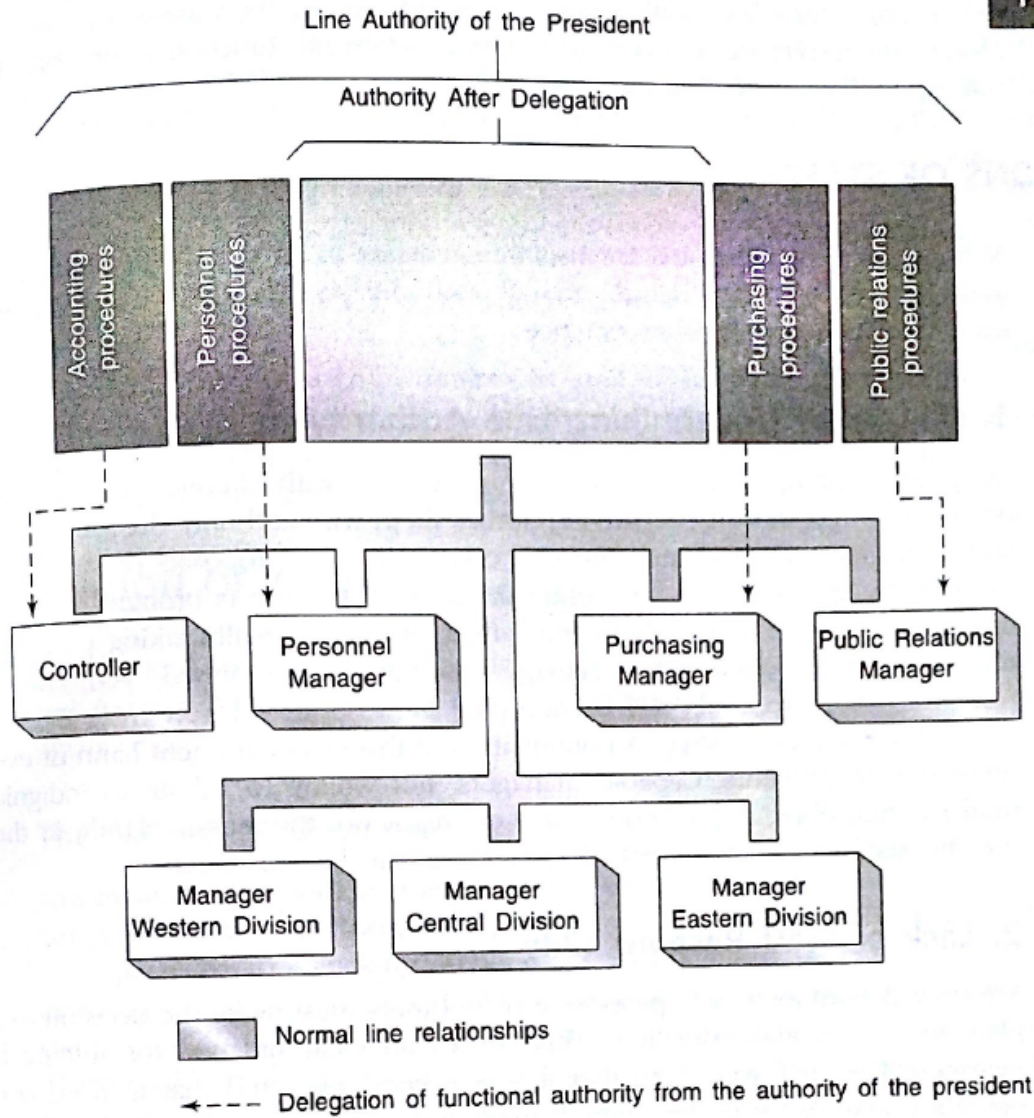
Answer:
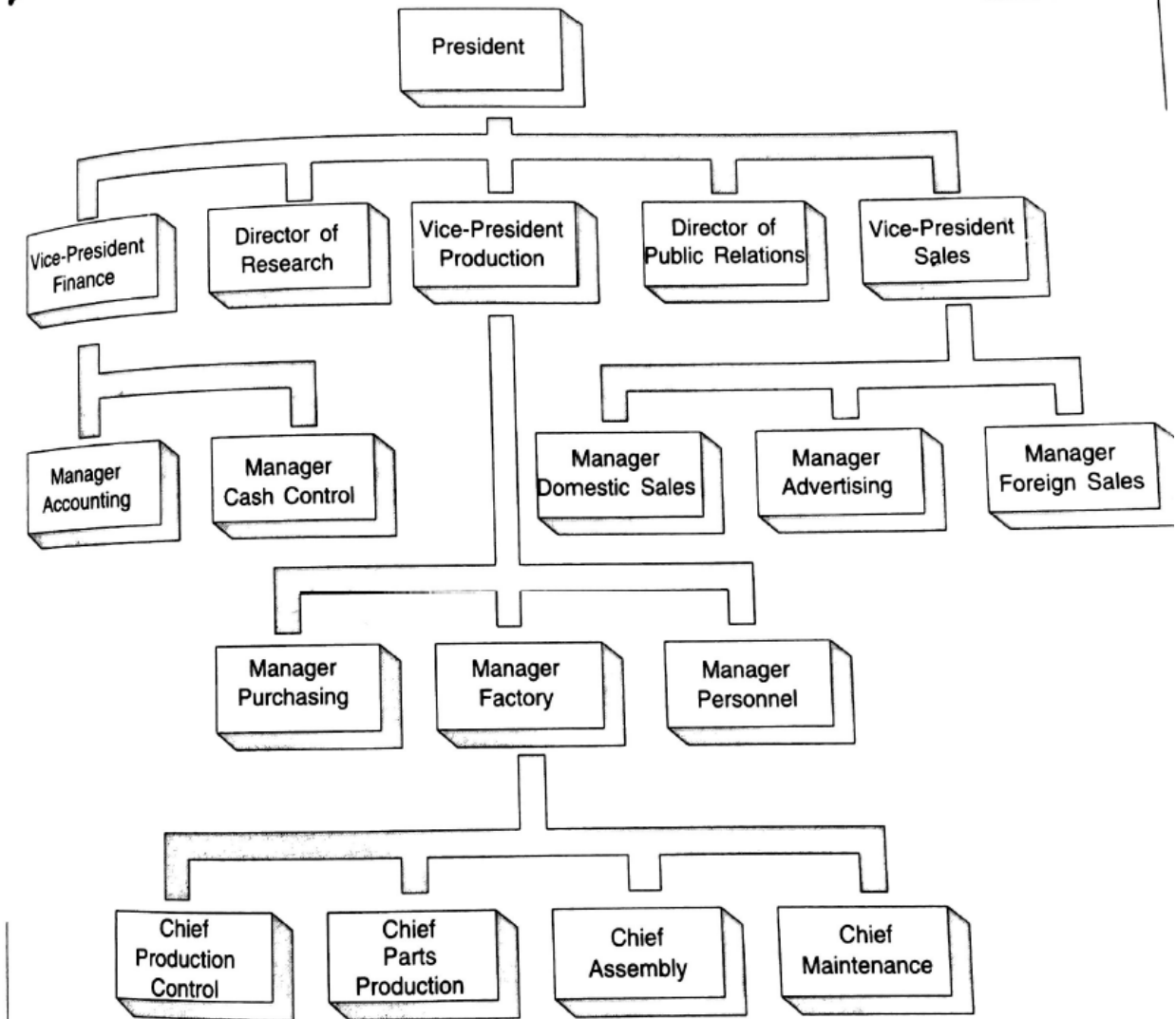
Line and Staff Organization of a Typical Manufacturing Company

