SUMMER – 19 EXAMINATION

Subject Name: PER **Model Answer** Subject Code: 17609

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**	
	i) ANs	**State the importance of Productivity in any organization.** **Importance of Productivity:** **(Give 4 Marks for appropriate significance and importance of Productivity with justification)** [1] Productivity may be defined as the ratio between output and input. Output means the amount produced or the number of items produced and inputs are the various resources employed, e.g. land and building, equipment and machinery, materials, labor etc. [2] Productivity is an overall measure of the ability to produce a good or service. It is relates with the efficiency of a machine. Just as it is desired to increase the efficiency of a machine, it is also aimed at to raise the productivity within the available resources. [3] Higher productivity leads to a reduction in production cost, reduces the sales price of an item, expands markets, and enables the goods to compete effectively in the world market. Improved Productivity is the essential requirement of Management, Workers and end user i.e. customers of any organization. [4] In any organization, if productivity increases, then profits increase. The resulting profits can then be used to pay for wage increases (inherent in inflation) without having to raise prices. In this way, productivity gains actually help in growth of organization	**04 Marks for appropriate significance and importance of Productivity with simple example**
	ii) Ans	**Compare a job production with mass production.** **Comparison between Job and Mass Production with respect to different parameters:** **(Any 4 points, 1 Mark for each)**	

S.N.	Parameters	Job Production	Mass Production
1	**Product Feature**	Made to satisfy a specific order	Same type of Product is manufactured to meet the continuous demand of product.
2	**Layout**	Process Layout	Product Layout
3	**Production Quantity**	Low	High
4	**Production Variety**	Large	Less
5	**Machines Used**	GPM	SPM, FMS
6	**Manufacturing Cycle Time**	More	Shorter
7	**WIP Inventory**	Large	Minimize
8	**Cost of Product**	High	Low
9	**Applications (Use)**	Aircrafts, Ships, Space Vehicle, Bridge & Dam etc.	Steel Bottling, Power fertilizer, Automobiles, Oil refinery.

Any 04 Points, 01 Mark for each

iii) **Explain the procedure of measurement of productivity? Discuss any two techniques.**

Ans **(Any 2 techniques used for Measurement of Productivity with equation, 2 Marks for each)**

Productivity Measurement:

[1] Measurement plays an important role in management of productivity. It helps to determine organization is progressing well or not. It also provides information on how effectively and efficiently any organization manages its resources.

[2] Productivity is difficult to measure and can only be measured indirectly, that is, by measuring other variables and then calculating productivity from them.

Procedures (Methods) of Productivity Measurement:

It has been said that, productivity measurement is the ratio of organizational outputs to organizational inputs. Thus Productivity is usually expressed in one of three forms:

[1] Partial productivity measurement (PPM)
[2] Multi-factor productivity measurement (MFPM)
[3] Total productivity measurement (TPM)

[1] Partial Productivity Measurement (PPM):

Partial productivity measurement is used when the firm is interested in the productivity of a selected input factor. It is the ratio of output values to one class of input. Inputs may be Labor, material or capital

$$PPM = \frac{\text{Outputs}}{\text{Inputs}}$$

Partial Productivity consist of

[a] Labor Productivity (LP):

It is indicated by units of output per labor hour or unit of output per shift. (Units/Hour)

Any 2 Techniques with Equation, 02 Marks for each

$$LP = \frac{\text{Units of Outputs}}{\text{Labor Hour (Inputs)}}$$

[b] Machine Productivity (MP):

It is indicated by units of output per machine hour or output per unit machine. (Units/Hour)

$$MP = \frac{\text{Units of Outputs}}{\text{Machine Hour (Inputs)}}$$

[c] Energy Productivity (EP):

It is indicated by units of output per KW-hr or Rupee value of output per KW-hr (Units/KW-Hr)

$$EP = \frac{\text{Units of Outputs}}{\text{KW-Hour (Inputs)}}$$

2] Multi-factor Productivity Measurement (MFPM):

This productivity measurement technique is used when the firm is interested to know the productivity of a group of input factors but not all input factors.

$$MFPM \quad \frac{\text{Outputs}}{\text{(Labor + Capital/Material)}}$$

[3] Total (Composite) Productivity Measures (TPM):

A firm deals about composite productivity when it is interested to know about the overall productivity of all input factors. This technique will give us the productivity of an entire organization or even a nation.

$$TPM = \frac{\text{Outputs (Goods \& service provided)}}{\text{Inputs (All resources used)}}$$

iv) **Enlist the various functions of PPC.**

Ans **Functions of Production Planning and Control (PPC):**

(List of any 8 Functions, ½ Mark for each)

[1] Material Function:

It includes the specification of materials, delivery dates, variety reduction procurement (Standardization) and make or buy decisions.

[2] Machine and Equipments:

It includes the detailed analysis of available production facilities, equipment down time, maintenance procedure and schedules.

[3] Methods:

It includes the analysis of alternatives and selection of best method with due considerations.

[4] Process Planning (Routing):

It includes fixation of path of travel, breaking down of operations and deciding the set up time and process time for each operation.

[5] Estimating:

It is carried out using extensive analysis of operations along with methods and routing and a standard time for operation are established using work measurement techniques.

[6] Loading and Scheduling:

It includes Loading of machines, determining the start and completion times for each operation and to coordinate with sales department regarding delivery schedules.

[7] Dispatching:

It includes assigning the definite work to definite machines, to issue required materials from stores, to issue jigs, fixtures and make them available at correct point of use, to record start and finish time of each job etc.

[8] Expediting:

It includes identification of bottlenecks and delays, to advise action plans for correcting the errors and to see that production rate is in line with schedule.

[9] Inspection:

This forms the basis for knowing the limitations with respect to methods, processes etc.

[10] Evaluation:

It consists of through analysis of all the factors influencing PPC which helps to identify the weak spots and corrective action.

