UNIT – I

COURSE OBJECTIVES:

1. To impart fundamental knowledge and skill sets required in the Industrial Management and Engineering profession, which include the ability to apply basic knowledge of mathematics, probability and statistics, and the domain knowledge of Industrial Management and Engineering
2. To produce graduates with the ability to adopt a system approach to design, develop, implement and innovate integrated systems that include people, materials, information, equipment and energy.
3. To enable students to understand the interactions between engineering, business, technological and environmental spheres in the modern society.
4. To enable students to understand their role as engineers and their impact to society at the national and global context.

SYLLABUS: UNIT – I

INTRODUCTION: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, differences between production management and industrial engineering, quantitative tools of IE and productivity measurement. Concepts of management, importance, functions of management, scientific management, Taylor's principles, theory X and theory Y, Fayol's principles of management.

INTRODUCTION:

DEFINITION OF INDUSTRIAL ENGINEERING:

The concept of industrial engineering has great significance in the industrial organizations. Today every organization is giving much importance to this concept. Industrial engineering may be defined as the "engineering approach to the detailed analysis of the use and cost of the resources of an organization". The main resources are men, money, material, equipment and machinery. These are valuable productive resources.

The industrial engineer carries out such analysis in order to achieve the objectives and policies of the organization. He is associated with organization structure administrative techniques human problems and at the same time he understands the relationship between efficiency and consent.

F.W.TAYLOR is considered as the father of the modern industrial engineering. He put forth his ideas on scientific management and work measurement in 1881 and as a result industrial engineer came out as a formal technique in USA. In 1885 frank b gilbert introduced motion study which is very much related with the work measurement technique of F.W.TAYLOR other pioneers in the field were L.H.GONT, EMERSON, CARL BRATH, and SHEWHART. Etc..,

HISTORY/EVOLUTION OF INDUSTRIAL ENGINEERING MANAGEMENT:

The origins of industrial engineering can be traced back to many different sources. **Fredrick Winslow Taylor (F.W. Taylor)** is most often considered as the father of **industrial engineering** even though all his ideas where not original. Some of the preceding influences may have been Adam Smith's treatise *The Wealth of Nations*, published in 1776, Thomas Malthus's Essay *on Population*, published in 1798, David Ricardo's *Principles of Political Economy and Taxation*, published in 1817, and John Stuart Mill's *Principles of Political Economy*, published in 1848. [1] All of these works provided Classical Liberal explanations for the successes and limitations of the Industrial Revolution. Adam Smith was an economist as were most of his contemporaries at the time. "Economic Science" is the phrase to describe this field in England prior to American industrialization. The amount of influence this literature had on Taylor is unknown.

Another major contributor to the field and **precursor to Taylor was Charles W. Babbage. Babbage** was mathematics professor at Cambridge University. One of his major contributions to the field was his book On the Economy of Machinery and Manufacturers in 1832. In this book he discusses many different topics dealing with manufacturing, a few of which will be extremely familiar to an IE. Babbage discusses the idea of the learning curve, the division of task and how learning is affected, and the effect of learning on the generation of waste. He also was very interested in different methods of wage administration and even suggested profit sharing as a viable approach. Charles Babbage was the first person to suggest building a mechanical computer, "analytical calculating machine" as he called it, for the purpose of solving complex mathematical problems. An idea that is far beyond the technology of his time but later proves to be a valuable concept to the modern IE.

In the United States during the latter part of the nineteenth century more developments where being made that would lead to the formalization of industrial engineering. Henry R. Towne stressed the economic aspect of an engineer's job. How was the engineer going to improve the bottom line for the company? Towne belonged to the **American Society of Mechanical Engineers (ASME)** as did many other early American pioneers in this new field. It was to the ASME that Towne expressed the need to develop a field focused on manufacturing systems. The IE handbook says the, "ASME was the breeding ground for industrial engineering."[2] Towne along with Fredrick A. Halsey worked on developing and presenting wage incentive plans to the ASME. It was out of these meetings that the Halsey premium plan of wage payment developed. The purpose of his plan was to increase the productivity of workers without negatively affecting the cost of production. The plan also suggested that some of the gains be shared with the employees as an incentive to keep it going. This is one early example of one profit sharing plan.

Henry L. Gantt also belonged to the ASME and was interested in selection of workers and their training. He, like Towne and Halsey, would present papers to the ASME on topics such as cost, selection of workers, training, good incentive plans, and scheduling of work. He is the originator of the Gantt chart, currently the most popular chart used in scheduling of work. Today however, the Gantt chart is coupled with statistics to

make more accurate predictions. Other types of charts that have developed out of the early scheduling efforts are the Program Evaluation and Review Technique (PERT) and Critical Path Mapping (CPM).

No history of industrial engineering would be complete without mentioning **Fredrick Winslow Taylor**. Taylor is probably the best known of the pioneers in industrial engineering. He used the ASME as present his ideas on the organization of work by management. He coined the term "scientific management" to describe the methods he developed through empirical studies. His work, like others, covered topics such as the organization of work by management, worker selection, training, and additional compensation for those individuals that could meet the standard as developed by the company through his methods. The Taylor method of Scientific Management had far reaching effects on the industrial revolution, in America, and abroad.

During the 1960s, and after, Universities began to adopt operation research techniques and add them to the curriculum for the Industrial Engineering Degree. Now for the first time the methods of industrial engineering could rest on an analytical foundation, instead of the old method of empiricism. New developments in mathematics for optimization as well as new methods of advanced statistical analysis helped to fill in the holes once left by the purely theoretical approach. However, problems where extremely large and complex to and until the digital computer was developed processing this kind of information was almost impossible.

APPLICATIONS OF INDUSTRIAL ENGINEERING:

Before 1940 industrial engineering was mainly applied to manufacturing industries for improving methods of productivity, to develop work standards, to formulate production control and wage policies. But after 1940 the use of industrial engineering also spread to non-manufacturing activities also. Such as construction, transportation firm, airline operation and maintenance, public utilities, government and military operations. etc.., in an industry besides the production other groups utilizing industrial engineering concepts are marketing, finance, purchasing, industrial relations etc..,

ROLE OF INDUSTRIAL ENGINEER IN THE ORGANIZATION:

An industrial engineer plays a vital role in the organization. No, organization can successfully run without industrial engineer. We can analyze the role of industrial engineer in the following manner.

1. **Advisor/Consultant:** Available to others for interpretation of data, review etc.
2. **Advocate/Activist:** Promote actively process or approach
3. **Analyst:** Separate a whole into parts and examine them to explore for insight and characteristics.
4. **Boundary Spanner:** Bridge the information/interest gap between industrial engineering and user.
5. **Motivator:** Provide stimulus and skill availability to a group or individual
6. **Decision Maker:** Select a preference from among many alternatives for topic of concern.
7. **Designer/Planner:** Produce the solution specific topic.
8. **Expert:** Provide a high level of knowledge, skill, & experience on a specific topic.
9. **Coordinator & Integrator**

10. **Innovator/Inventor:** Seek to produce a creative or advanced technology solution
11. **Measure:** Obtain data and facts about existing conditions
12. **Project Manager:** Operate, Supervise and evaluate projects.
13. **Trainer/Educator:** Skills and knowledge of an industrial engineer
14. **Data gather.**
15. **Negotiator.**
16. **Optimum use of resources:** His role is very significant in utilizing the existing productive resources in most efficient and effective manner. He always tries to minimize the wastage of resources. Optimum utilization of resources is essential to achieve best results in production, marketing, HR. etc..,
17. **Minimizing the cost of resources and production:** He always tries to minimize the cost of production with different techniques and methods. No, organizations can success without getting maximum production with minimum cost.
18. **Production, Planning and Control:** Designing plans to achieve continuous production without any interruption is the main function of industrial engineer. He designs production plans and also control production mechanism.
19. **Product, Design and Development:** He has perfect knowledge about design and development. Product design and development play a vital role in getting profits. He always try to design best product and also try to develop it. Generally he designs products according to the attitude and interest of customers.
20. **Inspection and Quality Control:** He frequently inspects the product and gives guide lines to the production department. He always tries to produce quality products. No organization cans success without producing quality products. He gives suggestions and guide lines to quality products.
21. **Plant Layout and Location:** He designs plant layout to achieve best results in each and every aspect. The success of an organization is also based on its plant layout and location.
22. **Work Study:** He designs work study reports and implement in the organization. He gives suggestions and guidelines to workers and employees. If there is any difficulty or problem. He rectifies it immediately.
23. **Method Study:** He designs production methods and implement them in the plant. No organization can successfully run without method study. He always tries to introduce new methods in production.
24. **Work Measurement and Work Standards:** He measures the work done by workers and employees with different techniques and methods. On the basis of work measurement wages and salaries are fixed. He also prepares work standards.

DEFINITION OF MANAGEMENT:

Management is a universal phenomenon. We can see it in every walk of life. Ex: house management, college management, hotel management etc.., now it is a rapidly growing discipline. Management is the process of getting things done with others as per firm's objectives. No, business firm or organizations can success without management. Several management experts have defined the term management in different ways. They are:

- **HENRY FAYOL** the father of management defines the term management as "to manage is to forecast and plan, to organize, to command, to coordinate and control."

- **HERALD KOONTZ** defines the term management as "management is the technique of getting things done through and with the people in formally organized groups."
- **F.W.TAYLOR** defines management as "management is the art of knowing what you want to do in the cheapest and best way."
- **PETER F DRUCKER** defines management as "management is concerned with the systematic organization of economic resources and its task is to make these resources productive."