BENEFITS OF STAFF

There are, of course, many important benefits in using staff. The necessity of having the advice of well-qualified specialists in various areas of an organization's operations can scarcely be overestimated, especially as operations become more complex.

Figure 9-2

Line Authority of the President

Authority After Delegation

Accounting procedures | Personnel procedures | Purchasing procedures | Public relations procedures

Controller | Personnel Manager | Purchasing Manager | Public Relations Manager

Manager Western Division | Manager Central Division | Manager Eastern Division

Normal line relationships

- - - - Delegation of functional authority from the authority of the president

LIMITATIONS OF STAFF

Although staff relationships are usually necessary to an enterprise and can do much to make it successful, the nature of staff authority and the difficulty of understanding it lead to certain problems in practice.

1. Danger of Undermining Line Authority

Operating managers often view staff personnel with skepticism. Too frequently, a president brings in staff executives, clothes them with authority (frequently very vague), and commands all other managers to cooperate. The proposals of staff specialists are received by the president with enthusiasm, and pressure is brought to bear upon the managers involved to put them into effect. What is actually taking place here is that the authority of department managers is being undermined; yet, grudgingly and resentfully, the proposals will be accepted because all will recognize the high tide of the staff specialists' prestige. A continuation of this situation might harm or even destroy operating departments. Capable managers, not willing to submit to indignity or wait until the tide ebbs, might resign; or they might put the matter bluntly to their boss—fire the staff specialists or get along without the line managers!

2. Lack of Staff Responsibility

Advisory departments only propose a plan; others must make the decision to adopt the plan and put it into operation. This creates an ideal situation for shifting blame for mistakes. The staff will claim that it was a good plan and that it failed because the operating manager was unqualified, uninterested, or intent on sabotage. The manager who must make the plan work will claim that it was a poor plan hatched by inexperienced and impractical theorists.

3. Thinking in a Vacuum

The argument that a staff position gives planners time to think is appealing, but it overlooks an important point: Because staff people do not implement what they recommend, it is possible that staff may think in a vacuum. The alleged impracticality of staff recommendations often results in friction, loss of morale, and even sabotage.

Another weakness in the suggestion that planners must be set off from line departments in order to think is the implication that operating managers are without creative ability. They may, indeed, be without specialized knowledge, but this can be furnished by able staff assistants. Good operating managers can analyze plans, see long-range implications, and spot fatal weaknesses as well as, and sometimes better than, most staff assistants.

4. Managerial Problems

Few would deny the importance of maintaining unity of command. It is not easy for a department head to be responsible to two or more people; at the worker level, it may be disastrous to attempt multiple responsibility. Some disunity in command may be unavoidable, since functional authority relationships are often unavoidable. But managers should remain aware of the difficulties of multiple authority and should either limit it—even with the loss of some uniformity or of the fruits of specialization—or carefully clarify it.

Furthermore, too much staff activity may complicate a line executive's job of leadership and control. A corporation president may be so busy dealing with the recommendations of a large number of staff assistants and straightening twisted lines of authority that time and attention may not be available for operating departments. Similarly, a business may become so intent on making policies and setting procedures that there is little time left to make instruments or provide transportation service.

Q.8   a. Define the various steps involved in the process of decision making.   (8)

Answer:

Following are the important steps of the decision making process. Each step may be supported by different tools and techniques.

Step 1: Identification of the purpose of the decision:

In this step, the problem is thoroughly analysed. There are a couple of questions one should ask when it comes to identifying the purpose of the decision.

- What exactly is the problem?

- Why the problem should be solved?

- Who are the affected parties of the problem?

- Does the problem have a deadline or a specific time-line?

Step 2: Information gathering:

In the process of solving the problem, you will have to gather as much as information related to the factors and stakeholders involved in the problem. For the process of information gathering, tools such as 'Check Sheets' can be effectively used.
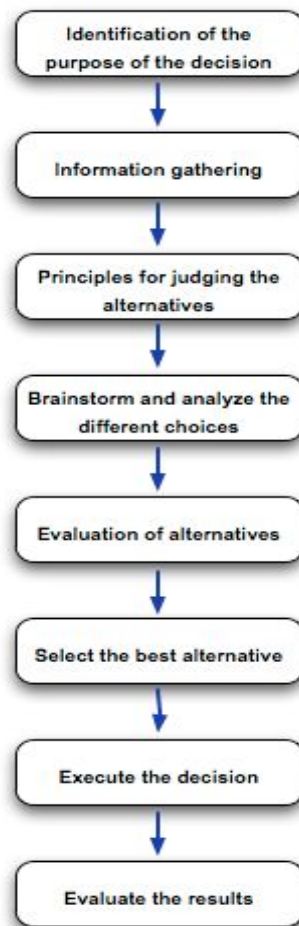
Step 3: Principles for judging the alternatives:

In this step, the baseline criteria for judging the alternatives should be set up. When it comes to defining the criteria, organizational goals as well as the corporate culture should be taken into consideration.

Step 4: Brainstorm and analyze the different choices:

For this step, brainstorming to list down all the ideas is the best option. Before the idea generation step, it is vital to understand the causes of the problem and prioritization of causes.

For this, you can make use of Cause-and-Effect diagrams and Pareto Chart tool. Cause-and-Effect diagram helps you to identify all possible causes of the problem and Pareto chart helps you to prioritize and identify the causes with highest effect.