List of any 08 Functions

½ for each

1	b	**Attempt Any <u>ONE</u> of the following:**	
	i) Ans	**Explain any six factors on which selection of material handling device depends.** **Factors Affecting the selection of Materials Handling Devices/Equipment:** **(List and briefly explain any six appropriate factors, 01 Mark for each)** **[1] Adaptability:** The load carrying and movement characteristics of the equipment should fit the materials handling problem. **[2] Flexibility:** The MH Equipment should have flexible to handle more than one material, referring either to class or size. **[3] Load Capacity:** The MH Equipment should have great enough load-carrying characteristics to do the job effectively. **[4] Power:** Enough power should be available to do the job. **[5] Speed:** Should consider the rapidity of movement of material, within the limits of the production process. **[6] Space requirements:** Should consider the space required to install or operate MH Equipment. **[7] Supervision required:** This refers to the degree of automaticity designed into the MH Equipment. **[8] Ease of Maintenance:** Equipment selected should be easily maintained at reasonable cost. **[9] Environment:** Equipment selected must conform to any environment regulations. **[10] Cost:** The consideration of the cost of the MH Equipment is an obvious factor in its selection	**List and briefly explain any six appropriate factors, 01 Mark for each**
	ii) Ans	**Explain the concept of line balancing. State its importance and objectives.** **(Give 02 Marks for Concept, 02 Marks for Importance & 02 Marks for Objectives)** **Concept of Line Balancing:** [1] Line balancing is commonly used technique to solve problems occurred in assembly line. [2] It is a technique to minimize imbalance between workers and workloads in order to achieve required run rate. [3] This can be done by equalizing the amount of work in each station and assign the smallest number of workers in the particular workstation. Here the job is divided into small portion called “job element”. [4] The basic aim is to maintain production at an equal rate. **Objectives of Line Balancing:** Line balancing technique is used to: [1] To manage the workloads among assemblers. [2] To identify the location of bottleneck.	**02 Marks for Concept, 02 Marks for Importance & 02 Marks for Objectives**

		[3] To determine number of workstation. [4] To reduce production cost. **Importance of Line Balancing:** [1] It helps to provide uniform rate of Production. [2] It provides less material handling. [3] It provides easy production control. [4] It helps to achieve effective use of facilities. [5] It helps to avoid congestion	
2		**Attempt Any <u>TWO</u> of the following:**	
	a) Ans	**What are the factors influencing the selection of a site for a new industry/plant? Explain** **Factors influencing the selection of a site for new Industry/Plant:** **(List of any 08 appropriate factors with brief explanation, 01 Mark for each)** The location of the plant can have a crucial effect on the overall profitability of a Project, and the scope for future expansion. There are a number of factors which should be considered while selecting a suitable site. The basic factors which influence the choice of plant location are; **[1] Proximity to market:** Organization may choose to locate facilities close to their market, not merely to minimize transportation costs, but to provide a better service. **[2] Integration with other parts of the organization:** If the new plant or facility is one of a number owned or operated by a single organization or group, it should be so situated that its work can be integrated with that of the associated units. **[3] Availability of labour and skills:** Certain geographical areas have traditional skills but it is very rare that a location can be found which has appropriately skilled and unskilled labour in the desired proportions or quantities. **[4] Availability of amenities:** A location which provides good external amenities is often more attractive than one which is more remote. **[5] Availability of transport:** It is important that good transport facilities are readily available. **[6] Availability of inputs:** A location near main suppliers will help to reduce cost and permit staff to meet suppliers easily to discuss quality, technical or delivery problems. **[7] Availability of services:** It includes; Gas, Electricity, Water, Drainage, Disposal of waste, Communications etc. **[8] Suitability of land and climate:** The geology of the area needs to be considered, together with the climate conditions. **[9] Regional regulations:** It is important to check at an early stage that the proposed location does not violate any local regulations. **[10] Safety requirements:**	**List of any 8 appropriate factors with brief explanation, 01 Mark for each**

		Some production units may present, or may be believed to present, potential dangers to the surrounding neighborhood. Location of such plants in remote areas may be desirable. **[11] Site cost:** As a first charge, the site cost is important, although it is necessary to prevent immediate benefit from jeopardizing long term plans. **[12] Special grants, regional taxes and import/export barriers:** Certain government and local authorities often offer special grants, low-interest loans, low rental or taxes and other inducements in the hope of attracting certain industries to particular locations.	
	b) Ans	**State the importance of operation sheet. How will it help you to improve process planning?** **(04 Marks for Importance of Operation Sheet, 04 Marks for Importance of Operation sheet in Process Planning)** **Importance of operation Sheet:** [1] A process planning used in the routing which is also known as Route Sheet, Process Sheet or Operation Sheet. [2] It consists of details of operations, sequences, types of machinery used and operation time. [3] Thus the operation sheet is the document that specifies the details of the process plan. The Operation (Route) sheet is important tool to the process planner as like the engineering drawing is to the product designer. [5] It should include all manufacturing operations to be performed on the work part, listed in the order in which they are to be accomplished. It is a listing of sequence of operations which must be performed on the component. **Importance of Operation Sheet in Process Planning:** The purpose of Operation (Route/Process) s sheet is to record and communicate the information that is essential for making each part. The information given in the Operation sheet can be used for variety of activities. It will help to improve process planning in following ways; [1] It becomes important document for costing and provides the information on the various details like set up and operation times for each job. [2] The machine and manpower requirements can be compute from the set up and operational times. [3] It helps to carry out scheduling. [4] It helps in cost reduction and cost control. [5] It helps to determine the efficiency of a work centre. [6] It helps to trace the material movement.	**04 Marks for Importance of Operation Sheet,** **04 Marks for Importance of Operation sheet in Process Planning**
	c) Ans	**List down eight important steps for planning a process for a product from raw material to finished product in an industry.** **(List of 08 Important steps used in Process Planning for a Product from raw material to Finished Product,** **01 Mark for each)** **Steps for Process Planning for a Product from Raw Material to Finished Product:** Specific activities involved in planning a process for a product from raw material to finished product in an industry are described below;	

[1] Analysis of the finished part requirements as specified in the engineering design:
In this stage, component drawing should be analyzed to identify its features, dimensions, and tolerance specifications. Part's requirement defined by its features, dimensions, and tolerance specifications will determine corresponding processing requirements

[2] Determining the sequence of operation required:
Basic aim is to determine the type of processing operation that has the capability to generate various types of features, given the tolerance requirements

[3] Selecting the proper equipment to accomplish the required operations:
Machine selection requires determining how the part would be processed on each of the alternative machines so that best machine can be selected. At this stage, organization has to decide whether to make or buy the component part. Break even analysis is most convenient method for selecting optimum method of manufacture or machine amongst the competing ones.

[4] Selecting the proper material for the components/parts:
The factors considered while selecting the materials are Function, Appearance, Reliability, Service life, Environment, Compatibility, Productivity and Cost.

[5] Calculating the specific operation setup times and cycle times on each machine :
Determination of set-up times requires knowledge of available tooling and sequence of steps necessary to prepare the machine for processing given work piece. For establishing accurate set-up times, detailed knowledge of equipment capacity, tooling, and shop practice also required.

[6] Documenting the established process plans:
Process plan is documented as job routing or operation sheet. Operation sheet also called "route sheet", "instruction sheet", "traveler", "planner". Information provided by route sheet is, Part identification, Description of processing steps in each operation, Operation sequence and machines, Standard set-up and cycle times, Tooling requirements for each operation and Production control information showing the planning lead time at each operation.