NATURE OF MANAGEMENT:

We can analyse the nature or characteristics of management in the following manner:

1. **Management is a process:** It is a process. It includes a number of aspects such as planning, organizing, directing, controlling, coordinating, staffing, motivating... etc.
2. **Management is a continuous process:** It is a continuous process. As long as universe exists it will exists. It is eternal or immortal.
3. **Management is an activity:** It is an activity. It includes decision making activities, informational activities and interpersonal activities. Etc.., which are essential for the success of an organization.
4. **Management is a discipline:** It is a separate branch of study like computers, mathematics, statistics... Etc. it is one of the important branch to carryout business very successfully.
5. **Management is dynamic:** Its nature is dynamic. It formulates several new policies according to time being. It designs new policies and methods according to changing business needs or business environment. Today a lot of research is going on management.
6. **Management is complex:** Its nature is complex. It has close relation with several subjects. It is interdependent. It depends on mathematics, social, economics... etc. there are several theories and principles formulated by management experts. Its functions are complex.
7. **Management is a group activity:** It is a group activity. It is associated with different people in the organization. It has several levels. Ex: - higher level, middle level, lower level.
8. **Management is both science and an art:** Management combines the features of both science and art. It is a scientific art. Science is a systematic body of knowledge relating to a specific field of study and contains journal facts that explain a phenomenon. Art is basically concerned with understanding the way a particular task is achieved in the best possible manner. While science provides the principles, the application of these principles is the subject matter of art.
9. **Management is an integrating process:** It is an integrating process. It integrates men, money, material for performing various operations and accomplishing the stated goals.
10. **Management is a profession:** It is a profession because some of its established principles are being applied in practice.

11. **Management is goal oriented:** It has certain goals and objectives. It always try to achieve these goals. It's a main goal is over all development of the society.

OBJECTIVES OF MANAGEMENT:

The main objectives of management are:

1. Achieving best results with minimum efforts.
2. To improve the efficiency of factors of production and productive resources.
3. To improve the condition of employers and employee's.
4. To provide equal opportunity to different sections of the people in the society.
5. To improve the standard of living of people.
6. To provide social justice.
7. To increase national output and national income.
8. To minimize cost of production and maximize profits.
9. To provide better quality products to consumers.
10. To promote industrial peace.
11. To achieve greater production in industrial organizations.
12. To promote knowledge and skill among human resources.
13. To meat social needs.

IMPORTANCE OF MANAGEMENT:

It has great significance in industrial organizations. Its role is very prominent in production, marketing, finance, human resources, research and development. No, industrial organization can service without management. We can analyze its importance in the following manner:

I. **Determination of objectives:**

Its role is very significant in determining objectives. Every business firm has certain objectives. It helps in determining these objectives in most efficient and effective way. Generally business is a risky affair. It includes a number of problems and uncertainties. These problems arise on various aspects. No, business organizations can success without over coming these problems.

II. **Achieving the objectives:**

Management plays a vital role in achieving the objectives of business firms. Every business firm has certain objectives as far as production, marketing, finance, HR... Etc. is concerned. Management guides the managerial personnel in each and every aspect. They can achieve the objectives very easily with the help of management principles.

III. **Optimum utilization of existing resources:**

Management plays a vital role in utilizing the existing productive resources in optimum manner. They can use the productive resources in a best way. Generally productive resources are very scare management helps in minimizing wastage of productive resources. Ex: - men, money, material, machinery etc. are valuable productive resources. Optimum utilization of these resources is essential.

IV. **Social benefits:**

Management play a vital role in social or societal development. It is a part and parcel of the society. Its main aim is to develop the society. It helps to supply quality products to the public. It has greater social responsibility. It must meet the needs of the society. It must satisfy the consumer needs, shareholder's needs, government needs... Etc. it makes the society more dynamic and result oriented.

V. **Establishers sound organization:**

Management helps in establishing a sound organization. It creates good relationship between superiors and subordinates. Sound organizations are essential to achieve greater production without efficient management. It is not possible to achieve greater production.

VI. **Meeting challengers:**

Management helps in meeting a number of challengers faced in industrial organizations with efficient management they can face several problems very easily and try to overcome from such problems. Several problems arises in the field of production, marketing, finance, HR related aspects.

VII. **National economic development:**

Management plays a significant role in national economic development. It helps to achieve rapid economic development and growth. It helps to increase national output national income, total saving, total investment, total demand and total supply.

VIII. **Smooth running of business:**

Management plays a vital role in smooth running of business organizations. Business organizations can run very smoothly with help of management. It helps in minimizing strikes and lockouts, retrenchments dispute's. It helps to produce goods and services continuously. It establishes good relations between management and labour force. Management promotes industrial peace.

FUNCTIONS OF MANAGEMENT:

Management is a universal phenomena. We can see it in every walk of life. It is an integral part of society. The process of getting things done through others as per firm's objectives is known as management. Henry fayol the father of management classified management functions into planning, organizing, commanding, coordinating and controlling.

Gullick and **Urwick** have described the management functions as POSDCORB. Here P stands for planning, O stands for organizing, S-staffing, D-directing, CO –coordination, R-reporting, B-budgeting.

However the functions of management can be divided into six categories:

A. Planning
B. Organizing
C. Staffing
D. Directing
E. Coordinating
F. Controlling

A. Planning: This is one of the important functions of management. Planning is a mental process requiring foresight and sound judgment. Planning is the process of deciding in advance what to do, when to do, where to do and how the results are to be evaluated. It is nothing but taking action in advance and deciding today what is to be done tomorrow. Efficient planning is essential to achieve the organizational goals in most efficient and effective manner. No, organizations can success without planning.

B. Organizing: It is the process of establishing relationships among the members of the organization. This relationship is created in the form of authority and responsibility. It is an important activity by which management brings together the manpower and material resources for the accomplishing of free determined goals. It also involves creating job positions at various levels and establishing mutual relationships between them. No, organizations can success without organizing.

C. Staffing: It refers to placing of right persons at the right job at the right time. It involves recruitment, selection, training etc., It involves training managers and other employee's to improve their capabilities and preparing subordinates for the future as well as ensuring their personal development and growth. While performing the staffing function managers prepare reports on the performance of their subordinates and make recommendations regarding their promotion. No, organizations can success without staffing.

D. Directing: It is the process of guiding the subordinates towards achieving the organizational goals. Generally managers issue day to day instructions and guide lines to the subordinates. Managers have to communicate decisions and instructions to the subordinates. It is nothing but giving guidance to the subordinates. It is concerned with the activating of the members of the organization for the accomplishment of the organizational goals. No, organization can successfully run without directing.

E. Coordinating: It is the process of integrating the activities of different units and organization to accomplish the organizational goals efficiently. The purpose of coordination is to ensure that the goals of units and subunits are pursued in harmony with each other keeping in view the goals of the organization. Coordination is needed at all levels of management due to the interdependent nature of activities assigned to various departments and units.

F. Controlling: It is the process of seeing whether the activities have been performed in conformity with the plains. It helps the management to get its policies implemented and to take corrective actions if

performance is not in accordance with the planned objectives. No, organization can successfully run without controlling.

DIFFERENCES BETWEEN PRODUCTION MANAGEMENT AND INDUSTRIAL ENGINEERING:

Production engineering basically deals with the manufacturing process based engineering such as fabrication, machining, casting, forging etc.

Industrial engineering has only one motive, I.e. to increase productivity (output to input) of an industry by designing techniques developed from scientific methods of engineering. It includes Time and motion study where a qualitative and quantitative evaluation of a work is carried out.

S.No.	BASIS	PRODUCTION MANAGEMENT	INDUSTRIAL ENGINEERING
1	Definition	Production management refers to planning, Co-ordinating and controlling the resources of production department which is engaged in production of a specific product or service	Industrial Engineering refers to the process of designing, developing and installing integrated systems to thee variable resources of productive systems.
2	Objective	The main objective of Production Management is to optimal utilise the resources so as to produce desired output.	The main objective of Industrial Engineering is to design such a integrated systems which ensures improvement in productivity.
3	Functions	It functions include selection of materials, Methods, Machinery, and Equipment, Estimating, Loading and scheduling, Routing, Despatching, Expediting or follow up, Inspection and evaluation.	It function include advising, advocating, analysing, decision making, co-ordinating and integrating, data gathering and measuring.
4	Application	It can be applied to only production activities	It can be applied to manufacturing as well as non-manufacturing activities.
5	Operation	Production managers operates the designed systems.	Industrial Engineer's designs the system but, does not operate them regularly.
6	Area of Focus	It focus on individuals to make them aware of using various tools, techniques and concepts effectively.	It focus on systems to make them highly productive.
7	Example	It gives training to individual in operating drilling system.	It supports engineers in designing drilling system.

QUANTITATIVE TOOLS OF IE AND PRODUCTIVITY MEASUREMENT:

The tools and techniques of industrial engineering aim at improving the productivity of the organization by optimum utilization of organization's resources, i.e. men, materials and machines.

The various tools and techniques of industrial engineering are:

i. **Method study**: To establish a standard method of performing a job or an operation after thorough analysis of the jobs and to establish the layout of production facilities to have an uniform flow of material without back tracking.
ii. **Time study:** This is a technique used to establish a standard time for a job or for an operation
iii. **Motion economy:** This is used to analyze the motions employed by the operators to do the work. The principles of motion economy and motion analysis are very useful in mass production or for short cycle repetitive jobs.
iv. **Financial and non-financial incentives:** These helps to evolve at a rational compensation for the efforts of the workers.
v. **Value analysis:** It ensures that no unnecessary costs are built into the product and it tries to provide the required functions at the minimum cost. Hence, helps to enhance the worth of the product.
vi. **Production, planning and control:** This includes the planning for the resources (like men, materials and machines), proper scheduling and controlling production activities to ensure the right quantity, quality of the product at predetermined time and pre-established cost.
vii. **Inventory control:** To find the economic lot size and the recorder levels for the items so that the items should be made available to the production at the right time and quantity to avoid stock out situation and with minimum capital lock-up.
viii. **Job evaluation:** This is a technique which is used to determine the relative worth of jobs of the organization to aid in matching jobs and personnel and to arrive at sound wage policy.
ix. **Material handling analysis:** To scientifically analyze the movement of materials through various departments to eliminate unnecessary movement to enhance of material handling.
x. **Ergonomics (Human engineering):** It is concerned with study of relationship between man and his working conditions to minimize mental and physical stress. It is concerned with man-machine systems.
xi. **System analysis:** System analysis is the study of various sub-systems and elements that make a system, their interdependencies in order to design, modify and improve them to achieve greater efficiency and effectiveness.
xii. **Operation research techniques:** These techniques aid to arrive at the optimal solutions to the problems based on the set objective and constraints imposed on the problems.

