Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N	Answer	Marking Scheme
1.	a)	Attempt any THREE of the following:	12
	(i)	Define production and list the types of production system.	
	Ans:	**Production**:- production is any process or procedure developed to transform a set of input elements like men, materials, capital, information and energy into a specified set of output elements like finished products and services in proper quantity and quality thus achieving the objectives of an enterprise. There are four factors of production. Those are as follows. A) Land & Natural resources B) Labour C) Capital D) Enterprise **List of Production System:** **1. Intermittent production** a. Job order production system. b. Batch order production system. **2. Continuous production** a. Mass production system. b. Process production.	Definition – 2 marks. List of production system – 2 marks.
	(ii)	How productivity is measured? Explain any one method of productivity measurement.	
	Ans:	**Measurement of productivity:** - For measurement of productivity, one must find out input and output of the system. To measure the input resources and goods or services supplied is a critical job as they are varying nature.	Explanation of productivity measurement – 2 marks

- To compare output and input, the better method is to convert both into money terms. So in general productivity of firm can be measured from following equation.

- Productivity = $\frac{Value\ of\ goods\ or\ services\ produced}{Value\ of\ input\ resources.}$

- Thus productivity can be measured either on aggregate basis or on an individual basis. If individual input resource is considered, the output is compared with any one of the input resource. Some of these are given below.

- **Labour Productivity:**

  In case of labour productivity input and output can be measured in terms of money or in terms of man hour.

  a. In terms of money,

  Productivity = $\frac{Total\ revenue\ from\ production}{Expenditure\ on\ labour.}$

  b. In terms of hours,

  Productivity = $\frac{Production\ in\ standard\ hours}{Actual\ man\ hours.}$

- **Material Productivity:**

  i. Material consist of direct material and indirect material, Direct material means which goes with the product and indirect material means other consumable like fuel, chemicals in heat treatment, cutting tools, coolant etc. Material productivity measures in terms of goods produced.

  ii. Therefore, Material Productivity = $\frac{Cost\ of\ number\ of\ unit\ produced}{Total\ material\ cost}$

- **Machine productivity:**

  It is measured in terms of hours.

  Machine Productivity = $\frac{Output\ in\ standard\ hours}{Actual\ machine\ hours}$

- **Overall Productivity:**

  For measuring total or overall productivity of any firm following formula is used,

  Overall Productivity = $\frac{Profit}{Investment}$

Any method with correct ratio – 2 marks.

	(iii) Ans:	Explain techniques for improving productivity. **Technique for improving Productivity** a) **Work Study: -** Work study aims two objectives one is to find out the best method of doing job and another one is to find the time taken to do it. This is done by breaking down the job into it various elements, eliminating all unnecessary movements and estimating the time taken to do this job with the help of stopwatch. Second aim is to ensure that all workers engaged in the job are trained to do it in the best way. b) **Human Relations: -** Good human relations help in co-oprative behavior from workers which results in increase in productivity. Human relations can be improved by labour participation in goal setting, simplification in communication system minimizing the conflicts, encouragement and awarding rewards etc c) **Incentives: -** When incentives schemes are introduced in a firm, it results a considerable improvement in productivity. It is something that encouraged a worker to put in more productivity effort. Works will not give 100% unless their interest in work is created by some kind of reward. d) **Cost Control: -** Productivity can be increased by reducing the cost of production. This can be done by keeping careful watch over expenditure, reduction in wastage, reducing machine breakdown time, reducing waiting time for inventory avoiding excessive handling, minimizing overtime expenses etc. e) **Product design: -** A good design of product helps in economical and convenient manufacturing. It will also minimize wastage or scrap and reduce the cost of production. In order to achieve high productivity, product design must be simple to understand, standardization and simplification increases the production efficiency, research and development contributes improvement in product design, product development reduces ineffective time due to change in design, design must considered the current the current available technology. f) **Working Conditions or ergonomics: -** It is nothing but the design the man machine system in such a way that to ensure high productivity and safety of workers. Working conditions like lighting, ventilation, working hours, supervision etc definitely affects the productivity. Also water facility, sitting room, bathroom, and toilets in sufficient numbers are considered to maintain working conditions. To motivate workers productivity related statement are displayed in a firm such that workers can read it frequently. g) **Management by objectives:-** It is process where the superior and subordinate management jointly identify common goal and define individual responsibility in terms of results expected from him h) **Total Quality Management: -** By this it obtained the greater customer satisfaction, fewer defects and less waste improved profitability and increased productivity.	Any four techniques with description -4 marks.
	(iv) Ans:	Define dispatching and list any two functions of dispatching department. **Definition of dispatching:** Dispatching is the routine of starting productive activities in motions, through release of orders in accordance with preplanned route sheets and operations sheet. **Functions of dispatching department:**	Definition – 2 marks. Any two functions – 2 marks.

		1. To issue work order to different departments. 2. To release material orders from stores. 3. To ensure release of correct tools, jigs and fixtures. 4. Keep a record of starting and completion date of each operation. 5. Collection of route sheet and other document from the shops. 6. Issue of inspection order of each operation.	
	b)	Attempt any ONE of the following:	**06**
	(i)	Discuss in brief important factors to be considered while making 'site selection' for new industry/plant.	
	Ans:	**Factors to be considered while making 'site selection' for new industry/plant:** **1. Availability of raw material:** As far as possible the site selected should be near the source of raw materials so that cost of transportation can be minimized and storing cost can be reduced especially when the raw material is heavy and bulky or cheap but looses a good amount of weight during processing. For example most of the iron and steel industries are situated in Orissa and Bihar, Paper industries in Ballarpur due to availability of raw material in these areas. **2. Availability of labour:** Available of right kind of labour in required numbers of reasonable rates is also deciding factor in site selection. Unskilled labours are amply available at major industrial areas and rural areas but however firms requiring skilled labour be situated near the urban industrial area. **3. Climatic condition:** Climatic conditions largely affect certain production processes and also the efficiency of employees. For example textile industries required moist climate due to which these types of industries are situated near Ahmadabad and Mumbai; similarly Tea and Coffee near Assam. **4. Proximity of market:** Market is another important factor affecting site selection. Industrial units using raw material should be located near the markets to serve the customer with minimum service cost. **5. Transport and communication facilities:** While selecting the site, adequate transportation facilities should be considered. The optimum site is the site which is well connected by various modes of transportation. **6. Availability of water:** Water is required for drinking and sanitary purpose of all industries. Therefore, clean and adequate water should be available near the site. **7. Availability of power and fuel:** All industries require power and fuel to run the prime movers. Therefore, the site selected should have these facilities available at cheaper rate. **8. Legal Aspects:** Local bye laws, taxes etc. are also important because they directly reflect in total cost. So while selection, it should also consider legal aspects. **9. Amenities and recreational facilities:** Facilities like schools, hospitals, garden,	Any six factors with explanation – 06 marks**.**