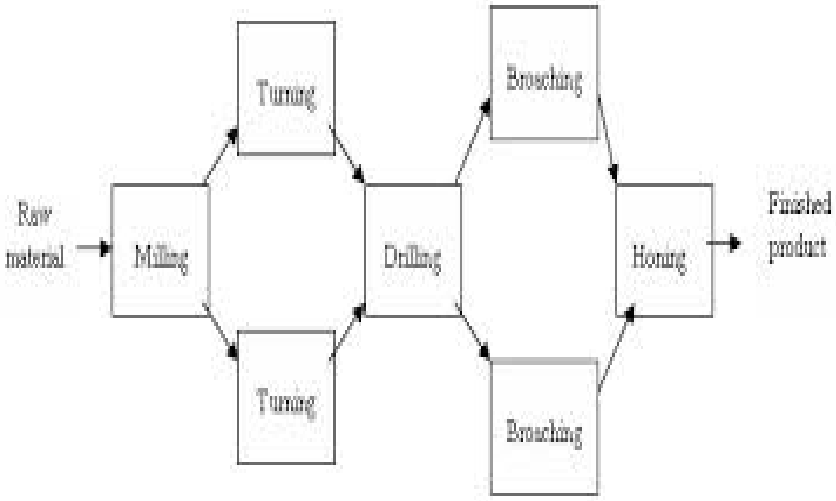
[7] Communicating the manufacturing knowledge to the shop floor:
Communication is essential to ensure that part will be processed according to most economical way. Process documentation and communication provide basis for improved part consistency and quality in manufacturing.

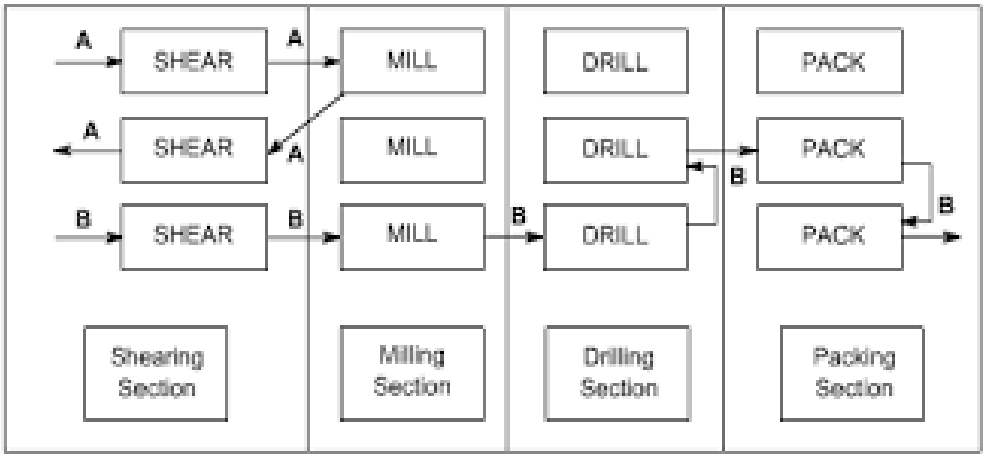
[8] Combining the operations to reduce production cycle:
In this many operations can be combined to put them in the best sequence to reduce the production time. This operation described in detail, in later section of this chapter.

[9] Inspection of tooling, gauges for proper working:
Inspection involves, determining the stages of inspection, the tools and gauges required for inspection. This operation described in detail, in later section of this chapter.

List of 08 Important steps used in Process Planning for a Product from raw material to Finished Product, 01 Mark for each)

3		**Attempt any FOUR of the following**	
	a) Ans	**State symptoms of good plant layout and bad plant layout** **Symptoms of good plant layout** [1] Material handling is minimized. [2] Bottlenecks and points of congestions are eliminated. [3] Work stations are designed suitably and properly. [4] The movements made by workers are minimized. [5] Waiting time of the semi-finished products is minimized. [6] Working conditions are safer, better and improved. [7] There is the utilization of cubic space. [8] Plant maintenance is simpler. [9] There are improved work methods and reduced production cycle time. [10] There is increased productivity and better product quality with reduced capital costs. **Symptoms of good bad layout** [1] Material handling time is more [2] Greater bottlenecks [3] poor working conditions [4] Less utilization of space [5] More plant maintenance [6] Reduced productivity	1 Mark each for any 2 correct points (symptoms of good plant layout) 1 Mark each for any 2 correct points symptoms of bad plant layout)
	b) Ans	**Define process planning and state its functions** **Process Planning** Process planning can be defined as the systematic determination of the methods by which a product is to be manufactured, economically and competitively. Process planning consists of devising, selecting and specifying processes, machine tools and other equipment to convert raw material into finished goods. **The principle functions of process planning are enlisted below:-** [1] To select the machining operations by viewing the engineering drawing of the part. [2] To generate the optimum sequence of machining operations. [3] To select the suitable machine tool. [4] To select the suitable cutting tool. [5] To determine the setup requirements. [6] To calculate the cutting parameters. [7] To prepare the tool path planning and generation of NC part program. [8] To design the Jig and Fixture.	2 Marks for definition & 1 Mark each for any 2 correct points
	c) Ans	**State the importance of inspection. Also explain floor inspection** [1] Inspection is the most common method of attaining standardization, uniformity and quality of workmanship. [2] It is the function of quality control. If the said item does not fall within the zone of acceptability it will be rejected and corrective measure will be applied to see that the items in future conform to specified standards. [3] Inspection is an indispensable tool of modern manufacturing process. [4] It helps to control quality, reduces manufacturing costs, eliminate scrap losses and assignable causes of defective work.	½ Mark each for 4 correct points

		Floor Inspection: In this, inspection is done at the place where the part is made or assembled. It suggests the checking of materials in process at the machine or in the production time by patrolling inspectors. This inspector moves from machine to machine and from one to the other work centres. Inspectors have to be highly skilled. This method of inspection minimize the material handling, does not disrupt the line layout of machinery and quickly locate the defect and readily offers field and correction.	2 Marks for explanation
	d) Ans	**Explain in brief product and process type layout** **Product Layout:-** It is also known as line layout. It implies that various operations on raw materials are performed in a sequence and the machines are placed along the product flow line i.e. machines are arranged in the sequence in which the raw material will be operated upon.  This type of layout is preferred for continuous production **Process Layout:-** It is also known as functional layout and is characterized by keeping similar machines or operations at one location. This type of layout is generally employed for industries engaged in job order production Example: - All lathes will be at one place, all milling machines will be at one place etc	2 Marks for explanation 2 Marks for explanation



e) **Define method study. State its objectives**

Ans "Method study is the systematic recording and critical examination of existing and proposed ways of doing work as a means of developing and applying easier and more effective methods and reducing costs."