The techniques that are more often used are:

a. Linear programming problems
b. Simulation models
c. Queuing models

d. Network analysis (CPM & PERT)

e. Assignment, sequencing and transportation models.

PRODUCTIVITY CONCEPTS AND MEASURES:

PRODUCTIVITY:

Productivity is the ratio between output and input. It is quantitative relationship between what we produce and what we have spent to produce.

Hence, $$Productive = \frac{OUTPUT}{INPUT}$$

Productivity is, above all, a **state of mind-set**. It is an attitude that seeks the continuous improvement of what exist. It is a conviction that **one can do better today than yesterday, and that tomorrow will be better than today.**

It is the driving force or dynamism behind developing and upgrading the quality of industrial activities.

IMPORTANCE OF PRODUCTIVITY:

- Productivity increases output.
- High productivity results in lower cost per unit of output resulting in higher levels of profit for a business.
- Higher profits for the firm will mean more funds available for its expansion, new business ventures and community support.
- It may also wish to pass on the benefits of lower costs to consumers in the form of lower prices.

CONCEPTUAL ASPECTS OF PRODUCTIVITY:

Productivity is an objective concept, which can be measured, ideally against a universal standard. As such, organizations can monitor productivity for strategic reasons such as corporate planning, organization improvement, or comparison to competitors. It can also be used for tactical reasons such as project control or controlling performance to budget.

Productivity is useful as a relative measure of actual output of production compared to the actual input of resources, measured across time or against common entities. As output increases for a level of input, or as the amount of input decreases for a constant level of output, an increase in productivity occurs. Therefore, a "productivity measure" describes how well the resources of an organization are being used to produce output.

Productivity is often confused with efficiency. Efficiency is generally seen as the ratio of the time needed to perform a task to some predetermined standard time. However, doing unnecessary work efficiently is not exactly being productive. It would be more correct to interpret productivity as a measure of effectiveness (doing the right thing efficiently).

EXPRESSIONS OF PRODUCTIVITY:

Productivity is usually expressed in one of three forms: partial-factor productivity, multifactor productivity, and total-factor productivity.

I. **Partial-Factor Productivity:** The standard definition of productivity is actually what is known as a partial-factor measure of productivity, in the sense that it only considers a single input in the ratio. The formula then for partial-factor productivity would be the ratio of total output to a single input. Managers generally utilize partial-factor productivity measures because the data is readily available. Labour based hours (generally, readily available information) is a frequently used input variable in the equation. Other partial-factor measure options could appear as output/machine, output/capital, output/energy, or output/inventory. Multifactor Productivity. A multifactor productivity measure utilizes more than a single factor, for example, both labour and capital. Hence,

II. **Multifactor productivity:** Multifactor productivity is the ratio of total output to a subset of inputs which for example could be labour and materials. Obviously the input factors must be measured in the same units, for example pounds sterling or standard hours.

III. **Total-Factor Productivity:** A broader gauge of productivity, total-factor productivity is measured by combining the effects of all the resources used in the production of goods and services (labor, capital, raw material, energy, etc.) and dividing it into the output.

Total output must be expressed in the same unit of measure and total input must be expressed in the same unit of measure. However, total output and total input can be expressed in different units of measurement. Resources are often converted to pounds sterling or standard hours so that a single figure can be used as an aggregate measure of total input or output.

Total productivity ratios reflect simultaneous changes in outputs and inputs. As such, total productivity ratios provide the most inclusive type of index for measuring productivity and may be preferred in making comparisons of productivity. However, they do not show the interaction between each input and output separately and are thus too broad to be used as a tool for improving specific areas.

Total-factor productivity is a measure favoured by the Japanese, whereas labour productivity is the measure most favoured in the UK and the United States.

DIFFERENCE BETWEEN PRODUCTION AND PRODUCTIVITY:

	Production	Productivity
Definition	It is defined as the act of manufacturing goods for their use or sale.	It is defined as the rate of which goods are produced.
Use	It is the actual process of conversion.	It is the utilization of resources to form goods
Work done	It is the amount of work done or manufactured that is the output.	It is the amount of work one gets for a certain spending cost.
Measurement	It is the measure of produced goods.	It is the measure of efficiency.

PRODUCTIVITY MEASURES:

It has been said that the challenge of productivity has become a challenge of measurement. Productivity is difficult to measure and stems from the fact that inputs and outputs are not only difficult to define but are also difficult to quantify.

One common problem with productivity measures is the inability to consider quality changes (e.g., output per hour might increase, but it may cause the defect rate to increase significantly). It is easier to conceive of outputs as tangible units such as number of orders picked, but other factors such as quality should be considered.

Experts have cited a need for a measurement program that gives an equal weight to quality as well as quantity (productivity). If quality is included in the ratio, output may have to be defined as something like the number of defect-free units of production or the number of units that meet customer expectations or requirements.

USE OF PRODUCTIVITY MEASURES:

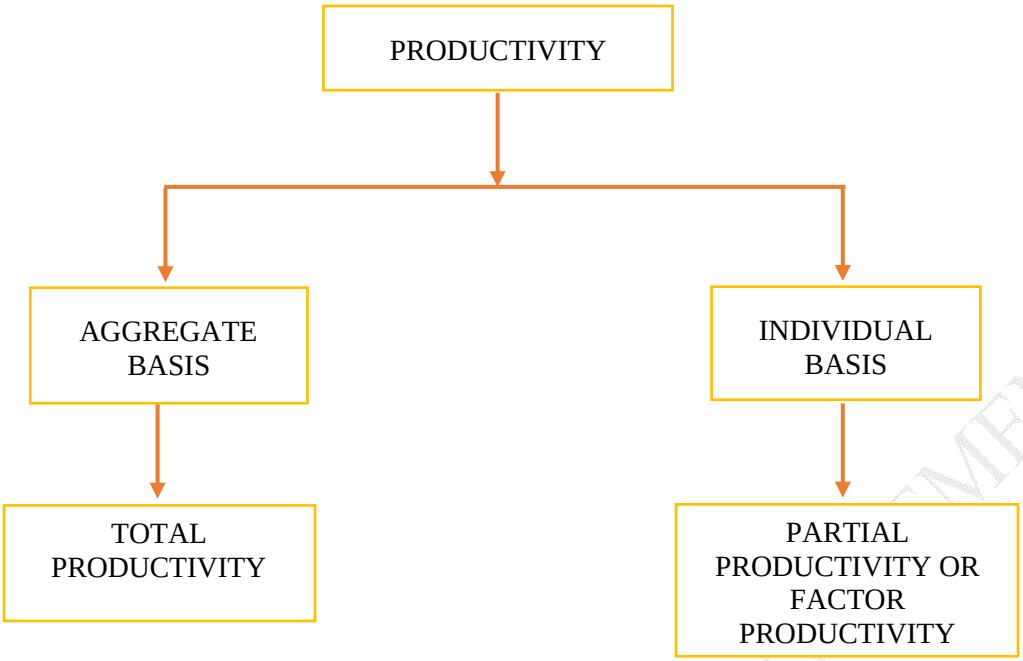
Productivity is a required tool in evaluating and monitoring the performance of an organisation. When directed at specific issues and problems, productivity measures can be very powerful. In essence, productivity measures are the yardsticks of effective resource use.

Managers are concerned with productivity as it relates to making improvements in their firm. Proper use of productivity measures can give the manager an indication of how to improve productivity: either increase the numerator of the measure, decrease the denominator, or both.

Managers are also concerned with how productivity measures relate to competitiveness. If two firms have the same level of output, but one requires less input thanks to a higher level of productivity, that firm will be able to reduce prices and protect or increase its market share or charge the same price as competitors and enjoy a larger profit margin.

Within a time period, productivity measures can be used to compare the firm's performance against industry-wide data, compare its performance with similar firms and competitors, compare performance among different departments within the firm, or compare the performance of the firm or individual departments within the firm with the measures obtained at an earlier time (i.e., is performance improving or decreasing over time?

TECHNIQUES FOR MEASUREMENT OF PRODUCTIVITY:



AGGREGATE BASIS: On aggregate basis, output is compared with all inputs taken (added) together. This is called as Total Productivity.

Hence, $$Total\ Productivity\ Index = \frac{TOTAL\ OUTPUT}{TOTAL\ INPUT}$$

Where,

Total Output = Total production of goods and services and

Total Input = Labor + Material + Capital + Energy.

This index measures the productivity of the entire organization with use of all resources. It is a way of evaluating efficiency of entire plant or firm.

Example:

10,000 Units Produced

Sold for Rs10/unit

500 labor hours

Labor rate: Rs.9/hr

Cost of raw material: Rs.30,000

Overhead: Rs. 15,500

Example: Total Productivity

$$TP = \frac{Output}{Labour + Materials + Overhead}$$

$$TP = \frac{(10000\ units) \times (Rs.10)}{(500) \times (Rs.9) + (Rs30,000) + (Rs.15,500)}$$

T P = 2.0

INDIVIDUAL BASIS: On individual basis, output is compared with any one of the input factor and this is called as Partial Productivity or Factor Productivity.

Factor productivity or partial productivity indices are of following types:

I. **Labor productivity**
II. **Material productivity**
III. **Machine Productivity**
IV. **Capital productivity**

LABOR PRODUCTIVITY: Labor productivity is simply defined as the ratio of Total output to the Labour input i.e.

$$Labour\ Productivity = \frac{Total\ Output}{Lobour\ Input}$$

Labor productivity depends upon how labors are utilized.