Then, you can move on generating all possible solutions (alternatives) for the problem in hand.

Step 5: Evaluation of alternatives:

Use your judgment principles and decision-making criteria to evaluate each alternative. In this step, experience and effectiveness of the judgment principles come into play. You need to compare each alternative for their positives and negatives.

Step 6: Select the best alternative:

Once you go through from Step 1 to Step 5, this step is easy. In addition, the selection of the best alternative is an informed decision since you have already followed a methodology to derive and select the best alternative.

Step 7: Execute the decision:

Convert your decision into a plan or a sequence of activities. Execute your plan by yourself or with the help of subordinates.

Step 8: Evaluate the results:

Evaluate the outcome of your decision. See whether there is anything you should learn and then correct in future decision making. This is one of the best practices that will improve your decision-making skills.

     b. What is forecasting? Explain the time series technique for forecasting.   **(8)**

Answer:

Forecasting is about predicting the future as accurately as possible, given all of the information available, including historical data and knowledge of any future events that might impact the forecasts.

Forecasting should be an integral part of the decision-making activities of management, as it can play an important role in many areas of a company. Modern organizations require short-term, medium-term and long-term forecasts, depending on the specific application.

Time series data often arise when monitoring industrial processes or tracking corporate business metrics. The essential difference between modeling data via time series methods or using the process monitoring methods discussed earlier in this chapter is the following:
Time series analysis accounts for the fact that data points taken over time may have an internal structure (such as autocorrelation, trend or seasonal variation) that should be accounted for.

• time series analysis
What we will analyze in details. The idea is that the evolution in the past will continue into the future.

Time series: stationary

trend-based

seasonal
Different time series will be considered: stationary, trend-based and seasonal. They differ by the shape of the line which best fits the observed data.

Methods : The methods which can be used are (linear) regressions, moving averages and exponential smoothings. They differ by the importance they give to the data and by their complexity.

moving average
The general expression for the moving average is
$$M_t = (X_t + X_{t-1} + \cdots + X_{t-N+1}) / N.$$

Results of Moving Average

Supplier	$	MA	Error	Error squared
1	9			
2	8			
3	9	8.667	0.333	0.111
4	12	9.667	2.333	5.444
5	9	10.000	-1.000	1.000
6	12	11.000	1.000	1.000
7	11	10.667	0.333	0.111
8	7	10.000	-3.000	9.000
9	13	10.333	2.667	7.111
10	9	9.667	-0.667	0.444
11	11	11.000	0	0
12	10	10.000	0	0

The MSE = 2.42 as compared to 3 in the previous case.

Regression

In statistics, **regression** analysis is a statistical process for estimating the relationships among variables. It includes many techniques for modeling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables (or 'predictors').

exponential smoothing

This is a very popular scheme to produce a smoothed Time Series. Whereas in Single Moving Averages the past observations are weighted equally, Exponential Smoothing assigns *exponentially decreasing weights* as the observation get older.

In other words, *recent observations are given relatively more weight in forecasting than the older observations*.

Q.9   a. What are the different methods for marketing communications?   (8)

Answer:

Below are details of the primary marketing tools used by marketeers.

1. Advertising

Includes using mass media like TV, radio, press, outdoor hoardings and transport media to reach large numbers of people. Mass advertising is undertaken to get to large numbers, usually with a product / service that has general appeal (car insurance, washing powder). More specialised vehicles such as direct mail, exhibitions, trade publications, point of sale material, sales literature tend to be targeted at specific types of people or groups ie SAGA for the over 50s, Canal Boat for narrow boat enthusiasts. The more specialised the product /service the more specialised the advertising becomes – ie a full page ad in The Mail on Sunday with a new gadget for plumbers rather than in a trade magazine for plumbers / DIY enthusiasts would simply be a waste of money.

2. Personal Selling

Traditionally this meant face to face selling by a seller to a buyer. This form of promotion is probably one of the most difficult to achieve as the first step involves " cold calling" and the seller has to establish a personal rapport with someone they do not know. The traditional slick door to door salesman with his foot in the door or the dubious double glazing rep who wouldn't leave until you had signed a contract has shifted towards a more impersonal but still direct cold calling approach – telemarketing (via call centres) As you will know the quality of some of these telemarketing operations can be extremely poor, and in some cases, down right dodgy. As a minimum they eat into your time and privacy. It is now a numbers game where an anonymous person tries to "personalise" themselves, but in fact they are reading from a script and all they know about you is your telephone number.