		play grounds should also be needed for employee and their family. **10. Scope of Future expansion:** Site selected should be in such a way that a plenty of land other facilities must be available for future expansion.	
	(ii) Ans:	Explain the concept of line balancing. State its importance and objectives. **Concept of line balancing :** - Line balancing means assigning the equal work content to each work station in the assembly line. - For example: If a product is completed by using three different machines – A, B & C in sequence. If 'A' can process 10 pieces / unit time, if 'b' can process 15 pieces / unit time & if 'C' can process 30 pieces / unit time. Then for line balancing, 3 machines of type A, 2 machines of type B with every machine of type C. So that constant output of 30 pieces / unit time at each work station can be achieved. **Importance of line balancing:** 1. By this the proper utilization of machine is taken place. 2. By this there is proper utilization of worker is taken place. 3. The idle time for man and machine is minimum in line balancing. 4. The production rate is more in line balancing. 5. The cost of production is cheaper than other method. **Objectives of line balancing:** **1.** To distribute the tasks evenly at every workstation. **2.** To minimize the ideal time at each workstation. **3.** To utilize all the resources in proper manner. **4.** To minimize cost of production.	Concept – 2Marks. Any two points or proper explanation of importance - 2 marks. Any two points of objectives – 2 marks.
2.		Attempt any TWO of the following:	**16**
	a) Ans:	Name different types of material handling equipments used in industry. Explain any one with neat sketch. **Types of material handling devices** **1.Trucks :** i) Power lift : a. Fork lift b. elevating platform ii) Hand Lift. iii) Porters trolley. **2.Tractors and trailers** **3. Hoist and cranes:** i) Hoist a. Chain hoist.	Classification – 4 marks Explanation of any one device with neat sketch – 4 marks (2 marks for explanation and 2 marks for sketch.) here one type

b. Electric hoist.

ii) Crane –

a. Over bridge crane

b. Jib crane.

4.Conveyers :

a. Belt conveyer.

b. Roller conveyer.

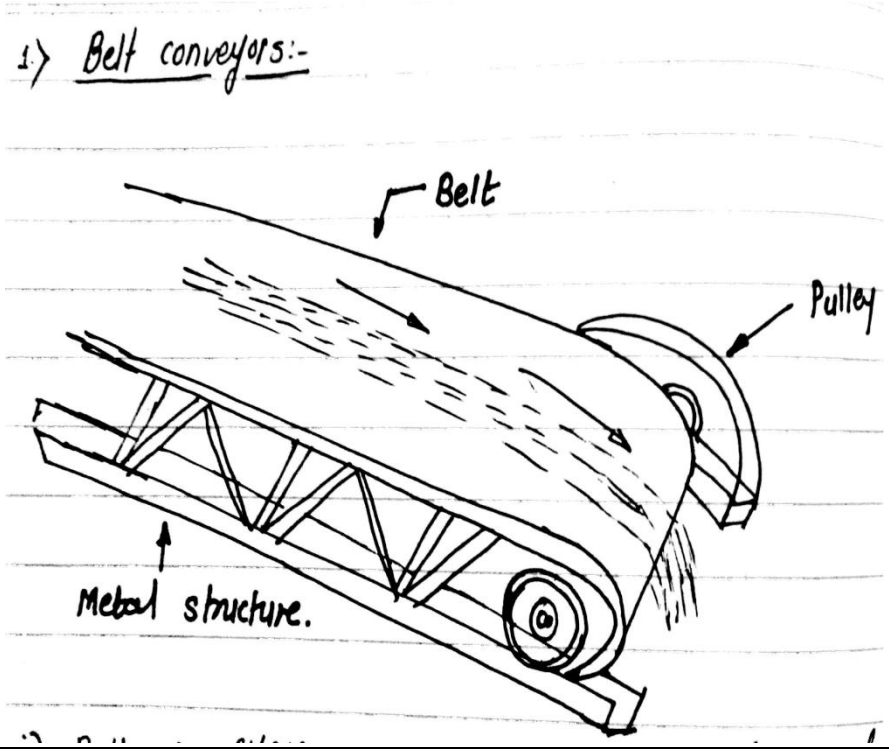
c. Chain Conveyer.

d. Screw conveyer.

5.Automated guided vehicle

Belt Conveyer:

1. Belt conveyers are particularly suitable for package handling because of their smooth, noiseless operation.
2. It can be used for handling of materials in horizontal or inclined direction.
3. Belt conveyer consists of an endless belt, idler roller, structure, a head pulley, a tail pulley and suitable drive.
4. The width of belt ranges from 8 cm to 100 cm. and material of belt can be rubber, plastic, leather, sometimes flat steel bands can also be used.
5. Speed of belt normally ranges from 1 m/s to 70 m/s.



given for example, examiner should consider any type of device.