Labor productivity can be higher or lower depending on factors like availability of work load, material, working tools, availability of power, work efficiency, level of motivation, level of training, level of working condition (comfortable or poor) etc.

Example

- 10,000 Units Produced
- Sold for Rs. 10/unit
- 500 labor hours
- Labor rate: Rs. 9/hr

What is the labor productivity?

- 10,000 units / 500hrs = 20 units/hr
- (10,000 units * Rs. 10/unit) / 500hrs = Rs. 200/hr
- 10,000 units / (500hrs *Rs. 9/hr) = 2.2 unit/Rs.
- (10,000 units * Rs. 10/unit) / (500hrs * Rs. 9/hr) = 22.22
- The last one is unit-less

MATERIAL PRODUCTIVITY: Material productivity plays an important role in cost of production.

$$Material\ Productivity = \frac{Total\ Output}{Material\ Input}$$ or

$$M\ P = \frac{Number\ of\ units\ Produced}{Total\ material\ cost}$$

Material productivity depends upon how material is effectively utilized in its conversion into finished product.

Material productivity can be increased by using skilled workers, adequate machine tools, good design of product etc.

MACHINE PRODUCTIVITY: Production system converts raw material into finished product through mechanical or chemical process with the help of machines and equipment's.

$$Machine\ Productivity = \frac{Total\ Output}{Machine\ Input} \quad \text{or}$$

$$M\ P = \frac{Output\ in\ standard\ hours}{Actual\ machine\ hours}$$

Machine productivity depends upon availability of raw material, power, skill of workers, machine layout etc.

CAPITAL PRODUCTIVITY: For any production set-up, facilities of machines, tools, land etc. are required which are assets of organization. Capital is needed for such assets.

$$Capital\ Productivity = \frac{Total\ Output}{Capital\ Input} \quad \text{or}$$

$$C\ P = \frac{Total\ Output}{Capital\ Employed}$$

Capital productivity depends on how effectively assets are utilized.

Productivity is an overall measure of the ability to produce a good or service. Productivity may also be defined as an index that measures output (goods and services) relative to the input (labour, materials, energy, etc., used to produce the output). There are two major ways to increase productivity: increase the numerator (output) or decrease the denominator (input). A similar effect would be seen if both input and output increased with output increasing faster than input; or if both input and output decreased with input decreasing faster than output. A productivity ratio can be computed for a single operation, a department, a facility, an organization, or even an entire country.

FACTORS AFFECTING PRODUCTIVITY:

There is quite a variety of factors that can affect productivity, these include:

- ✓ Capital investments in technology and equipment
- ✓ Capital investments in facilities
- ✓ Economies of scale
- ✓ Workforce knowledge and skill resulting from training and experience
- ✓ Technological changes
- ✓ Work methods and procedures
- ✓ Systems

- ✓ Quality and reliability of suppliers
- ✓ Quality of management
- ✓ Legislative and regulatory environment

IMPROVING PRODUCTIVITY:

Improvement may be realized through improved methods, investment in machinery and technology, improved quality, and improvement techniques and philosophies such as just-in-time, total quality management, lean production, supply chain management principles, and theory of constraints.

A firm or facility may undertake a number of key steps toward improving productivity:

- Develop productivity measures for all operations; measurement is the first step in managing and controlling an organization.
- Look at the system as a whole in deciding which operations are most critical, it is overall productivity that is important.
- Develop methods for achieving productivity improvement, such as soliciting ideas from workers (perhaps organizing teams of workers), studying how other firms have increased productivity, and re-examining the way work is done.
- Establish reasonable goals for improvement.
- Provide management support and encouragement.
- Measure improvements and publicize them.

However, organizations must be careful not to focus solely on productivity as the driver for the organization. Organizations must consider overall competitive ability. The Company's success is also influenced and achieved through other factors including quality, cycle time, reasonable lead time, innovation, and factors directed at improving customer service and satisfaction.

ADVANTAGES OF PRODUCTIVITY:

- ➢ It emphasizes the efficient utilization of all the factors of production which are scarce universally.
- ➢ It attempts to eliminate wastage.
- ➢ It facilitates the comparison of the performance of a company to its competitors or related firms, in terms of aggregate results and of major components of performance.
- ➢ It enables the management to control the performance of the company by identifying the comparative benefits raising out of the use of different inputs.

SCIENTIFIC MANAGEMENT MEANING:

Application of scientific principles and theories to management is called scientific management. According to Taylor scientific management means knowing exactly what you want men to do and seeing that they do

it in the best way and the cheapest way. The scientific methods consist of research and experiments, collection of data, analysis of data and formulation of certain new principles.

PRINCIPLES OF SCIENTIFIC MANAGEMENT:

Principles of scientific management propounded by Taylor are:

1. Science, Not Rule of Thumb.
2. Harmony, Not Discord.
3. Mental Revolution.
4. Cooperation, Not Individualism
5. Development of each and every person to his or her greatest efficiency and prosperity.

1. **Science, Not Rule of Thumb:** In order to increase organisational efficiency, the 'Rule of Thumb' method should be substituted by the methods developed through scientific analysis of work.

   Rule of Thumb means decisions taken by manager as per their personal judgments. According to Taylor, even a small production activity like loading iron sheets into box cars can be scientifically planned. This will help in saving time as well as human energy. Decisions should be based on scientific enquiry with cause and effect relationships.

   This principle is concerned with selecting the best way of performing a job through the application of scientific analysis and not by intuition or hit and trial methods.

   The work assigned to any employee should be observed and analyzed with respect to each element or part thereof and the time involved therein so as to decide the best way of performing that the work and to determine the standard output for same.

2. **Harmony, Not Discord:** Taylor emphasized that there should be complete harmony between the workers and the management since if there is any conflict between the two, it will not be beneficial either for the workers or the management.

   Both the management and the workers should realize the importance of each other. In order to achieve this state, Taylor suggested complete mental revolution on the part of both management and workers.

   It means that there should be complete change in the attitude and outlook of workers and management towards each other. It should always be kept in mind that prosperity for an employer cannot exist for a long time unless it is accompanied by the prosperity of the employees of that organisation and vice versa.

   It becomes possible by

   (a) Sharing a part of surplus with workers
   (b) Training of employees,
   (c) Division of work
   (d) Team spirit
   (e) Positive attitude
   (f) Sense of discipline
   (g) Sincerity etc.,

Management should always be ready to share the gains of the company with the workers and the latter should provide their full cooperation and hard work for achieving organizational goals. Group action with mutual-trust and understanding should be perfect understanding the focus of working.

This principle requires that there should be perfect understanding between the management and workers and both should feel that they are part of same family. It helps to produce synergy effect since both management and workers work in unison.

For example, in most of the Japanese companies, paternalistic style of management is in practice and there is complete openness between workers and the management. Usually, workers don't go on the strike but, if at all they do so, they just wear a black badge and work even more than the normal hours just to impress upon the management that their focus is on their demands as well as organisational objectives.

3. **Mental Revolution:**

The technique of Mental Revolution involves a change in the attitude of workers and management towards each other. Both should realize the importance of each other and should work with full cooperation. Management as well as the workers should aim to increase the profits of the organisation.

For this the workers should put in their best efforts so that the company makes profit and on the other hand management should share part of profits with the workers. Thus, mental revolution requires a complete change in the outlook of both management and workers. There should be a spirit of togetherness between workers and management.

4. **Cooperation, Not Individualism:**

This principle is an extension of principle of 'Harmony, not discord' and lays stress on mutual cooperation between workers and the management. Cooperation, mutual confidence, sense of goodwill should prevail among both, managers as well as workers. The intention is to replace internal competition with cooperation.

Both 'Management' and 'Workers' should realize the importance of each other. Workers should be considered as part of management and should be allowed to take part in decision making process of the management. Management should always welcome their suggestions and should also reward them if their suggestions prove to be beneficial for the organisation viz. reduction of costs or increase in production etc.

At the same time, workers should also resist from going on strike or making unnecessary demands from management. Workers should be treated as integral part of organisation and all important decisions should be taken after due consultation with workers. Both of them should visualize themselves as two pillars whose soundness alone can ensure achievement of common goals of the organisation.

Taylor also suggested that there should be proper division of work and responsibility between the two. Management should always guide, encourage and help the workers.

5. **Development of each and every person to his or her greatest efficiency and prosperity:**

Efficiency of any organisation also depends on the skills and capabilities of its employees to a great extent. Thus, providing training to the workers was considered essential in order to learn the best method developed through the use of scientific approach. To attain the efficiency, steps should be taken right from the process of selection of employees. Employees should be scientifically selected.

The work assigned to each employee should suit his/her physical, mental and intellectual capabilities. Efficient employees produce more to earn more. This ultimately helps to attain efficiency and prosperity for both organisation and the employees.

ELEMENTS OF SCIENTIFIC MANAGEMENT:

To bring scientific management into practice, Taylor suggested the following techniques or elements. They are:

1. **Scientific task setting:** Setting the standard task of every worker through scientific investigation
2. **Work study:** Work study means a systematic objective and critical determination of operational efficiency in an organization. It includes method study, motion study, time study, fatigue study. Etc.
3. **Rate setting:** It means determination of wages and salaries. Taylor suggested differential piece rate system. If the wages are fixed on the basis of the quantity or volume of the work done by the workers, it is called piece rate system.
4. **Planning the Task:** It refers to determination of the quantity of o/p to be produced by each and every worker in advance.
5. **Standardization:** It refers to determination of certain standards in production. In other words maintaining quantity at various levels.
6. **Scientific Selection & Training:** It refers to using scientific methods & techniques in selection & training. According to him every organization must follow scientific techniques & methods in selection & training. They have to recruit qualified efficient & experienced persons.
7. **Differential Piece Wage Plan:** It refers to payment of wages & salaries on the basis of quantity of work done by the workers & employees. This plan encourages workers to produce more output.
8. **Specialization:** It refers to division of labour Taylors suggested functional foremanship even at the shop or floor level under this system an operator or worker works under the control of eight foremen, four at the shop level & four at the office level.