The definition suggests examination of existing as well as proposed ways of doing work.

Objectives:-

1) To define correct sequence of operations
2) To find effective method of doing work
3) To reduce idle time of worker and machine
4) To improve resource utilization
5) To achieve economy
6) To develop better physical working environment
7) To select right material
8) To evolve innovative procedures

2 Marks for definition

1/2 Mark each for any 4 correct points

f) Differentiate between jigs and fixtures

Ans

S. No.	JIGS	FIXTURES
1	Jig guides the tool	Fixture usually holds the work piece securely
2	Jigs are rarely (or never) clamped on machine table	Fixtures usually clamped on machined table
3	Jigs contains tool guiding and work holding elements such as drill bushes	Fixtures contains work holding elements
4	Jig prevents wrong movement of tool	Fixture prevents wrong loading and unloading of work piece
5	Jigs are lighter in construction	Fixtures are heavy in construction

1 Mark each for any 4 correct points

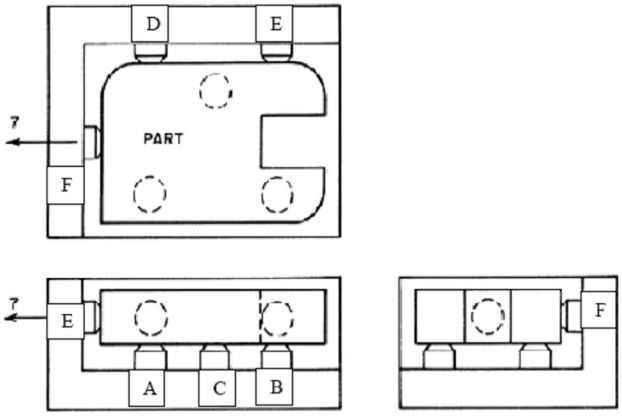
4 **a) Attempt an THREE of the following**

i) Explain 3-2-1 principle of locations with suitable example and neat diagram

Ans

3-2-1 Principle of Location used in Jig & Fixtures:

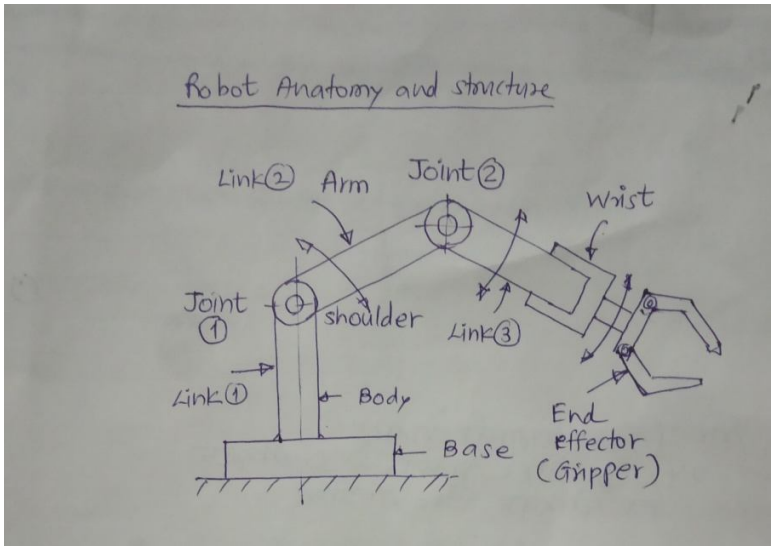
It is also known as six pin or six point location principle. In this, the three adjacent locating

		surfaces of the blank (work piece) are resting against 3, 2 and 1 pins respectively, which prevent 9 degrees of freedom. The rest three degrees of freedom are arrested by three external forces usually provided directly by clamping. Some of such forces may be attained by friction. 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.  Figure:- Locating the workpiece using 3-2-1 principle **Example of 3-2-1 Principle:** For this, refer the below figure; [1] The work piece is resting on three pins A, B and C which are inserted in the base of the fixed body. [2] The work piece cannot rotate about the axes XX and YY and also cannot move downward. [3] In this way, the **five degrees of freedom** 1,2,3,4 and 5 have been arrested. [4] Two pins D and E are inserted in the fixed body, in a plane perpendicular to the plane containing pins A, B & C. [5] Now the work piece cannot rotate about the Z axis and also it cannot move towards the left. [6] Hence the addition of pins D and E restrict three more degrees of freedom, namely 6, 7 and 8. [7] Another pin F in the second vertical face of the fixed body, arrests **degree of freedom 9**.	2 Marks for explanation & 1 Marks for diagram & 1 Mark for example
	ii)	**Explain JIT system of production. State its merits**	
	Ans	Just in time refers to the producing the part/component only when it is required. According to Just in time approach material is made available when it is demanded for further activities **Just in time assures** [1] Right material [2] At right place [3] At right cost [4] At right time [5] At right quantity [1] JIT is a Production methodology which aims to improve overall productivity through elimination of waste and which leads to improved quality. [2] JIT concept was implemented in Japan to eliminate waste of materials, machines, capital, manpower and inventory throughout the manufacturing system. [3] JIT is a philosophy rather than a technique. By eliminating all wastes and seeking	2 Marks for explanation & 1/2 Mark each for 4 correct merits

		continuous improvement, it aims at creating a manufacturing system that is responsive to the market needs. [4] It was first developed and perfected within the Toyota Manufacturing Plants by Taichi Ohno as a means of meeting customer demands with minimum delays. For this reason Taichi Ohno is known as the father of JIT. **Merits of JIT** [1] Reduce inventory level [2] To eliminate unwanted costs associated with inventory [3] To satisfy customer requirement [4] To ensure production flow [5] To optimize lead time	
	iii) Ans	**Write the classification of sensors used in robotics** **Classification of Robot Sensor:** Robot Sensors senses and capability includes vision and hand eye coordination, touch, hearing, sensors will divided into the following categories. **[1] Vision Sensor:** Robot vision is made possible by means of video camera, a sufficient light source and a computer programmed to process image data. The camera is mounted either on the robot or in a fixed position above the robot so that its field of vision includes the robots work volume. **[2] Tactile Sensor:** 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: **2.1 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. **2.2 Stress Sensor** is used to measure the magnitude of the contact force. Strain gauge devices are typically employed in force measuring sensors. **[3] Proximity Sensor:** They are used to sense when one object is close to another object. On a robot, the proximity sensors would be located on or near the end effectors. **[4] Voice Sensor:** Voice programming can be defined as the oral communication of commands to the robot or other machine. The robot controller is equipped with a speech recognition system which analyzes the voice input and compares it with a set of stored word patterns. When a match is found between the input and the stored vocabulary word the robot performs some actions which correspond to the word.	1 Mark each for 4 correct points
	iv) **Ans**	**Explain the concept of ERP** **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	4 Marks for correct explanation