	b) Ans:	State and explain the various factors affecting process planning. **Factors affecting process planning.** **a. Size and shape of part:** The size and shape of many components decides the basic operations for the manufacturing of pert. For example : For manufacturing a shaft, the necessity information is shape of raw material, size of shaft, according to that we select the sequence of operations, machines to be used and material handling activities. **b. Strength characteristics of the part:** The part strength also decides that which type of process is employed for producing it. Because the different types of load acted on the part during its working such as impact load, tensile load or shock load etc. according to that process planning is done. **c. Quantity required:** According to the no. of output produced, the process planning is decided. For example: Part which is manufacture in large no. for that general purpose machine is used and for large size and less no. of part special purpose machines are used. **d. The accuracy and surface quality required:** For achieving accuracy, product should be manufactured such a way that it should give higher dimensional accuracy and high degree of surface finish according to that machines and process is to be selected. **e. Utilization of existing equipments:** While selecting the process, full capacity of existing machines & its tooling must be utilized, otherwise the existing machinery will remain idle and more capital will be invested on new machines. **f. Skill of manpower:** Skill of available manpower must be known to determine the need for added operations to avoid defectives due to poor workmanship. **g. Delivery date of components or product:** Short time period of delivery generally do not allow process engineer to select most economical process and tool for economic production. Due to insufficient time, he may use less efficient machine and tool on hand. On other hand, longer delivery schedule give process engineer sufficient time to go details of each aspect to select most economical process.	(Any 4 points with appropriate explanation-8 Marks)
	c) Ans:	How inspection stages are determined? State the significance of operation sheet. Following points taken into considerations for determine stages of inspection. 1. Type of production system. i.e. Job, batch or mass etc. 2. Nature of product i.e. complex which consist of more number of parts or simple one. 3. Process selected for manufacture which consist of simple or complex operations or which consist of cheap or costly operations. 4. Type of layout i.e. line layout or functional layout etc. 5. Finding the key operations in process responsible for the essential function of the product. 6. The cost incurred on inspection i.e. money spend on inspection and cost of allowing defective parts per lot.	Any four points – 4 marks.

		Significance of operation sheet. 1. The operation sheet gives the information that is very vital to process engineer. 2. It helps the supervisor to know which operation is being performed on the job. 3. It helps the worker to clearly understand the drawing. 4. It also instructs the worker about the speed, feed and depth of cut to be used for particular operation. 5. It also gives the information about the time required for the operation. This can help the process engineer to schedule the similar jobs. 6. The information like the availability of machines can also be obtained from the operation sheet. 7. As the operation sheet is one of the activity in the process plan, it helps to get a systematic process plan.	Any four points of significance – 4 marks.
3.		Attempt any FOUR of the following:	**12**
	a)	State different types of plant layout. Explain any one type.	
	Ans:	**Types of plant layout.** There are three types of plant layout depending upon the volume of production. They are 1. Line or Product layout. 2. Functional or Process layout. 3. Project or Fixed position layout. **Line or Product layout:** In this type of layout, the machine and auxiliary services are arranged in line according to sequence of operations to be performed. The raw materials enter in the line at one end, the operations are carried out in succession in a smooth flow and finished product is delivered at other end of the line. In this layout, there will be a separate production line for each type of product. Product layout is suitable for continuous production where there is a stable product demand.	List of Types – 1 mark. Explanation of any one type with sketch – 3 marks

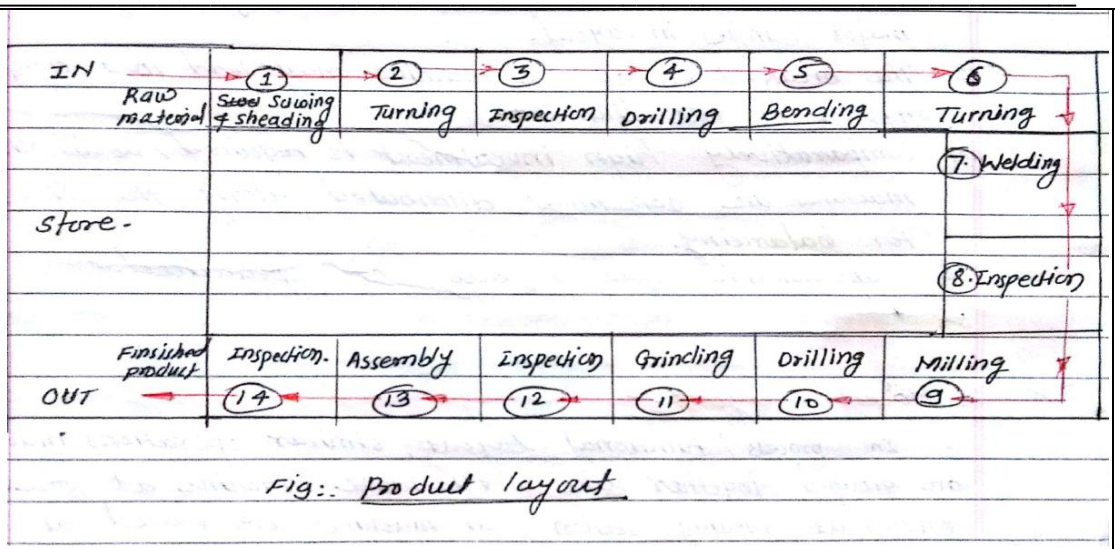


Fig:: Product layout

Functional or Process layout:

Process layout also known as functional layout. In this layout machine performing similar operations are grouped together, and are not arranged according to any particular sequence of operations. The machine group together in different department or even different building therefore lot of cross movement of work take place. Due to this, process layout is suitable for low volume of production & where the product is not standardized.