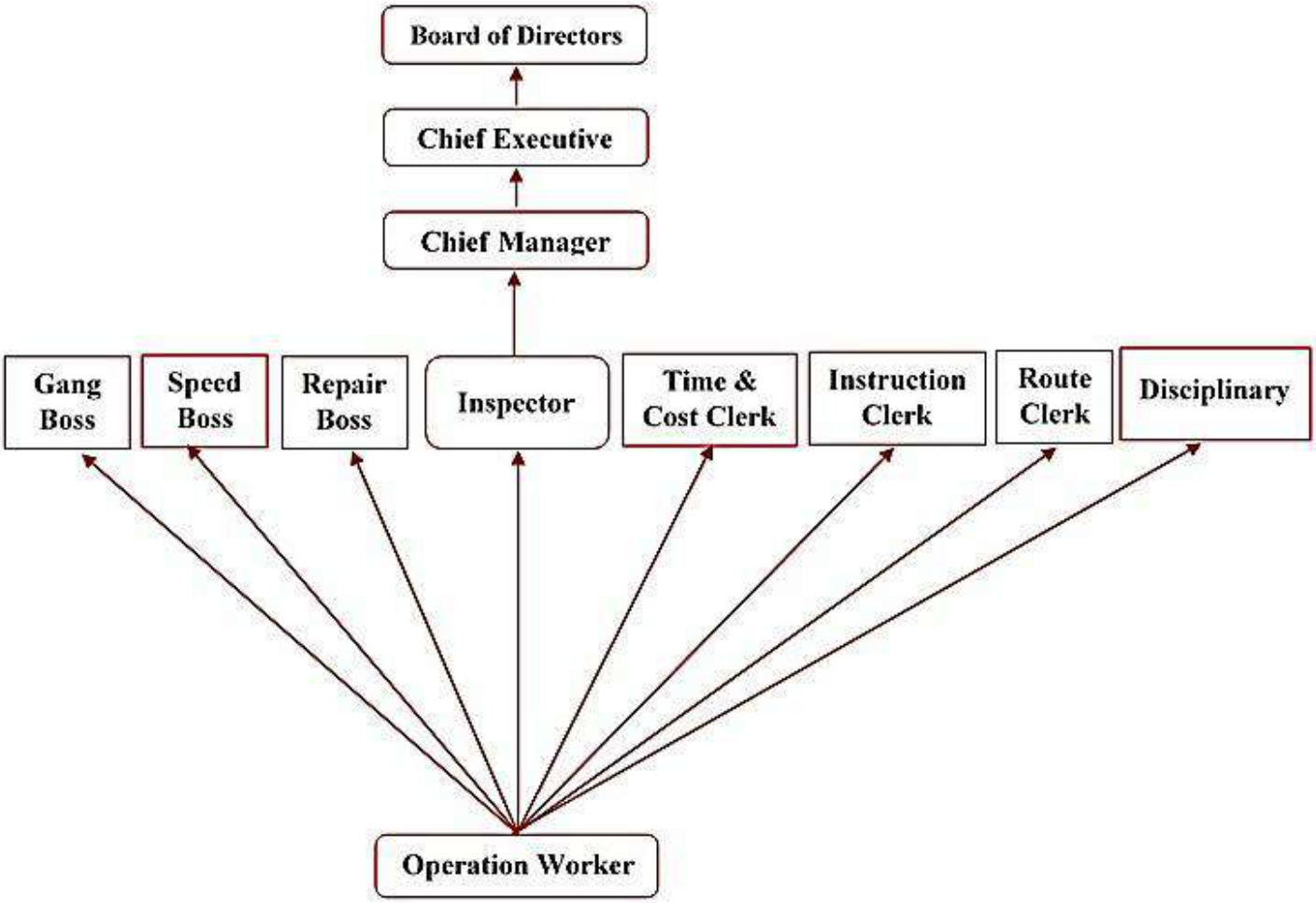
   The four foremen at shop level are

   a) Gang boss
   b) Speed boss
   c) Repair boss
   d) Inspector

   The four foremen at office level are

   a) Time & Cost Clerk
   b) Instruction Card Clerk
   c) Route Clerk
   d) Disciplinarian

Taylor's scientific theory of management can be understood with the help of following chart.



DOUGLAS MCGREGOR THEORY- X & THEORY- Y?

Douglas McGregor presented two sets of assumptions in the form of theory -X & theory- Y. To explain the nature of employees & to understand human behaviour. These two sets of assumptions are popularly called theory- X & theory -Y.

THEORY -X:

This theory is based on the following assumptions. They are

1) Employees are inherently lazy
2) They require constant guidance & support.
3) Sometimes they require even coercion & control
4) Given an opportunity they would like to avoid responsibility.
5) They do not show up any ambition but always seek security.
6) He explained all the negative features of employees in theory -X.

THEORY Y:

This theory is entirely different from theory- x. it is based on the following assumptions. They are:

1) Some employee's consider work as natural as play or rest.

2) These employees are capable of directing and controlling performance as their own. They are much committed to the objectives of the organization. They show much interest towards the objectives of the organization.
3) Higher wages and salaries makes these employee's more dynamic, committed to organization.
4) Given an opportunity they not only accept responsibility but also look for opportunities to outperform.
5) Most of them are highly imaginative creative and discipline in handling organizational issues. He explained all the positive features of employee's in theory -Y.

FREDERICK WINSLOW TAYLOR'S SCIENTIFIC MANAGEMENT:

At the outset, it must be made clear that in the world of management, there is no concept of management which might be called 'Scientific Management'; capable of universal application and commanding wide acknowledgment from scholars and practitioners of management.

What Frederick Winslow Taylor calls scientific management is typically a management philosophy pioneered and practiced by him (and his followers) according to his own ideology; and is something like 'India of My Dreams' as envisaged by Gandhiji. Accordingly, Taylor's Scientific Management is popularly called as 'Taylorism'.

INTRODUCTION TO FREDERICK WINSLOW TAYLOR AND HIS WORK:

F.W. Taylor (1856-1915) was an American, who joined Midvale Steelworks, Philadelphia (U.S.A.) as a machinist; and gradually rose to the position of the Chief Engineer-through hard work and progress. F.W. Taylor conducted his experiments in three companies viz., Midvale Steel Works, Simonds Rolling Machine and Bethlehem Steel Works.

Taylor's Scientific Managements was, in fact, a movement known as the 'Scientific Management Movement' pioneered by Taylor and carried on by his followers. The important publications of Taylor are all combined into one book titled 'Scientific Management'.

TAYLOR'S MAIN OBSERVATION:

Throughout his life career, Taylor had observed that there was excessive inefficiency in the management and functioning of industrial enterprises. In fact, the primary blame for the inefficient functioning of industrial enterprises was put by Taylor on management; for it was management who did not know what constituted a fair day's task and also the 'best way' of doing the same.

Therefore, he came out with his new concept of management, called scientific management.

SCIENTIFIC MANAGEMENT DEFINED:

Scientific management might be defined as : Scientific management involves the application of a scientific approach to managerial decision making (consisting of-collection of data, an analysis of data and basing decisions on the outcome of such analyses); and discarding at the same time, all unscientific approaches, like – rule of the thumb, a hit or miss approach and a trial and error approach.

FREDERICK WINSLOW TAYLOR DEFINED SCIENTIFIC MANAGEMENT IN THE FOLLOWING WORDS:

"Scientific Management consists in knowing what you (i.e. management) want men to do exactly; and seeing to it that they do it in the best and the cheapest manner."

PRINCIPLES OF SCIENTIFIC MANAGEMENT:

The fundamental principles, which would support the concept and practice of scientific management, are the following:

i) Science, not the rule of the thumb.

ii) Harmony, not discord.

iii) Co-operation, not individualism.

iv) Maximum production, in place of restricted production.

v) Development of each person to the greatest of his capabilities.

vi) A more equal division of responsibility between management and workers.

vii) Mental revolution on the part of management and workers.

Following is a brief comment on each of the above principles of scientific management.

i) Science, not the rule of thumb:

The basic principle of scientific management is the adoption of a scientific approach to managerial decision making; and a complete discard of all unscientific approaches, hitherto practiced by managements.

ii) Harmony, not discord:

Harmony refers to the unity of action; while discord refers to differences in approach.

iii) Co-operation, not individualism:

Co-operation refers to working, on the part of people, towards the attainment of group objectives; while regarding their individual objectives-as subordinate to the general interest.

iv) Maximum production, in place of restricted production:

In Taylor's view the most dangerous evil of the industrial system was a deliberate restriction of output. As a means of promoting the prosperity of workers, management and society, this principle of scientific management emphasizes on maximising production and not deliberately restricting it.

v) Development of each person to the greatest of his capabilities:

Management must endeavour to develop people to the greatest of their capabilities to ensure maximum prosperity for both-employees and employers.

vi) A more equal division of responsibility between management and workers:

The principle of scientific management recommends a separation of planning from execution. According to this principle, management must be concerned with the planning of work; and workers with the execution of plans.

vii) Mental revolution on the part of management and workers:

According to Taylor, scientific management, in its essence, involves a complete mental revolution on the part of both sides to industry viz. workers and management (representing employers).

In fact, this principle of scientific management is the most fundamental one ensuring success of it. It is like the foundation on which the building of scientific management must be erected.

AN OUTLINE STRUCTURE OF TAYLOR'S SCIENTIFIC MANAGEMENT:

Though Taylor's work and practice of it is quite comprehensive and detailed; yet the major aspects of work done by him could be summarized into the following outline structure:

1. Determination of a fair day's task for each worker through scientific methods (including the best way of doing a job).
2. Scientific selection and training of workers.
3. Standardisation of raw materials, tools and working conditions.
4. Functional foremanship.
5. Differential piece-rate system of wage-payment.