		➢ Inventory management ➢ Shipping and payment ERP came to represent a larger whole that reflects the evolution of application integration beyond manufacturing. 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:** [1] An integrated system that operates in (or near) real time without relying on periodic updates. [2] A common database that supports all applications [3] A consistent look and feel across modules	
b)		**Attempt any ONE of the following**	
	i) Ans	**State the significance of time study. What are the different time study equipments used to perform time study?** [1] It can be used to examine time of existing method [2] implemented for setting standard time required for operation [3] Used to determine performance rating of worker [4] IT can be used to reduce per unit cost of product [5] It can be used for finding productivity [6] IT helps to decide under and over capacity of the plant **Time Study Equipment** **[1]** Stop Watch:- When the elements have been selected for time study timing starts. **[**2] Recording sheets such as Gantt charts, operation sheets etc [3] Process charts such as flow process charts, operation process chart, two handed process chart etc [4] Clock/ watch 5. Boards for holding watches and paper 6. Videotape recorders.	1 Mark each for any correct 4 points 2 Marks for any 2 correct points with description
	ii) Ans	**How 5's can be used as waste management technique** 5's can be used as a waste management technique as it has the main objectives to eliminate the waste. [1] It keeps the inventory at needed level only. [2] It Keeps the workplace in order and cleans. [3] It aims to eliminate unwanted items. [4] SEIRI in 5's refers to the removal of unrelated material from the work place. [5] SEIKETSU refers to the standardization of work being done which eliminate the wasteful work and material. So, with the help of such waste prevention approach in 5's it can be efficiently used as waste management technique	6 Marks for explanation

5		**Attempt any FOUR of the following**	
	a) Ans	**State at least eight principles of jigs/ fixture design** The following principles should be considered for design of jigs/ fixtures **1.Rigidity:** jigs/ fixtures should be sufficiently stiff/rigid to achieve required accuracy during machining. **2.Fool proofing:** The fool proofing or mistake avoiding system should be provided so that no human error may occur during use of jigs/ fixtures. **3.Easy clamping/de clamping :** The component should be easily clamped/de clamped during positioning the component. **4.Simplicity in design:** The design should simple and easy for use and manufacturing. It reduces cost of jigs/ fixtures. **5. Easy ejection of component:** Ejectors should be provided to remove the component after machining using suitable ejector mechanism. **6.Design for safety:** Safe and convenient for use. Minimum chances of accidents, avoid sharp corners, projected parts like bolts,etc **7. Locating points :** Good facilities should be provided for locating the work. The position of work piece should be accurate with use of locating points. **8.Economical**: The cost and benefits should be considered and design of jigs/ fixtures Should be simple so that its manufacturing should be economical. **9.Easy visibility for operator :** During machining operator can easily observe the process and work piece without any obstruction or movement of body unnaturally. **10.Burr grooves:** The burr or clearance grooves should be provided for easy removal of metal chips, burrs after machining	½ Mark each for ant 8 points
	b) Ans	**Why power devices are used in clamping ? What are the disadvantages in hand clamping?** **Reasons for use of power devices are used in clamping are given below:** **1. Quick acting and less time:** Power driven clamps are preferred as they are quick acting and less time is required for clamping **2. Easy controllable:** Easy for use and reliable and operated without causing any fatigue to the operators. **3. More accuracy**: It will exert equal forces during clamping and avoid bending, deformation due to unequal forces. **Disadvantages of hand clamping:** 1. **Time consuming:** It is time consuming to clamp the component manually. 2. **Less accuracy of clamping:** hand clamping may causes improper forces applied during clamping and less accuracy during clamping**.** 3. **Less clamping force:** The operator can not apply larger efforts/forces to clamp heavy or large size components. 4. **Fatigue to the operators:** It causes fatigue to the operator if repetitive clamping is required with more efforts.	1 Mark each for any 2 reasons 1 Mark each for any 2 disadvantages
	c) Ans	**State the characteristics of lean manufacturing(any eight)** Lean is the management philosophy developed by Toyota production system. It focuses on reducing waste. It has following characteristics 1. **Reduction of waste:** waste is to be minimized or reduced to zero level at every stage of manufacturing. 2. **Just in Time approach:** Do not produce more quantity than the order of customers to eliminate inventory. 3. **Short cycle times:** To improve rate of production and avoid long production run 4. **Quick changeover:** To eliminate changeover time of production batch, fast set ups	½ Mark each for any 8 points

		are used for quick changeover. 5. **Single piece production: one-piece** flow means that parts are moved through operations from step to step with no work-in-process (WIP) in between either **one piece** at a time or a small batch at a time. 6. **Continuous improvement:** Gradual and continuous improvement on the basis of Kaizen philosophy. 7. **Continuous flow work cells:** It is a method of manufacturing that aims to move a single unit in each step of a process, rather than treating units as batches for each step 8. **Multi skilled employees:** The workers can perform various activities. 9. **Empowered employees:** managers build stronger teams and more productive work forces.	
	d) Ans	**Explain the robot anatomy and structure with sketch.** **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. **Sketch/Figure:**  **Robot Structure:** **It consist of** **1.Arm:** The arm is the part of the robot that positions the end effectors and sensors to do their pre-programmed task. 2. **End-effectors:** It is designed to perform the task like grasping, transporting, lifting etc. It also is used to perform operations on work piece. 3. **Actuator:** An actuator is a device that produces translatory or rotary movement of the links or makes the freedom possible. These are the drives for the manipulator, which connects the controller with manipulator. 4. **Sensors:** They perform two major tasks. One is to collect information about the different links, arms with their status and other one is to inform controller about outside environment. 5. **Controller:** Controller coordinates the movement of the arm. The controller receives the input data from the computer, controls the actuator motion and takes the feedback information through various sensors. 6. **Drive:** The drive is the motor that moves the links into their designated position.	1 Mark for anatomy 1 Mark for structure 2 Marks for sketch

e) Ans

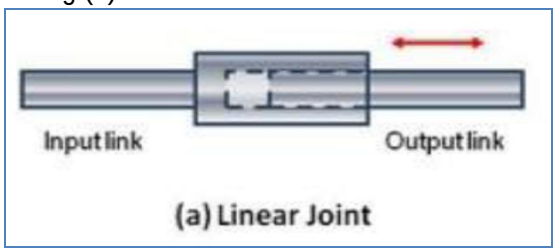
Describe any two joints types used in robotics arms and wrist

Joint used in robotics arm:

1) Linear Joint or Prismatic joint:

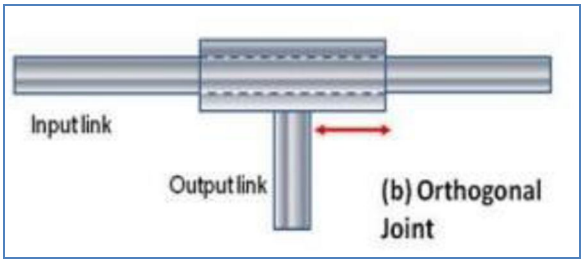
- The linear joint provides the translational sliding motion between the input and output link.
- The axes of the links are parallel to one another.