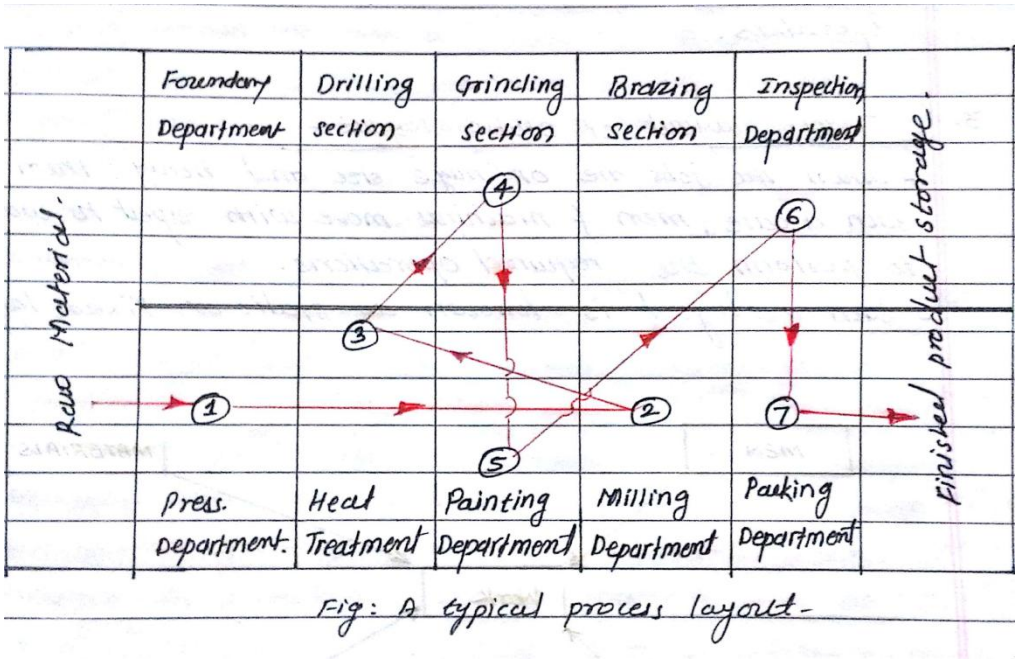
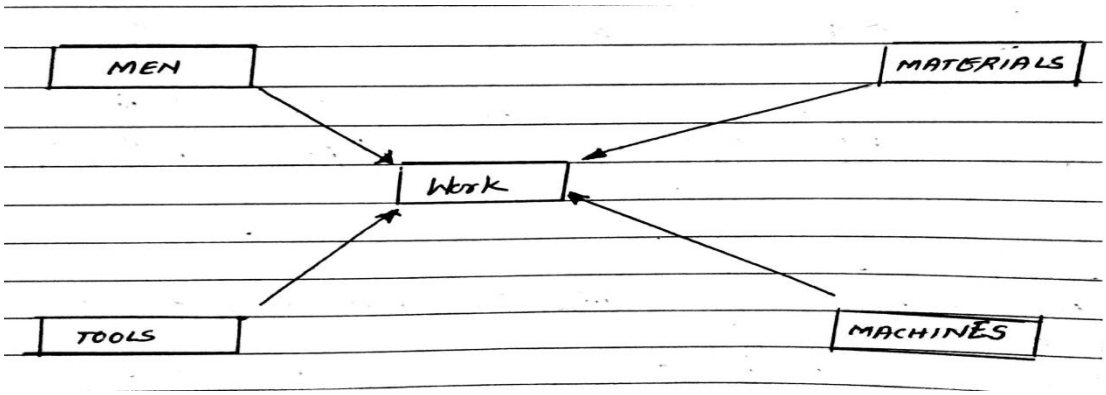


Fig: A typical process layout.

Project or Fixed layout:

When the jobs are huge size and heavy, then, in such case, men and machines move

		with respect to work/job to perform the required operations. Such a layout is known as static or fixed position layout. Such type of layout is typical in customer oriented type production like ship building, air craft construction, large turbo generators, etc.  	
	b) Ans:	State and explain the basic principle to be followed to develop a good plant layout. Following are the basic principle to be followed to develop a good plant layout. **1. Overall integration:** A good layout is one that integrates men, materials, machine and supporting services, and others in order to get the optimum utilization of resources and maximum effectiveness. **2. Smooth flow of product:** A good layout is one that makes the material to move in forward direction towards the completion stage, i.e., there should not be back tracking. **3. Minimum distance travelled:** This means minimum movement of men and materials. The facilities should be arranged such that, the total distance travelled by the men and material should be minimum and as far as possible straight line movement should be preferred. **4. Space utilization:** The good layout is one that utilized both horizontal and vertical space. It is not only enough if only the floor area is utilized optimally but the third dimension, i.e., the height is also utilized effectively. **5. Flexibility:** The good layout is that can be altered without much cost and time, i.e., future requirements should be taken into account while designing the present layout. **6. Minimum handling:** A good layout is that which reduced the material handling to minimum. **7. Maximum visibility:** The plant should be planned in such a way that, there should not be any difficulty in supervision, co-ordination and control. There should not be no 'hiding space' into which goods can be mislaid. **8. Employee satisfaction and safety:** A good layout is one that gives due consideration to workers safety and satisfaction and safeguard the plant and machinery against fire, theft etc.	Any four points with explanation – 4 marks.

		9. Maximum accessibility: All servicing and maintenance point should be readily accessible without making any hindrance to the production process. For this purpose there must be sufficient space between different machines.	
	c) Ans:	Explain in brief steps involved in process planning. **Steps involved in process planning:** **1. Analysis of Product and its specification: -** During analysis, following parameter should be considered, a. Drawing and specification of product. b. Quality of product. c. Number of parts/components per product. **2. Make or buy decision:** Process planning determines what parts are to be manufactured in the firm itself and what parts are to be purchased from outside. **3. Selection of basic manufacturing process:** Once the decision is taken what parts to be manufactured, next step is to decide the manufacturing process. The alternative methods are compared and most practical and economical method is decided by calculating and comparing total cost for two or more feasible method. **4. Determining sequence of operation:** Once the best manufacturing process is selected, sequence of operation to be performed on each component is determined. **5. Combine the operations:** If possible practically, combine as many operations as possible. As it is economical to combine the operations. **6. Selection of machine tools/equipments:** Selection of correct machine is closely related to the process of manufacture. While selecting the machine, following factors should be considered: a. Size and form of work piece. b. Accuracy and surface finish required. c. Quantity required. **7. Inspection:** At this stage, inspection devices and stages are decided. **8. Requirement of tools, gauges etc.:** To determine and order the tools and gauges required to manufacture the part. **9. Labour requirement:** Kind/Skill of labour required to do the job. **10. Time standards:** To determine the time standards for performance of the job and fixing the rates of payment. **11. Prepare the route sheet and operation sheet.**	Proper explanation with correct sequence of steps – 4 marks.
	d) Ans:	State and explain how the different operations can be combined? Bye two methods operation can be combined. 1. **Simulation method:** In this method, different operations are combined together and performed the simultaneously in one setting. For example, straddle milling, gang milling operation, slot making operation on CNC machine centers etc. 2. **Integration Method:** When a set of operations selected for a process arranged so as to perform one after other, not simultaneously is the method of integration. Here operations are carried out in succession without disturbing setups. For example operations on turret lathe, multi spindle automats, CNC operations etc.	Two methods with proper explanation – 4 marks.