Following is a brief account of the above aspects of scientific management:

1. **Determination of fair day's task for each worker through scientific methods (including the best way of doing a job):**

   For determining a fair day's task for each worker, Taylor recommended the use of scientific methods involving the conduct of the following three types of work studies, viz.,

   a) Time study
   b) Motion study
   c) Fatigue study

   The following points are not worthy in this context:

   - An average worker (or representative worker) is first selected for conducting the above work-studies. In case otherwise, the standards of work fixed would be either too high or too low.
   - The above three work-studies (i.e. time, motion and fatigue studies) are to be considered together to arrive at a fair day's task.

2. **Scientific selection and training of workers:**

This aspect of scientific management is, in fact, the staffing angle of it. The workers, under scientific management, must be properly selected by adhering to a carefully- designed selection procedure. Further, selected workers must be imparted training in best methods of performing a job.

3. Standardisation of raw materials, tools and working conditions:

By standardisation, Taylor implies two varieties of standardisation:

- Raw materials, tools, machines and other facilities of work must be of a reasonably good quality; so that the quality of production is reasonable.
- Another variety of standardization which Taylor refers to is uniformity in providing work-facilities and work conditions to all workers, doing a similar type of job.

4. Functional Foremanship:

The scheme of functional foremanship recommended by Taylor is, in fact, an introduction of managerial specialisation-at the shop-level. In Taylor's view, instead of a single foreman performing all the aspects of the foremanship task, there must be a number of foremen-each concerned with only a particular aspect of foremanship.

Each foreman, being a specialist in performance of his role, is a functional foreman. Hence, the nomenclature of the scheme as 'functional foremanship'.

In the context of the scheme of functional foremanship, Taylor compares workers with students in a school class-room; where a student is imparted teaching in a particular subject by a specialized teacher of that subject – instead of a single teacher teaching all the subject to students.

In the scheme of functional foremanship recommended by Taylor, there is a provision for eight foremen of the following types:

(i) Route Clerk: The route clerk is a foreman who would lay down the route (or journey) of raw materials from the raw-material stage to the finished product stage as passing through different processes and machines.

(ii) Instructions Card Clerk: The instructions card clerk is a foreman who would determine the detailed instructions for handling a job; and prepare a card containing such instructions.

(iii) Time and Cost-Clerk: The time and cost clerk is a foreman who would record the time taken by a worker in completing a job; and would also compile the cost of doing that job.

(iv) Shop Disciplinarian: The shop disciplinarian would look after the maintenance of discipline in the workshop and deal with cases of absenteeism, misbehaviour and other aspects of indiscipline.

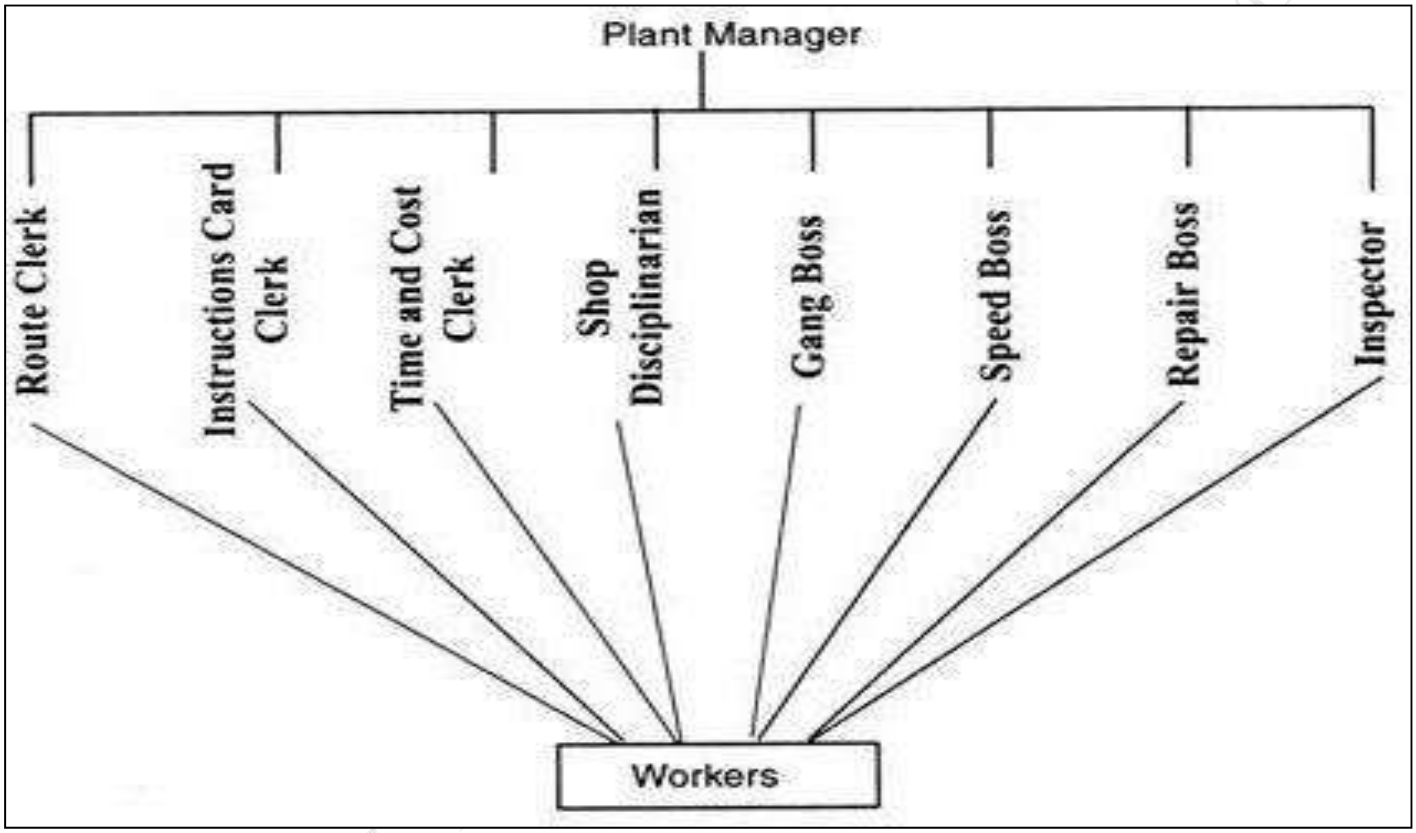
(v) Gang Boss: The gang boss is the supervisor proper. He would see to it that all work-facilities are made available to workers and they start their work as per the instructions imparted to them.

(vi) Speed Boss: The speed boss is a foreman who would determine the optimum speed at which machines are to be operated; so that both-over speeding and under-speeding of machines are avoided. In this way, less depreciation is caused to machines; industrial accidents are averted and quality of production is also maintained.

(vii) Repair Boss: The repair boss is a foreman, who would look after and take care of the repairs and maintenance of machines.

(viii) Inspector: Inspector is a foreman who would look after the quality of production.

The following chart illustrates the functioning of the scheme of the functional foremanship:



5. Differential piece-rate system of wage-payment:

In order to motivate workers positively as also negatively to produce the standard output, Taylor devised a scheme of wage payment, known as the 'Differential piece-rate system of wage-payment.'

The inherent features of this scheme are:

(i) A standard output for each worker is determined in advance through scientific work studies.

(ii) Two rates of wage-payment (based on piece rate system) are established-

a. A higher rate per unit of output; and

b. A lower rate per unit of output.

(iii) Workers who produce the standard output or exceed the standard are paid according to the higher rate for all the units produced by them. Those workers who are unable to come up to the standard are paid according to the lower rate for all the units produced by them.

Let us take an example to illustrate the working of this system of wage payment. Suppose the standard output is 25 units; and the two rate of wage payment are – Rs.2 per unit (the higher rate) and Rs. 1.80 p. per unit (the lower rate).

Now, if a worker produces 25 units or more; he would be paid on total production done by him according to Rs.2 per unit. If, on the other hand, a worker produces only 24 units (taking the extreme case); he would be paid on all the 24 units produced by him, according to the lower rate i.e. Rs. 1.80 p per unit.

In the latter case, the worker is not only suffering a shortfall of payment on one unit produced less by him as against the standard of 25 units; but also suffering a shortfall of payment of 20 p. per unit on all the 24 units produced by him. Thus there is a severe penalty for the inefficient worker in being paid according to the lower rate on total production done by him.

MERITS OF SCIENTIFIC MANAGEMENT:

Some of the merits of scientific management are:

i. **More production and higher profits:** Scientific management makes for a more systematized way of managing-enabling employers (of course, through their managements) to have more production at the minimum cost; and ultimately reap higher profits.

ii. **Job satisfaction:** Under scientific management, a standardized work-environment (raw materials, tools, machines, conditions of work etc.) is provided to workers which would enable them to derive what is known as 'job satisfaction' – the biggest happiness for workers, according to the psychologist.

iii. **Personality development:** As one of the basic principles of scientific management is the 'development of each person to the greatest of his capabilities' workers get an opportunity, under scientific management, to develop themselves fully according to their potential.

iv. **Higher standard of living:** Scientific management is oriented towards maximum production; which would lead to more of consumption of goods on the part of people, in the society. This naturally, would mean an increase in the standard of living of people.

CRITICISM OF SCIENTIFIC MANAGEMENT:

Scientific management has come in for a severe criticism at the hands of the employer, the worker, the psychologist and the theoretician.

Some of the major points of attack on scientific management from different quarters are as follows:

i. **Unsuitable for the small employers:** Scientific management is wholly unsuitable for the small employers. Techniques like time, and motion studies, introduction of managerial specialization, etc. are too costly to be afforded to by the small employers.

ii. **Unemployment:** Scientific management leads to unemployment of workers; especially when mechanical devices are introduced to replace manual labour.

iii. **Retarding human development:** According to psychologist, scientific management aims efficiency at the cost of initiative. It totally takes away initiative from workers. In fact, under scientific management, workers are reduced to the status of machines; totally deprived of the thinking function.