The linear joint as shown in fig.(a)



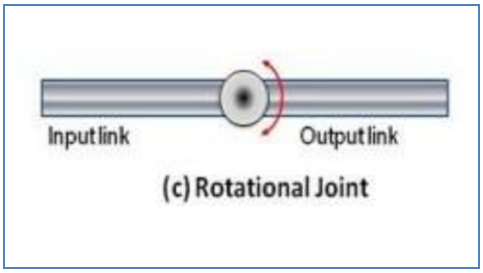
2) Orthogonal Joint:

- The orthogonal joint provides the translational sliding motion between the input and output link.
- The axis of the output link is perpendicular to that of the input link.
- The orthogonal joint as shown in fig.(b)



3) Rotational joint:

- The rotational joint provides the relative rotational motion between the input and output link.
- The axis of rotation is perpendicular to the axes of input and output link.
- The rotational joint as shown in fig.(c)

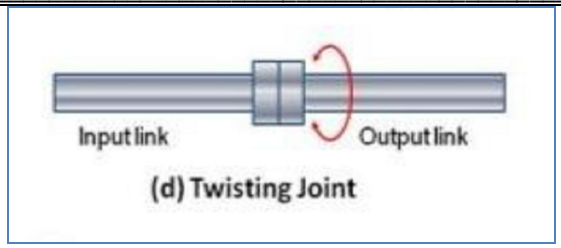


4) Twisting Joint:

- The twisting joint provides the relative twisting motion between the input and output link.
- The axis of rotation is parallel to the axes of input and output link.
- The twisting joint is shown in fig.(d)

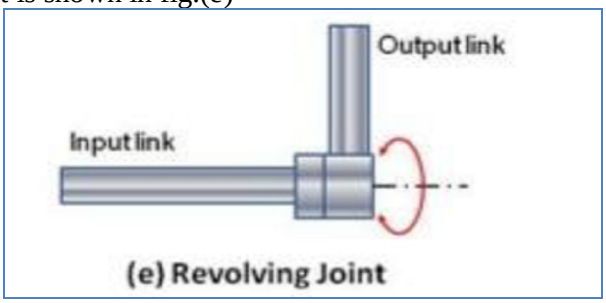
1 Mark each for description and

1 Mark each for sketch of any 2 points



5) Revolving joint:

- The revolving joint provides the relative rotational motion between the input and output link.
- The axis of input link is parallel to the axis of rotation of the joint.
- The axis of output link is perpendicular to the axis of rotation of the joint.
- The revolving joint is shown in fig.(e)



f) Ans

What are grippers? Explain vacuum actuated gripper in brief.

1 Mark for explanation

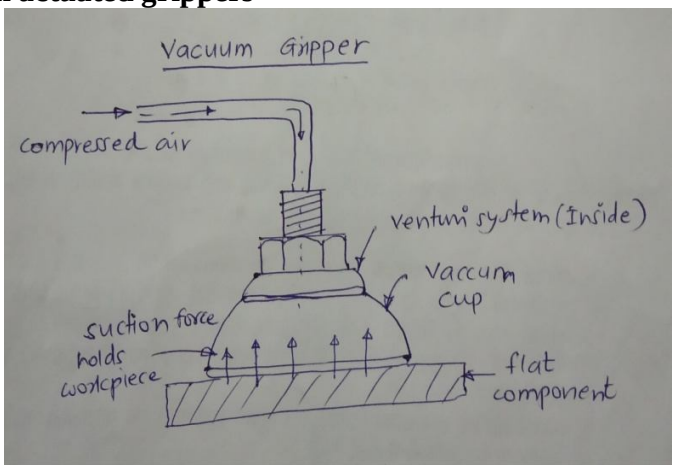
Grippers:

- They are the grasping or holding devices to hold the components/ objects by using suitable mechanism. It operates similar to fingers used by human being for holding or gripping of component.
- They are used to movement of components/ objects from one point to another location.

Sketch of Vacuum actuated grippers

2 Marks for description of vacuum gripper

1 Mark for sketch



Vacuum actuated grippers(vacuum cups or suction cups)

- Vacuum gripper also called vacuum cups or suction cups which uses vacuum as gripping force.
- The lifting and holding is done by cups or vacuum surface driven by vacuum system.
- It works on the principle of vaccum generated by vacuum pump or venture system.

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 : a. Weight of the part b. Part size and shape. c. Nature and type of part etc. Some time to increase the contact area, multiple cups are used vacuum cups are used to lift flat as well as curved surfaces.
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 GANTT CHART used in PPC. State its advantages and disadvantages**

Ans

GANTT CHART:

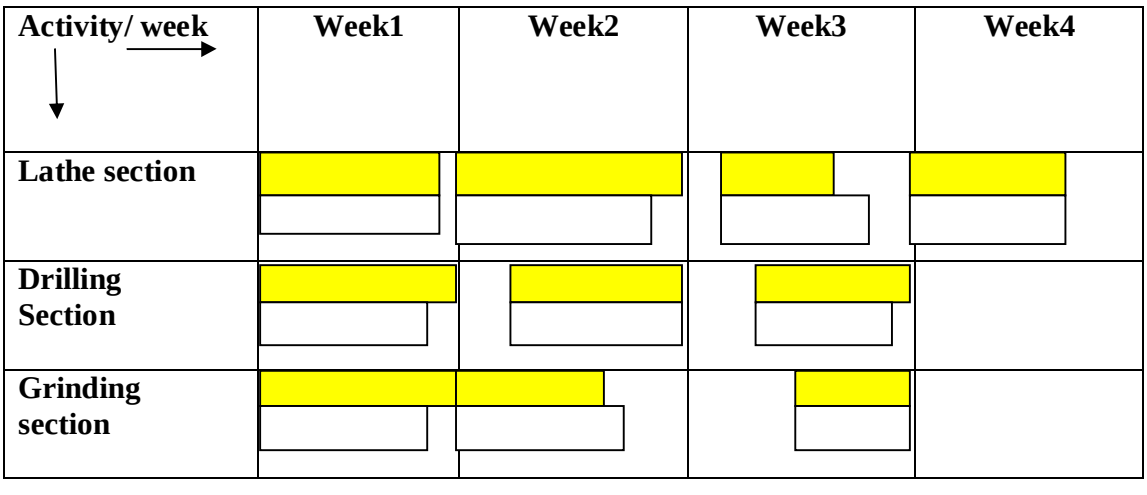
- It is graphical tool which provides graphical presentation of activities of production section with reference to the time scale for effective control of PPC.
- A Gantt chart is "the earliest and best known type of control chart especially designed to show graphically the relationship between planned performance and actual performance.
- This chart lists the tasks to be performed on the vertical axis, and time intervals on the horizontal axis.
- 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.