<table>
<tr><td></td><td>e)

Ans:</td><td>What are the objectives of method study?

Objectives :-
1. Improvement in process and procedures.
2. To find the best way of doing job.
3. Better workplace layout and better working condition.
4. Less fatigue to operators.
5. Better product quality.
6. Improvement in the use of materials, machines and manpower.
7. Efficient and fast material handling.
8. Greater job satisfaction, higher standards of safety and health.
9. Reduction in waste and scrap.
10. Smooth and streamline flow of production and processes.</td><td>Any four points – 4 marks.</td></tr>
<tr><td></td><td>f)

Ans:</td><td>Differentiate between Jigs and Fixtures.
<table><tr><th>Sr.No</th><th>Jigs</th><th>Fixtures</th></tr><tr><td>1.</td><td>Jigs holds and locate the work piece and also guide the cutting tool to the work.</td><td>Fixture only holds and locates the work piece and does not guide the tool.</td></tr><tr><td>2.</td><td>Jigs are movable device and generally not fixed to the machine table.</td><td>Fixture are fixed device, usually clamped or bolted to the machine table.</td></tr><tr><td>3.</td><td>Jigs are usually lighter in construction than fixtures.</td><td>Fixtures are usually heavy in construction.</td></tr><tr><td>4.</td><td>It requires drill bushes.</td><td>It requires setting block.</td></tr><tr><td>5.</td><td>Most jigs uses standard parts such as drill –bushes, dwell pins etc.</td><td>Fixtures does not use standard components.</td></tr><tr><td>6.</td><td>Jigs are used on drilling, reaming, tapping, and counter boring operation.</td><td>Fixtures are used with turning, milling, grinding, shaping etc.</td></tr></table></td><td>Any four points – 4 marks.</td></tr>
<tr><td>4</td><td>a)

i)

Ans</td><td>Attempt Any Three of the Following

Explain any two clamping devices with neat sketch

[1] Screw clamp:- It is particularly useful when a component is to be gripped on its edges. This arrangement insures easy machining of top surface of work piece.

[2] Equalizing clamp: - It is used for exerting equal pressure on two spots of the face of the work piece. It consists of clamp, legs and screws.</td><td>1 Mark each for any two correct</td></tr>
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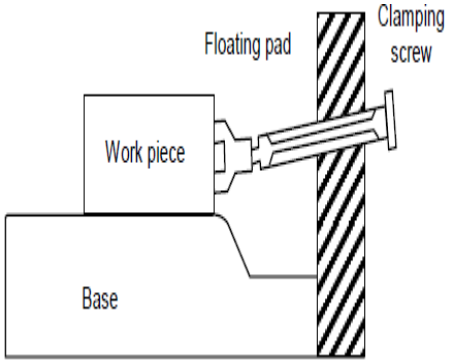


Figure:- Screw Clamp

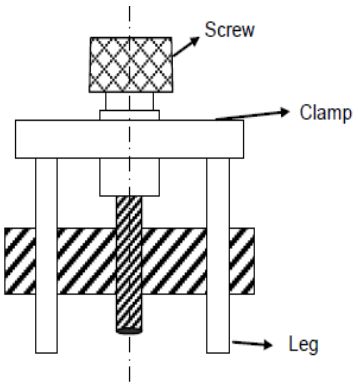


Figure:- Equalizing Clamp

[3] Pivoted clamp:- It consist of strap and screw . It eliminates used of spanner for clamping the work piece.

[4]) **Latch clamp**:- This is special type of clamp which provide a means of entry for loading and unloading of work piece. For this strap or latch can be swung out or in.

[5] Wedge clamp: - it consists of jig body, button, wedge and screw. It is extensively used in jigs and fixture due its rapid action. The clamp is operated by actuating the handle, which in turns lock and unlock the work piece.

[6] Hinged Jaw clamp:- This clamp is similar to swinging latch clamp in which the latch is hinged to enable the work piece to be loaded and un loaded. The clamp can be made integral with the latch

[7] Two way clamp:- It is rapid clamping device , consist of two levers by which clamping takes place in two direction with one screw.

[8] Cam operated clamp:- These clamp find broad application and are fast and positive in action. The clamp is operated by simply actuating the handle up or down which locks or unlocks the strap with the work.

explanation

And

1 Mark each for any two correct diagram

ii) Explain the concept of ERP

Ans

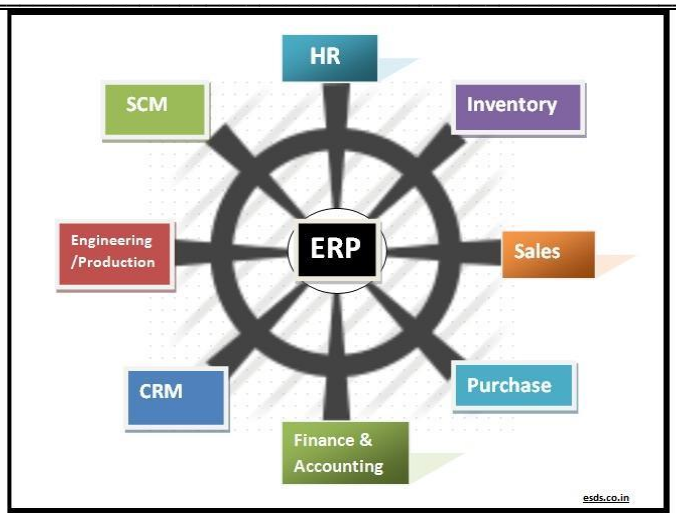
Enterprise resource planning (ERP) is a business management software—usually a suite of integrated applications—that a company can use to collect, store, manage and interpret data from many business activities, including:

- Product planning, cost
- Manufacturing or service delivery
- Marketing and sales
- Inventory management
- Shipping and payment

ERP came to represent a larger whole that reflects the evolution of application integration beyond manufacturing.