ADVANTAGES OF SCIENTIFIC MANAGEMENT:

The following are the principal advantages of scientific management.

1. It provides trained minds for achieving higher degree of excellence in all branches of shop management.
2. It completely revolutionizes and improves layout, routing, scheduling, purchasing, stores keeping and accounting.
3. It aims to standardize the materials, tools, equipment and methods of work.
4. It offers facilities for specialization and division of labour.
5. It replaces the old system of management rule of thumb method and introduces new and scientific methods.
6. Careful time and motion studies eradicate delays, avoid bodily strains of the workers, eliminate wastage and thereby contribute to the efficiency of the workers and ensures waste less utilization of the resources.
7. It seeks to introduce a mental revolution in the ideas of both the employer and employee and assures co-operation of the labour force.
8. It seeks a reduction in the cost of production through increased output. This would help the organization to complete on a better footing and thereby enlarge the market.
9. The workers are in a position to get higher wages. This removes most of the causes for industrial disputes and unrest. Further, enhanced earnings also lead to higher standard of living of the workers Thus, scientific management does justice to various sections of the society such as producers, workers and the consumers.

DISADVANTAGES OF SCIENTIFIC MANAGEMENT:

In spite of the illuminating advantages referred above, the concept of Scientific Management has become a subject of burning criticism. Not only the workers, but also the employees and even industrial psychologists are questioning the validity of Scientific Management. We shall now briefly examine the criticisms levelled by these three parties under distinct headings:

DISADVANTAGES OF SCIENTIFIC MANAGEMENT FROM EMPLOYERS POINT OF VIEW:

Most of the employers are highly reluctant to adopt the principles of Scientific Management. They object the introduction of the principles of Scientific Management on the following grounds.

1. **High Costs:** It is a costly affair. A thorough overhauling of the existing plant and organizational structure is highly expensive. Time and motion studies as well as other improvements involve a heavy initial outlay of capital.
2. **Unsuitable for Small Firms:** Since the introduction of Scientific Management involves huge expenditure, small firms cannot afford to adopt it.
3. **Response from the workers:** The system can be successfully implemented only with the heart felt co-operation of the workers. If they fail to respond favourably, the system shall fail to bring the desired results.

DISADVANTAGES OF SCIENTIFIC MANAGEMENT FROM EMPLOYEES POINT OF VIEW:

The principal objections raised by the organized trade unions and the labour class are as follows:

1. **Loss of Individual's Initiative:** The leading objection to Scientific Management that comes from workers is that it leads to excessive job standardization. Under Scientific Management, methods of work are all standardized and instructions are given to the workers by the foreman. The workers are supposed to perform the work in the same style and carry out the instructions given by the foreman. This tends to destroy the individual worker's initiative, renders their skill useless, makes their work monotonous and converts them into automatic machines.
2. **Speeding up of Workers:** Scientific Management aims to speed up the workers, not consideration of their health and well-being. Mere speeding up of the workers without corresponding structural changes in the organization and working conditions shall not lead to higher output but create only harmful mental conditions in the workers.
3. **Autocratic Control of Functional Bosses:** Another severe objection raised against the Scientific Management is that it is undemocratic in nature as it gives absolute control to the functional bosses and lessens the interest and responsibility of the workers. The workers ought to obey the orders and the instructions given by the superior or the foreman.
4. **Creation of Unemployment:** The critics of scientific management also argue that scientific management creates unemployment and hits the workers hard as a consequence of the adoption of labour saving devices both in the machinery and in the arrangement of work.
5. **Unfairness:** Another objection is that it tends to be unfair to the workers. A lion's share of the additional profit arising out of increased efficiency does not go to the workers but goes to the coffers of the employer. It is also stated that the introduction of Scientific Management, has the effect of lowering the wages of the workers. But it is not true because Taylor himself has proved with statistical data that workmen in the scientifically managed companies received wages 35% higher than those doing the same job in other companies.
6. **Monotony:** Separation of planning function from that of doing, and excessive specialization, reduces the work to a mere routine. It would create monotony. Monotony refers to a mental state of slackness, inefficiency and a loss of interest in the job.

7. **Opposed by Trade Unions:** Under Scientific Management, the dominant issues of wages and working conditions are scientifically determined. This aspect embraces the workers and tries to introduce ideal conditions of work. Such a thing will naturally upset the very basis of the trade union movement.
8. **Absence of Non-financial Incentives:** Absence of non-financial incentives is another drawback of the Scientific Management. Non-financial incentives can do many things more than what financial incentives can do.

DISADVANTAGES OF SCIENTIFIC MANAGEMENT FROM INDUSTRIAL PSYCHOLOGISTS POINT OF VIEW:

The objections raised by the industrial psychologists are mainly based on the human element involved in the management. They view that Taylor's principles are too impersonal and undermine the importance of the human factor. The following are the main objections raised by them.

1. Workers are human beings and cannot be standardized in the same way as machines and materials. Any attempt to standardize their activities will not result in a success.
2. The Scientific Management places emphasis on discovering the one best way of doing a work without considering the individual difference of the workers. Each human being has his own genius, abilities, style and mode. Hence, the best can be obtained only by giving scope to shape their carrier according to their carrier abilities and aptitudes.
3. Payment of wages on piece rate basis will make the workers disappointed, particularly the beginners and untrained workers.

HENRY FAYOL'S PRINCIPLE OF MANAGEMENT:

He is the French industrialist; engineer and the father of management subjected 14 principles of management for the successful running of an organization. He also identified 6 activities to be accomplished in an organization. These 6 are:

- Technical activities: - which are related to procurement of technology and its related aspects.
- Financial activities: - which are related to procurement of financial resources and its related aspects.
- Marketing activities: - which are related to buying and selling and its related aspects.
- Managerial activities: - which are related to organizing and controlling.
- Accounting activities: - which are related to maintenance of books of account.
- Security activities: - which are related to providing security to the property of the people in the organization. It is also called security sources.

FAYOL'S 14 PRINCIPLES:

1. **Division of work:** Dividing the work among different personal. So as to achieve specialization. This concept promotes efficiency and specialization at various levels. This is essential to achieve optimum

results in production, marketing, finance, HR, R & D activities. The success of an organization is also based on this principle.

2. **Authority and responsibility:** It means giving orders for superiors to subordinates generally. The authority wasted in the hands of superiors or top management in the organization. Top management means chairman, board of directors, MD & CEO. They have the decision making powers. Responsibility means obligation to accomplish by assigned as in most efficient and effective manner. Lack of responsibility leads to so many problems in the organization.
3. **Discipline:** It means obedience towards rules and retardations. It is nothing but showing respect to each other. It promotes dignity and honesty among the employee's and employers. It stabilizes superior subordinate relationship, no organization can successfully run without following this principles.
4. **Unity of command:** It means an employee must receive orders from our superior only for any action or activity. It avoid the confusion and conflict. Unity of command is essential for the success of an organization.
5. **Centralization:** It refers to concentration of authority at one place in the organization. In other words centralization means concentration of authority in the hands of a few top management personnel. These persons must take decisions. Decentralization means delegation of authority from top management to middle and lower levels. According to fayol there should be balance between centralization and decentralization. However he gave much importance to centralization.
6. **Unity of direction:** It refers to, there should be one head and one plan. It minimizes the risk and uncertainty at various levels. Unity of direction is essential for the successful running of an organization.
7. **Subordination of individual interest to general interest:** This principle is based on the assumption that organization is superior individuals. If there is any conflict between individual interest and general interest, the latter must prevail. It means the organization must be superior to individuals because organization is the basis for management.
8. **Scalar chain:** It refers to the process of flow of information from top to bottom and from bottom to top level management. Effective communication is essential for the successful running of an organization. There should not be any interruption in the flow of communication.
9. **Remuneration of personnel:** It refers to the process of payment of wages and salaries to workers and employee's. There should be fair and equitable wage and salary system in every industrial organization. Every organization must pay fair wages and salaries to workers and employees. Good remuneration system encourages workers and employee's to put more effort on production. Good remuneration system is essential for the success of an organization.
10. **Order:** It refers to placing right things at the right place. In other words is the process of maintaining men, money, and machinery in a systematic way or proper way. It role is also very prominent in the organization. Efficient order mechanism is essential for the success of an organization.

11. **Initiative:** It refers to taking actions and decisions independently. Every worker and employee must work with initiative.
12. **Stability of tenure:** It refers to stability in employment. Every organization must protect the existing employment and workers. They should provide job security to the employee's and workers. If they have job security they may pay more effort on production and ultimately the organization name and fame increases.
13. **Equity:** It refers to equal treatment without any discrimination. There is should not be any discrimination against cast, gender, religion, area... Etc. the organization must give equal importance to all cadres. They have to pay equal pay for equal work. There should not be any exploitation of labor force.
14. **Esprit de corps:** It refers to team spirit and team work. It is based on the principle of union is strength. It is nothing but devotion and loyalty towards the organizational goals.

HENRY FAYOL'S 14 PRINCIPLES THEN AND NOW:

Now let us see what Fayol's principles means in the contemporary business situations especially service based and high tech economies like USA. Carl A. Rodrigues of Mont Clair State University, Upper Montclair, New Jersey, USA has come out with the following conclusions in his paper "Fayol's 14 Principles of Management. Then and Now. A Framework for Managing Today's Organisations Effectively" published in Journal "Management Decision" 39/10(2001) PP 880-889.