2 Marks for Description

Application in PPC:
It represents graphically on a time scale as to when certain operation would be performed. It is also useful in recording the progress of the schedule.

Example of GANTT chart for production activity.
An example of typical Gantt chart is shown in following figure in which various departments or sections of the industry shown at one side and comparison of actual and planned work shown in front of respective department or section.

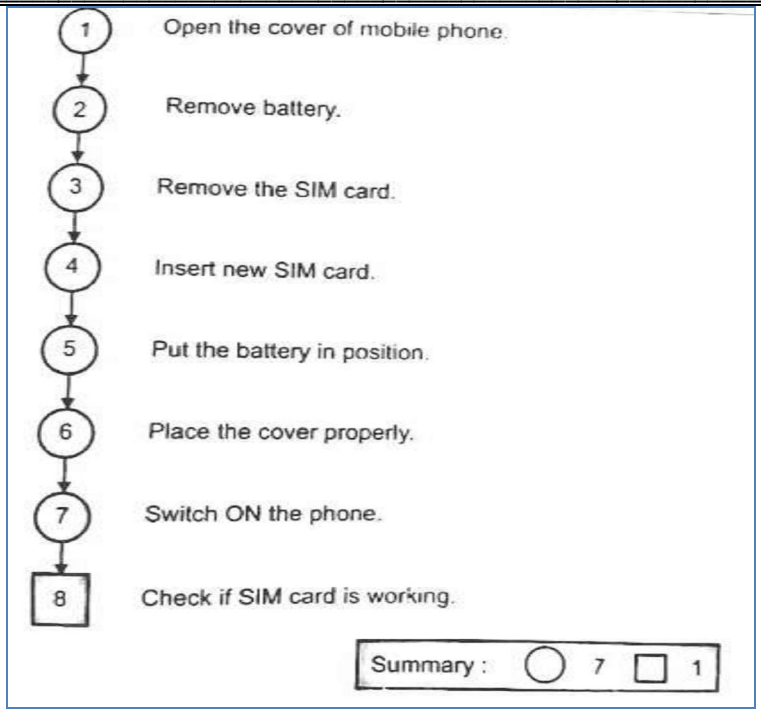
2 marks for example



Advantages of GANTT chart

1. Easy to understand the progress of the task or work to be done.
2. Gantt chats are simple to understand and easy to construct

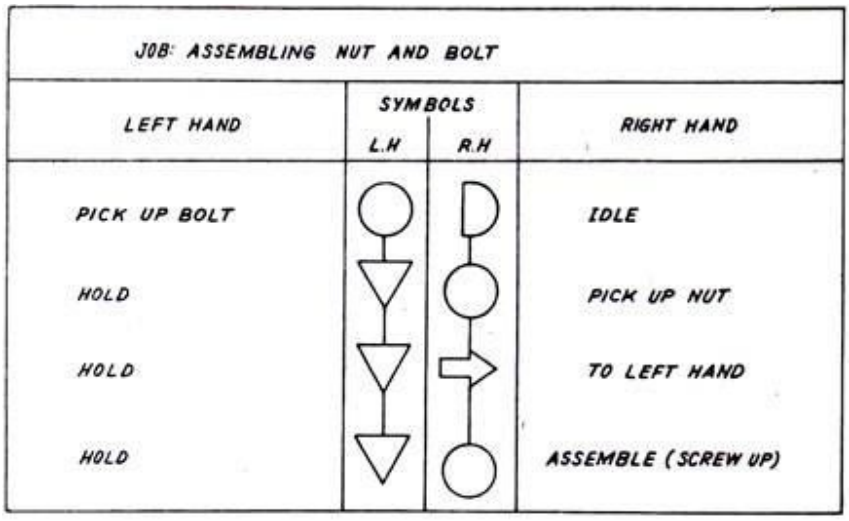
		3. Shows graphically the relationship between planned performance and actual performance. 4. Helps for production control by showing difference between planned and actual progress. 5. Changes in schedules can be done easily at minimum cost. **Disadvantages of GANTT chart** 1. It gives limited information about the activities. Suitable only for simple projects 2. Updating chart with large number of activities is difficult and time consuming. 3. Charts with complex activities and projects are difficult to use. 4. Does not show effect of delays in activities and its effect on completion of project	Mark each for any 2 correct points Mark each for any 2 correct points
	b) Ans	**Explain the different recording techniques used in method study. Also outline process chart for checking diameter of 50mm of shaft.** **Different recording techniques used in method study:** Process charts are used to record the data systematically so that none of the information needed for study and analysis is missed. **A. Chart indicating process sequence:** 1.Outline process chart 2.Flow process chart 3.Two hand process chart **B. Chart using a time scale:** 1. Multiple activity chart, 2. Simo chart **C. Flow diagrams/Models** 1. String diagram 2. Flow diagram 3.Cycle graph 4.Chronocycle graph **1.Outline process chart:** • An outline process chart is a process chart which gives an overall view of a process by recording only the main operations and sequences in proper sequence. • It gives overall picture of the process using basic symbols like operation and inspection. Example : Changing of Sim card of mobile Task/Job : Change SIM card of mobile phone Charted by :XYZ Chart begins with: Open the cover of mobile phone. Charted at : ABC Chart ends with: Check SIM card working or not. Date : 18/02/2019	2 Marks each for any two technique with short & 4 Marks for outline process chart



. Two handed process chart

- Two handed process chart is also known as Left and Right Hand process chart.
- The two-handed process chart is generally used for repetitive operations, when one complete cycle of the work is to be recorded.
- The aim of this investigation is to eliminate or reduce the unwanted motion to minimum and to arrange the best of motions in a possible sequence

Example: Assembly of Nut and bolt



Summary

L.H		R.H	
○	1	○	2
▽	3	▽	-
⇨	-	⇨	1
D	-	D	1

Cycle graph:

- In making a cycle graph, a small electric bulb is attached to the hand, finger or any other part of body whose motion is to be analysed or recorded.
- Path of the light of the bulb is same as that of the body member. As bulb moves through the space for one complete cycle, path is photographed by still photograph.
- The path traced by the body member is the bulb appears as white continues line in the background of the working area. However, there is no indication of the direction or speed of motion.