1 Mark for Concept

and



3 Marks for Explanation

ERP provides an integrated view of core business processes, often in real-time, using common databases maintained by a database management system. ERP systems track business resources—cash, raw materials, production capacity—and the status of business commitments: orders, purchase orders, and payroll.

ERP (Enterprise Resource Planning) systems typically include the following **characteristics:**

- An integrated system that operates in (or near) real time without relying on periodic updates
- A common database that supports all applications
- A consistent look and feel across modules

iii) Explain the concept of continuous improvement

Ans

Kai = Change **Zen = for the better**

Kaizen is a Japanese term that basically translated to continuous improvement or change to become good is a management concept originated by the Japanese in order to continuously effect incremental changes for the better, involving everybody within the organization from worker to managers. Kaizen is aimed at producing more & more value with less & less waste, attaining better working environment& developing stable process by standardization. The implementation cycle includes Planning of activities to be done. Prepare the action plan for performing those activities after that check the possibilities of performing those and feasibility of the same. Act according to the action plan. This cycle is also called as PDCA cycle.

Marks

iv) Explain robot anatomy and structure with sketch

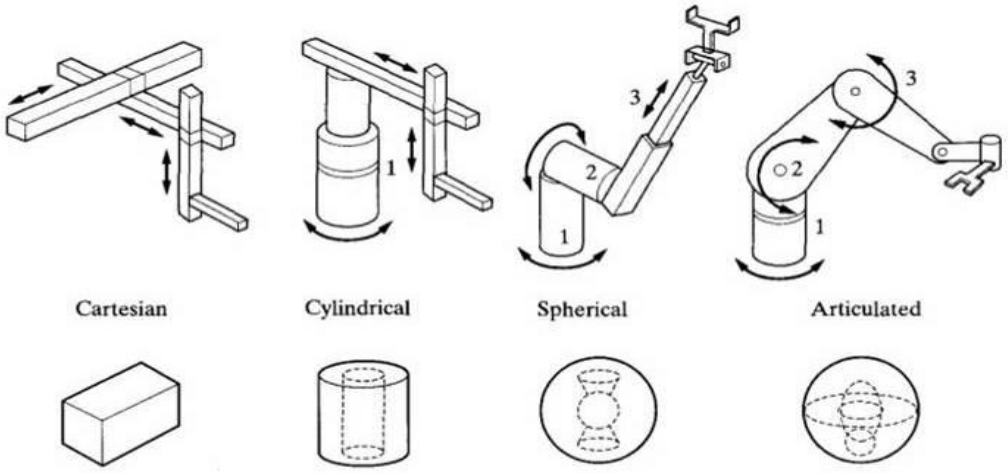
Ans

Robot Anatomy:- Robot anatomy concerns with the physical construction and characteristics of the body , arm , wrist which are components of the robot manipulator. Most robots are mounted on a base. The body is attached to the base and the arm assembly to the body. At the end of arm there is a wrist & consists of various joints which provides sliding and rotation motion. End effectors are attached to the wrist that performs the work.

2 Marks for Description

And

Robot may be attached permanently to the floor, may move along overhead rails or may be equipped with wheels to move on floor.
Five common anatomies of robots are available:-
1) Rectangular 2) Cylindrical 3) Spherical 4) Jointed arm 5) SCARA



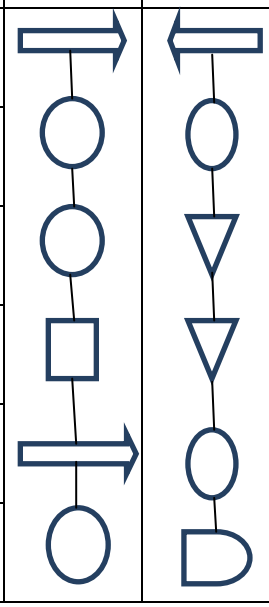
2 Marks for Sketch

4 **b)** **i)** **Ans**

Attempt any **ONE** of the following

Construct two handed process chart for the assembly of Nut and bolt with summary

- Task :- Assembly of Nut and Bolt
- Chart begins :- Both hands free before task
- Chart ends :- Both hands free after task
- Charted by :- -----
- Date of Charting :- ------

Left Hand		Right Hand	
Description	**Symbol**	**Symbol**	**Description**
Nut to the workstation			**Bolt to the workstation**
Position nut on bolt			**Grasp the bolt securely**
Thread nut			**Hold the bolt**
Inspect			**Hold**
To the bin			**Transfer assembly to left hand**
Drop the assembly to bin			**Wait**

4 Marks for Chart

And

2 Marks for Summary

Symbol					
Frequency (L.H.)	3	2	1	----	----
Frequency (R. H.)	2	1	----	2	1

ii) **Explain pull and push types of manufacturing system** — 3 Marks

Ans

Pull Type Manufacturing System:

[1] Just in Time (JIT) is a pull system which is also known as Make to Order Production.
[2] Pull System means that parts are produced to order and the production is matched with demand for the final assembly of products.
[3] In Make to order production system, there is a direct interaction with customers during all the stages but it is expensive during engineering phase..

Characteristics of Pull (Make to Order) Manufacturing System:

[1] Direct interaction with customers
[2] Production schedule changes with changes in customer order
[3] Capacity utilization is lower
[4] Capacity requirements planning are critical
[5] Shop floor control is critical
[6] Distribution is less complicated

Examples: Custom Tailored Clothing, Special Purpose Machinery and product made to customer specifications

Push type system — 3 Marks

It is often said that Material Requirements Planning (MRP) is a Push system. In MRP the detailed quantity of raw material required for production is planned. It tells when each item must be ordered and delivered so as to ensure timely delivery**.**