3. Sales Promotion

These are events with short term objectives, held over a specific time period. Price cuts, BOGOFs (buy one get one free), competitions, prize draws are examples of sales promotions.

They can also be offers for a limited number of products, ie collectables such as figurines where only 100 of each type are made. There are hundreds of firms who specialise in sales promotions, finding ideas and then running them for companies.

4. PR (Public Relations)

Companies post positive articles about themselves and their products and services in the media. Large companies like Boots, for example will send press releases to all the national media about their annual results. As part of their ongoing PR plan they meet regularly with investment analysts from the City to explain their strategy. Some companies use figureheads as part of their PR plan (ie Richard Branson is Virgin) The overriding aim with every article is to "sweat it" in as many ways as possible. Max Clifford has made a fortune "sweating" information about what people have / have not done.

Internet marketing is technically a form of both advertising and public relations, because sometimes you are paying for the media and controlling the message, and sometimes you are communicating to the public at no charge. Internet marketing is increasingly important as more and more people shop online or start their search for a supplier of products and services online. Recent surveys show that about 85% of potential buyers like to check out a company online before they buy from them.

b. Compare and contrast the Maslow and Herzberg theories of motivation.   (8)
Answer:

According to Maslow's theory, there are four types of needs that must be satisfied before a person can act unselfishly. As Figure 10.1 shows, the needs are arranged in a hierarchical order. The upward climb is made by satisfying one set of needs at a time. The most basic drives are physiological. After that comes the need for safety, then the desire for love, and then the quest for
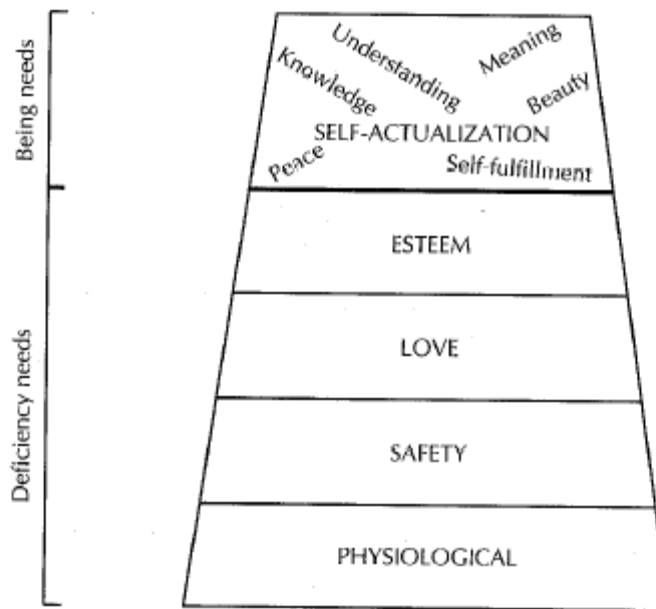

FIGURE 10.1
Maslow's Hierarchy of Needs (Adapted from Goble, *The Third Force.*)

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esteem. Note the softening of terminology used to describe the move up the ladder. We're *driven* to satisfy the lower needs, but we're *drawn* to meet the higher ones.

Maslow referred to the four lower needs as "deficiency needs" because their lack creates a tension within us. He saw nothing wrong with the human desire to scratch where we itch. As long as we can work to satisfy the cravings, we're moving toward growth. It's when a repressive society or a warped individual curtails our freedom to satisfy our needs that we become ill. Satisfying needs is healthy. Blocking gratification makes us sick.

The urge to fulfill needs is potent but not overpowering. Maslow thought that the Freudian label *instinct* overstated the case. Maslow used the term *instinctoid* to designate a less insistent motivational force. People *can* resist the pull of physiological, safety, love, and esteem needs, but it's not easy.

Herzberg found that the factors causing job satisfaction (and presumably motivation) were different from those causing job dissatisfaction. He developed the motivation-hygiene theory to explain these results. He called the satisfiers motivators and the dissatisfiers hygiene factors, using the term "hygiene" in the sense that they are considered maintenance factors that are necessary to avoid dissatisfaction but that by themselves do not provide satisfaction.