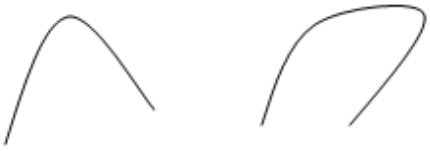
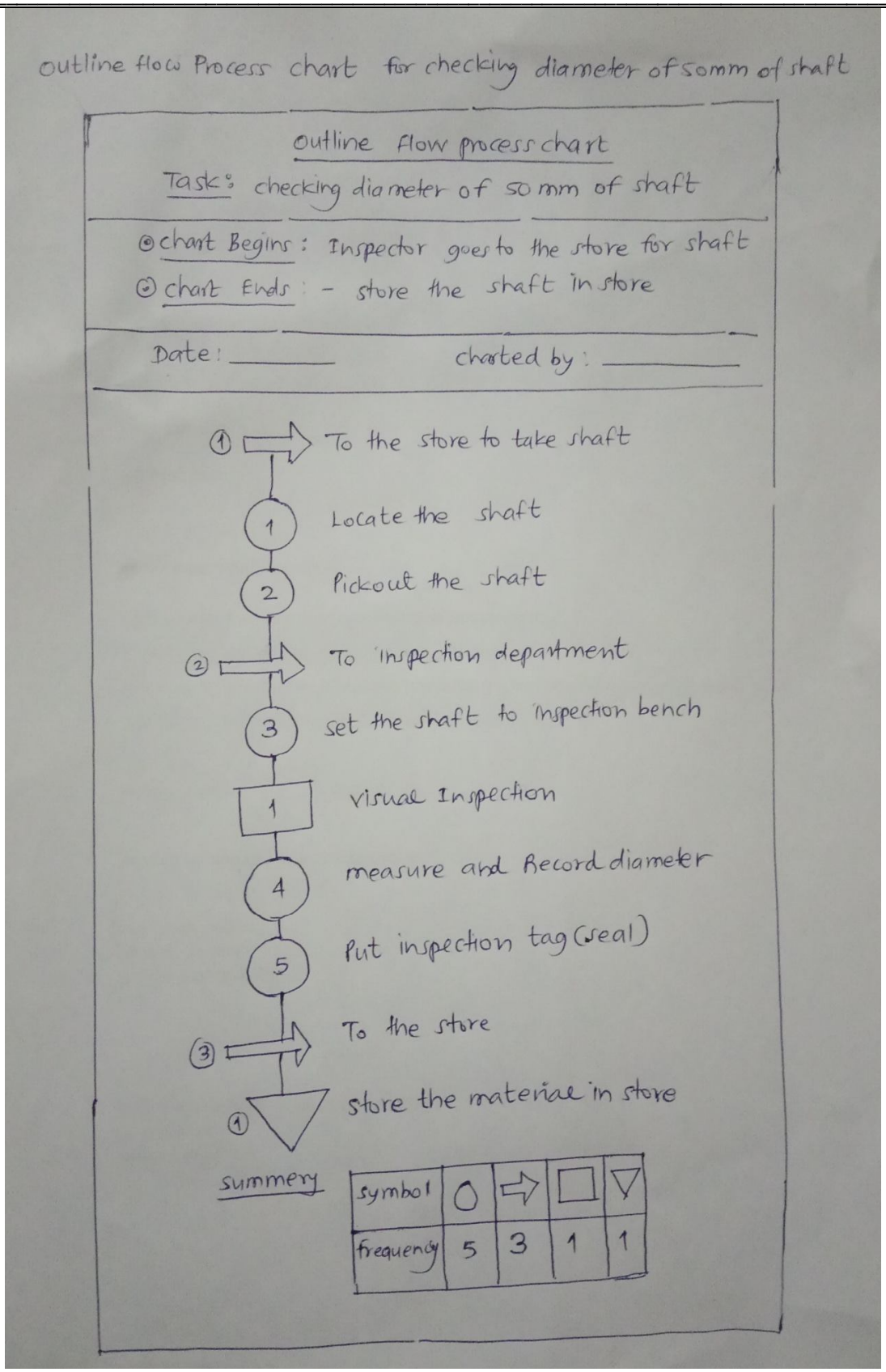


Figure Cycle graph

Process chart for checking diameter of 50 mm Shaft.

Outline flow Process chart for checking diameter of 50mm of shaft



c) **What are actuators? Explain Mechanical and Hydraulic actuators type with advantages and disadvantages.**

Ans

Actuators:

- An "actuator" can be defined as a device that converts energy into physical motion.
- Actuators are the devices which coverts input energy in to the motion required for performing the task by the arm of the robot.
- An actuator is a device that produces translatory or rotary movement of the links or makes the freedom possible.
- These are the drives for the manipulator, which connects the controller with manipulator.
- They are classified as per the input energy used to obtain motion output
  1. Mechanical actuator 3. Hydraulic actuator
  2. Pneumatic actuator 4. Electrical actuator
- Actuators will help to apply efforts and forces during lifting or lowering or other applications of robots.

Mechanical Actuators:

- When mechanical linkages, gears,etc are used to transform motion for robotics components, it is known as Mechanical actuators
- The operation of mechanical actuators is based on combinations of mechanical components, such as gears and rails, or pulleys and chains.

Types:

1. Gears like rack and pinion
2. Mechanical Linkages
3. Belt drives and Chain drives
4. Ball screws

Advantages:

1. Simple and less costly
2. It can able to transfer larger forces easily.
3. Do not require external energy for its actuation.

Disadvantages:

1. Less accurate movements.
2. More wear and friction occurs.

Hydraulic actuators:

- When pressurized oil or fluid energy is used to transform motion for robotics components, it is known as Hydraulic actuators.
- It uses pump to supply high pressure oil to the actuator mechanism like piston and cylinder, Gear motors, vane motors, etc

Types:

1. **Linear actuators**- Single, Double acting cylinder, etc
2. **Rotary actuators**- Gear motors, Vane motors, piston motor, etc

Advantages:

- They are used to carry heavy loads.
- They are more efficient.
- More accurate movements are possible.

Disadvantages:

- Requires more floor space
- Maintenance cost is high

They are employed where speed requirement is comparatively low.

2 marks for Actuators description

1 Mark for type,

½ Mark each for 2 merits,

½ Mark for 2 demerits

(Mechanical Actuator)

1 Mark for type,

½ Mark each for 2 merits,

½ Mark for 2 demerits

(Mechanical Actuator)

(Hydraulic Actuator)