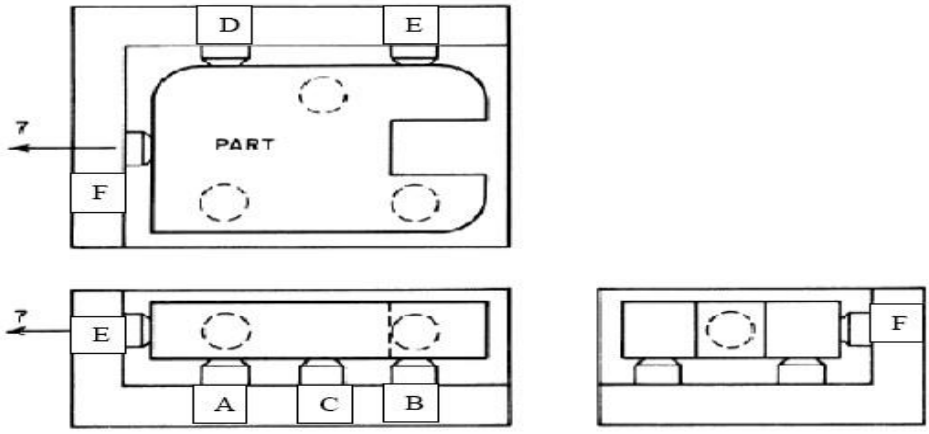
Push type" means Make to Stock in which the production is not based on actual demand. "Push type" is represented by "Make to Stock" (MTS) in which the production is not based on actual demand.

5 a) Attempt any **FOUR** of the following

Ans

Explain 3-2-1 principle of location with suitable example — 2 Marks for Explanation and 2 Marks for Sketch

[1] It is also known as six pin or six point location principle. In this, the three adjacent locating surfaces of the blank
(work piece) are resting against 3, 2 and 1 pins respectively, which prevent 9 degrees of freedom.
[2] The rest three degrees of freedom are arrested by three external forces usually provided directly by clamping.
The **3-2-1 principle** states that the six locators are sufficient to restrict the required degree of freedom of any work piece. In this, motion is restricted using clamps and locators. A three pin base can restrict five motions and six pins restrict nine motions.



b) **State and explain general principle of jig and fixture design** — 1 Mark each for Any 4 Points with explanation

Ans

Principle of jigs and fixture design:

1. Before planning the design of a tool, compare the cost of production of the work with present tools with the expected cost of production, using the tool to be made. Confirm that the cost of building jigs & fixture is not in excess of expected gain.
2. Before lying out the jigs & fixture decide upon the location point & outline a clamping arrangement.
3. Make all clamping & building devices as quick acting as possible.
4. In selecting the location points, see that two component part of a machine can be located from corresponding points & surfaces.
5. Make the jig 'fool-proof' that means design it in such way that work cannot be inserted except in the correct way.
6. For rough casting, make some of the locating points adjustable.
7. Locate clamps so that they will be in the best position to resist the pressure of cutting tool when at work.
8. Wherever possible make all clamps, integral parts of jig or fixture.
9. Avoid complicated clamping arrangements which are liable to wear or get out of order
10. Place or clamps as nearly as possible opposite to some bearing point of the work to avoid springing.
11. Round all corners.

c) **What is mean by 5' S? Explain the meaning of each "S" in detail** — 2 Marks for meaning

Ans

Meaning of 5'S:-

5'S is the name of a workplace organization methodology that uses a list of

five Japanese words which are seiri, seiton, seiso, seiketsu and shitsuke constitute the

system.

Interpretation of "S":-

Japanese Term	English Equivalent	Meaning

SEIRI	Tidiness	Unrelated materials in workplace
SEITON	Orderliness	Set everything in proper for quick storage and retrieval
SEISO	Cleanliness	Clean the workplace, everything should be janitor
SEIKETSU	Standardization	Standardize the way of manipulating the cleanliness
SHITSUKE	Discipline	Practice 5's daily, make it a way of life this also means a commitment

2 Marks for Interpretation

d) Explain spherical configuration with neat sketch

Ans

Spherical Configuration

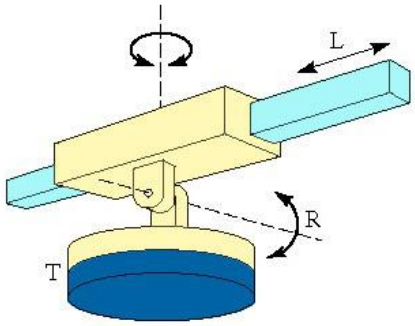
These robots have a work space of spherical shape. In general, the arm is linked to the base with a twisting (T) joint and rotatory (R) and or linear (L) joints. The designation of the arm for this arm can be TRL or TRR. Robots with the description of TRL are also called **polar robots**.

IT uses telescopic arm that can be raised or lowered about a horizontal pivot point. The pivot point is mounted on a rotating base and gives the robot its vertical movement. These various joints provide the robot with the ability to move its arm within a spherical envelope.

2 Marks for explanation

And

2 Marks for sketch



e) Explain tactile sensors in robots

Ans

Tactile Sensors:-

Tactile sensors provide the robot with the capability to respond to contact forces between itself and other objects within its work volume. Tactile sensors can be divided into two types:

[1] Touch Sensor is used simply to indicate whether contact has been made with an object. A simple micro switch can serve the purpose of a touch sensor.

[2] Stress Sensor is used to measure the magnitude of the contact force. Strain gauge devices are typically employed in force measuring sensors.

4 Marks

f) What are grippers? Explain vacuum actuated grippers in brief

Ans

Grippers:-

A gripper is a device which enables the holding of an object to be manipulated. a gripper enables holding, tightening, handling and releasing of an object.

Vacuum Grippers:-

The vacuum grippers also called vacuum cups or suction cups which uses vacuum as a gripping force. The lifting and holding is done by cups or vacuum surface driven by vacuum system. The Vacuum pump or venture system. — 1 Mark

[1] Usually the cups are available in round or oval shape. The common diameter size of cups is in between 30 mm to 200 mm. The selection of cup and number of cups required depends on:
[2] Weight of the part.
[3] Part size and shape.
[4] Nature and type of part etc.
Sometime to increase the contact area, multiple cups are used. Vacuum cups are used to lift flat as well as curved surfaces. — 3 Marks