Principles	Name of Principle	THEN	NOW
1	Division of Work	Specialisation in workers Job design Generalisation in workers' Job design	Generalisation in workers' Job design
2	Authority & Responsibility	Managers are empowered	Employees are empowered
3	Discipline	Formalised Controls	Informal, Peer pressure controls
4	Unity of Command	Subordinates report to only one boss	Subordinates report to multiple bosses
5	Unity of Direction	Functions have only one plan and one boss	Functions have multiple plans and multiple bosses
6	Subordination of individual interest to common good	Employees are committed to the organisation	Organisation is committed to the employees and vice versa
7	Remuneration of personnel	Reasonable Pay reward system	Performance based reward system
8	Centralisation	Trickle down decision making	Task relevant ad hoc decision making
9	Scalar Chain	Hierarchical, formalised communication channel	Less formalised, flatter communication structure

10	Order	Internal information system for control purposes	Internal information system for coordination purposes
11	Equity	Commitment obtained through kindness	Commitment obtained through a sense of ownership
12	Stability of tenure of personnel	Train employees and encourage them to remain	On-going employee training and development
13	Initiative	Managers conceive and implement new ideas	Workers conceive and implement new ideas
14	Espirit de corps	Maintaining high morale among employees is imperative	Maintaining high morale among employees is desirable.

COMPARISON: TAYLOR'S AND FAYOL'S PRINCIPLES OF MANAGEMENT:

Taylor's principles of scientific management and Fayol's principles of management are mutually complementary. Both of them evolved their principles through practical experience and brought them forward to the world through their books.

Both of them realized the importance of management in industrial progress. As a result, they endeavoured to develop a rational and systematic basis of management. However, the two pioneers differ from each other in the following aspects.

1. Taylor's principles and techniques are relevant mainly with respect to production activities. As he focused his attention on factory management, as a result, his principles are directly applicable at the shop floor. Whereas Fayol's principles have wider relevance in functional areas and his principles can be applied to all kinds of activities.
2. Taylor called his philosophy 'scientific management' whereas Fayol described his approach as 'General administration'.
3. Taylor's principles and techniques aimed at improving productivity of labour and following on workers' efficiency. Whereas Fayol focused on achieving managerial efficiency.
4. Taylor looked at the management from supervisory viewpoint and suggested principles with bottom upward approach. On the other hand, Fayol analysed management from the angle of top management based on top downward approach.

A comparison between the contributions of the two pioneers helps us to conclude that Fayol's theory is more widely applicable than that of Taylor's and has stood the test of time. However, Taylor's contribution to management is also very significant as it lends a scientific touch in solving managerial problems.

Sl.	Basis of difference	Henri Fayol	F. W. Taylor
1	Perspective	Top level of management	Shop floor level of a factory
2	Unity of Command	Staunch Proponent	Did not feel that it is important as under functional foremanship a worker received orders from eight specialists
3	Applicability	Applicable universally	Applicable to specialised situations
4	Basis of formation	Personal experience	Observations and experimentation
5	Focus	Improving overall administration	Increasing Productivity
6	Personality	Practitioner	Scientist
7	Expression	General Theory of Administration	Scientific Management

ROLE OF MATERIAL MANAGEMENT:

- To procure raw material at low cost.
- To maintain consistent quality.
- To ensure continuous supply of raw material.
- To minimize the carrying costs and ordering costs.
- To maintain good relationship with supplier.
- Efficient record-keeping and prompt reporting.
- To develop new sources and new materials.
- Training and development of personnel.

DISTINGUISH BETWEEN 'MANAGEMENT AND ORGANISATION':

MANAGEMENT	ORGANISATION
Management is defined as the process by which managers in an organization accomplish things through the efforts of other people in grouped activities.	Organization is an identifiable group of people Contributing their efforts towards the attainment of common goals.
Management is a profession which helps the individuals to perform every profession in a scientific manner.	Organization is a structure which defines her relationships between individuals and positions in an organization.
It helps in attainment of goals through limited resources.	Strong and result oriented internal organization helps in growing and diversifying the business.
Management helps in continuing the organization. It makes sure that business is continued.	Organization makes sure that manpower is recruited and effectively utilized at various organizational levels.
It makes sure that; organizational operations are carried out smoothly without any difficulty.	It makes' sure that all the resources are utilized in an optimum manner
Management is an art and science.	Organization is not an art or science. It is a social group designed for attaining certain goals.

IMPORTANT QUESTIONS IN UNIT -II FROM PREVIOUS QUESTION PAPERS

1. Define the terms industrial engineering and productivity. [8] April – 2015 Set 1
2. Explain the quantitative tools of IE and productivity measurement. [7] April – 2015 Set 1
3. Write the differences between production management and industrial engineering. [8] May/June – 2015 Set 1
4. Briefly discuss the importance of industrial engineering. [7] May/June – 2015 Set 1
5. Define Industrial engineering? Discuss the development and applications of industrial engineering. [7] May/June – 2015 Set 2
6. Discuss Quantitative tools of industrial engineering and productivity Measurement? [8] May/June – 2015 Set 2
7. Explain the concept of management and bring out its importance in present day Context. [7] May/June – 2015 Set 3
8. Discuss the principles of scientific management. [8] May/June – 2015 Set 3
9. What do you mean by management skills? How do skill requirements differ at various levels of management? [8] May/June – 2015 Set 4
10. Discuss Fayol's principles of management? [7] May/June – 2015 Set 4
11. Define Industrial management and give its advantages and applications. [8M] Dec – 2015 Set 1
12. Explain the functions of management. [7M] Dec – 2015 Set 1
13. Define Industrial Engineering. [3M] April – 2016 Set 1
14. Differentiate between production and productivity. [4M] April – 2016 Set 1
15. Explain the contributions of Taylor for scientific management and how it leads to the concept of scientific management. [8M] April – 2016 Set 1
16. State the functions of the management in an organisation. [4M] April – 2016 Set 1
17. Define scientific management. [3M] April – 2016 Set 2
18. State the role of an Industrial Engineer in shop floor. [4M] April – 2016 Set 2
19. Explain the tools that are used in Industrial engineering for solving managerial problems. [8M] April – 2016 Set 2
20. Describe the importance of management in an Organization. [4M] April – 2016 Set 2
21. What do you understand from the term production management? [3M] April – 2016 Set 3
22. Explain the scope and application of Industrial Engineering. [4M] April – 2016 Set 3
23. Explain Henri Fayol's principles of management thoughts. [6M] April – 2016 Set 3
24. State the relationship between Management, Administration and Organization. [6M] April – 2016 Set 3
25. How Industrial Engineering plays an important role in an industry? [3M] April – 2016 Set 4
26. Define Productivity. What are the different kinds of productivity measures? [6M] April – 2016 Set 4
27. Explain briefly about Douglas McGregor theory X and theory Y on motivation and management with the assumptions. [6M] April – 2016 Set 4
28. Differentiate between production management and Industrial engineering. [4M] April – 2016 Set 4

29. What is scientific management and explain its importance. [3M] Nov/Dec – 2016 Set 1
30. Discuss about the functions of management. [8M] Nov/Dec – 2016 Set 1
31. What is productivity? What are the methods that are used to measure productivity? [8M] Nov/Dec – 2016 Set 1
32. What do you understand from scientific management? Explain. [8M] Nov/Dec – 2016 Set 1
33. Explain Taylor's principles of management. [8M] Nov/Dec – 2016 Set 1
34. Explain the importance of an industrial engineer. [3M] April – 2017 Set 1
35. Describe the nature and importance of management in modern business organization. [8M] April – 2017 Set 1
36. Explain the system approach and contingency approach to management. [8M] April – 2017 Set 1
37. Briefly explain the development of industrial engineering. [3M] April – 2017 Set 2
38. Name and describe the various levels of management with their functions. [8M] April – 2017 Set 2
39. Give a brief note on:
    I. Classical theory of management II. Scientific management. [8M] April – 2017 Set 2
40. Differentiate between production management and industrial engineering. [3M] April – 2017 Set 3
41. Describe the various stages of evolution of management. [8M] April – 2017 Set 3
42. State and describe the Fayol's principles of management. [8M] April – 2017 Set 3
43. What are the quantitative tools of Industrial engineering? [3M] April – 2017 Set 4
44. State and describe the characteristics of modern management. [8M] April – 2017 Set 4
45. Describe the principles of scientific management in brief. [8M] April – 2017 Set 4
46. Explain the concept of management. What is its importance? [8M] April – 2017 Set 1
47. Explain the development of industrial engineering. [7M] April – 2017 Set 1
48. What is the difference between productivity and production? [3M] Nov/Dec – 2017 Set 1
49. Explain theory x and theory y and show as a manager how you would apply them to motivate your staff. [8M] Nov/Dec – 2017 Set 1
50. What is productivity? Enumerate the reasons for low productivity? [8M] Nov/Dec – 2017 Set 1
51. Write the differences between production management and industrial engineering.[8M] Nov – 2017 Set 1
52. State and describe the Fayol's principles of management. [7M] Nov – 2017 Set 1
53. Define management state the important characteristics of management. [4M] April – 2018 Set 1
54. What are the qualities required for an industrial engineer? [6M] Nov – 2017 Set 1
55. Describe the principles of scientific management in brief. [10M] Nov – 2017 Set 1
56. List out any four functions of management? [4M] April – 2018 Set 2
57. Differentiate between production management and industrial engineering? [6M] April – 2018 Set 2
58. Define scientific management. What are the criticisms to scientific management? Write the basic approaches to scientific management. [10M] April – 2018 Set 2
59. Differentiate between production management and industrial engineering? [4M] April – 2018 Set 3
60. What is McGregor theory X and theory Y? Explain. [8M] April – 2018 Set 3

61. Briefly describe the principles of management given by Henry Fayol?	[8M] April – 2018 Set 3
62. Bring out the contrast between theory X and theory Y?	[4M] April – 2018 Set 4
63. What are the functions of management?	[4M] April – 2018 Set 4
64. List out the applications of industrial Engineering?	[8M] April – 2018 Set 4
65. Briefly describe productivity measurement system?	[4M] April – 2018 Set 4