The following table presents the top six factors causing dissatisfaction and the top six factors causing satisfaction, listed in the order of higher to lower importance.

Factors Affecting Job Attitudes

Leading to Dissatisfaction	Leading to Satisfaction
• Company policy • Supervision • Relationship w/Boss • Work conditions • Salary • Relationship w/Peers	• Achievement • Recognition • Work itself • Responsibility • Advancement • Growth

Herzberg reasoned that because the factors causing satisfaction are different from those causing dissatisfaction, the two feelings cannot simply be treated as opposites of one another. The opposite of satisfaction is not dissatisfaction, but rather, *no* satisfaction. Similarly, the opposite of dissatisfaction is *no* dissatisfaction.

Implications for Management

If the motivation-hygiene theory holds, management not only must provide hygiene factors to avoid employee dissatisfaction, but also must provide factors intrinsic to the work itself in order for employees to be satisfied with their jobs.

Herzberg argued that *job enrichment* is required for intrinsic motivation, and that it is a continuous management process. According to Herzberg:

- The job should have sufficient challenge to utilize the full ability of the employee.
- Employees who demonstrate increasing levels of ability should be given increasing levels of responsibility.
- If a job cannot be designed to use an employee's full abilities, then the firm should consider automating the task or replacing the employee with one who has a lower level of skill. If a person cannot be fully utilized, then there will be a motivation problem.

Critics of Herzberg's theory argue that the two-factor result is observed because it is natural for people to take credit for satisfaction and to blame dissatisfaction on external factors. Furthermore, job satisfaction does not necessarily imply a high level of motivation or productivity.
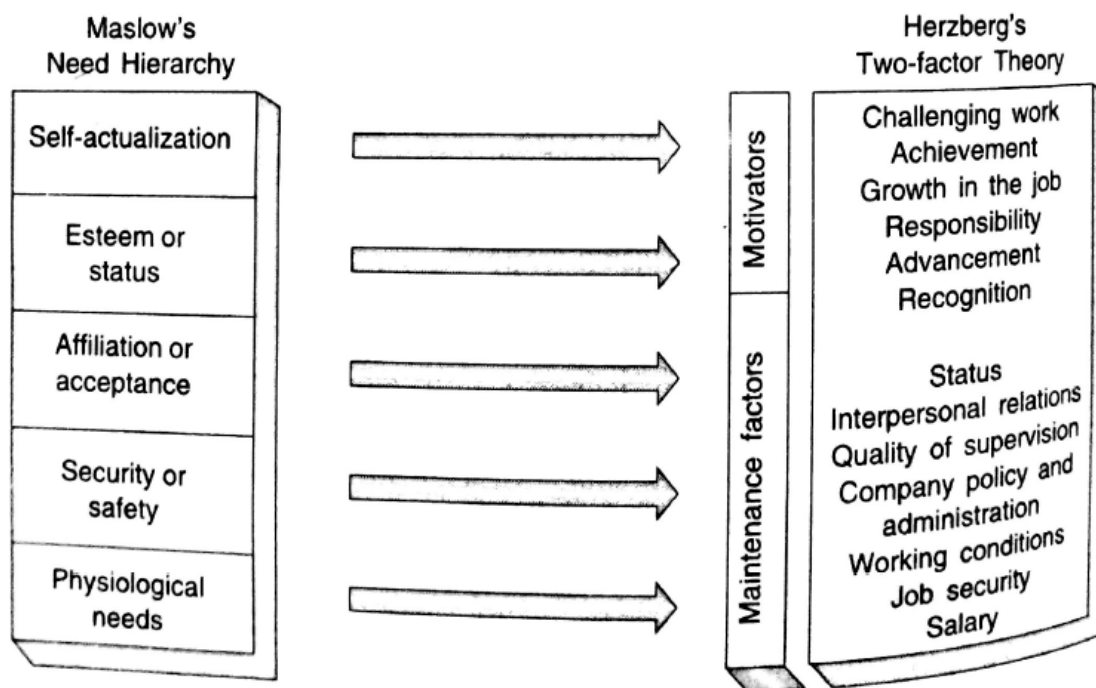
TEXT-BOOKS

I.   Operations Research, An Introduction, Hamdy A. Taha, Eight Edition, PHI, 2007
II. Engineering Management, Fraidoon Mazda, Low Price Indian Edition, Addison-Wesley