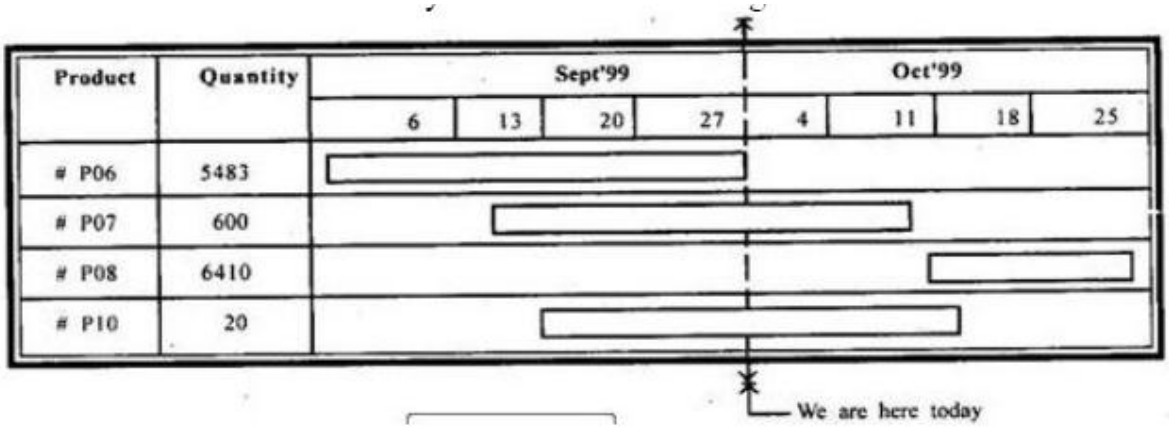
Examples: Vacuum cup or Suction Cup, some vacuum grippers use a closed-cell foam rubber layer for gripping application.

6 Attempt any **TWO** of the following

a) Explain the GANTT CHART used in production planning and control. Sate its advantages and disadvantages

Ans

Gantt Chart is a project planning tool that can be used to represent the timing of tasks required to complete a project. Because Gantt chats are simple to understand and easy to construct, they are used by most project managers for all but the most complex projects.
[1] In a Gantt Chart, each task takes up on row.
[2] Dates run along the top in increments of days, weeks or months, depending on the total length of the project.
[3] The expected time for each task is represented by a horizontal bar whose left end marks the expected beginning of the task and whose right end marks the expected completion date.
[4] Tasks may run sequentially, in parallel or overlapping.
[5] Gantt charts are particularly helpful ways of dealing with scheduling tasks, understanding critical paths of project and planning of resources — 2 Marks for explanation



2 Marks for Diagram

Figure:- Gantt Chart

Advantages of Gantt chart:
[1] Gantt Chart is simple graphical display technique, suitable for less complex situations
[2] Gantt charts are extremely easy to understand. — 2 Marks for

[3] It can quickly reveal the current or planned situation to all concerned.
[4] It does not provide any rules for choosing but simply presents a graphical technique for displaying results (and schedule) and for evaluating results (make span, idle time, waiting time, machine utilization, etc.)
[5] There is clarity in communicating important shop information by using Gantt chart

any four Advantages

Disadvantages of Gantt chart:
[1] The Gantt chart must be updated periodically to account for new jobs.
[2] It is used for communicate relatively less information.
[3] Lack of adequate depiction of interrelationship between the separate tasks.
(It means how the ability to start one task depends upon the successful completion of other tasks.)
[4] Requires greater time to maintain

2 Mark for any four Disadvantages

b) **A shop floor activity consists of three elements. Calculate the standard time for the activity. The various allowances are given as percentage of normal time.**

Elements	A	B	C
Observed time (min)	1.25	1.2	2.85
Rating factor (%)	90	115	85
Relaxation allowance (%)	12	13	8
Delay allowance (%)	3	6	5
Personal allowance (%)	8	6	4

Ans

Elements	Observed time	Rating	Basic Time (Normal Time)
A	1.25	90	=1.25 X (90 / 100) **= 1.125**
B	1.2	115	=1.2 X (115/100) **= 1.38**
C	2.85	85	=2.85 X (85 / 100) **= 2.4225**

4 Marks for Calculating Total time

Total time = 1.125 + 1.38 + 2.42 = 4.9275 Min

3 Marks for Calculating Allowance Time

1) **Relaxation Allowance =** (12/100 X 4.9275) + (13/100 X 4.9275) + (8/100 X 4.9275)
= 0.5913 + 0.6405 + 0.3942
= 1.626 Min

2) **Delay Allowance** = (3/100 X 4.9275) + (6/100 X 4.9275) + (5/100 X 4.9275)
= 0.1478 + 0.2956 + 0.2463
= 0.6897 Min

3) **Personal Allowance** = (8/100 X 4.9275) + (6/100 X 4.9275) + (4/100 X 4.9275)
= 0.3942 + 0.2956 + 0.1971

		= 0.8869 Min **Standard Time** = (4.9245 + 1.626 + 0.6897 + 0.8869) **= 8.1301 Min**	1 Mark for Standard Time
	c)	**What are actuators? Explain mechanical and hydraulic actuators type with advantages and disadvantages**	
	Ans	**Actuators:-** An **actuator** is a component of a machine that is responsible for moving or controlling a mechanism or system.	2 Marks
		Mechanical Actuator:- A mechanical actuator functions to execute movement by converting one kind of motion, such as rotary motion, into another kind, such as linear motion. An example is a rack and pinion.	1 Mark for Explanation
		The operation of mechanical actuators is based on combinations of structural components, such as gears and rails, or pulleys and chains.	1 Mark for Advantages
		Advantages:- [1] Simple in construction [2] Reliable	1 Mark for Disadvantages
		Disadvantages:- [1] Slightly lower efficiency compare to other [2] Frequent Maintenance required	1 Mark for Explanation
		Hydraulic Actuator According to Pascal, when there is an increase in pressure at any point in a confined incompressible fluid, then there is an equal increase at every point in the container. Hydraulic actuators are designed based on this principle (Pascal's law).	1 Mark for Advantages
		Hydraulic actuators are majorly used for a systems which require very large force, but not very restrictive on positioning and accuracy.	1 Mark for Disadvantages
		Advantages of hydraulic actuators: 1. They can move moderate to heavy loads. 2. They are more efficient and deliver better performance than others. 3. Power to weight ratio of these actuators is high.	
		Disadvantages:- [1] Leakage of fluid [2] hydraulic fluid is flammable [3] lags in the control of the system due to the transmission lines and oil viscosity changes from temperature	