



WINTER – 19 EXAMINATION

Subject Name: Production Engineering and Robotics

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)	<b>Attempt any THREE of the following</b>	12
	i)	<p><b>Definition of Productivity:</b></p> <ul style="list-style-type: none"> <li>• Productivity may be defined as the ratio of output to input. The output means the amount produced and input are the various resources employed.</li> <li>• Productivity is the efficiency with which the resources are employed.</li> </ul> <p><b>Methods for productivity improvement:</b></p> <p>a) <b>Work Study:</b> -</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• This is done by breaking down the job into its various elements, eliminating all unnecessary movements and estimating the time taken to do this job with the help of a stopwatch. Second aim is to ensure that all workers engaged in the job are trained to do it in the best way.</li> </ul> <p>b) <b>Human Relations:</b> -</p> <ul style="list-style-type: none"> <li>• Good human relations help in co-operative behavior from workers which results in increase in productivity.</li> <li>• Human relations can be improved by labour participation in goal setting, simplification in communication system minimizing the conflicts, encouragement and awarding rewards, etc</li> </ul> <p>c) <b>Incentives:</b> -</p> <ul style="list-style-type: none"> <li>• When incentives schemes are introduced in a firm, it results a considerable improvement in productivity.</li> <li>• 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.</li> </ul>	<p>2 Mark Definition</p> <p>2 Method – 2 marks</p>



ii)	<p><b>Types of production system:</b></p> <p><b>a. Intermittent production:</b></p> <p>1. Job Production                      2. Batch production</p> <p><b>b. Continuous production:</b></p> <p>1. Mass production      2. Flow production</p> <p><b>Features of batch production:</b></p> <ul style="list-style-type: none"> <li>• Manufacture of a number of identical articles either to meet a specific order or to meet a continuous demand.</li> <li>• Machines are grouped on functional basis. Semi-automatic, special purpose automatic machines are generally used</li> <li>• Cost of production is more than mass production system and less than job production system.</li> <li>• Process layout is adopted in batch production. Example: Pharmaceutical products, ready-made Clothes, Furniture, castings, etc</li> </ul>	<p>Types – 2 marks</p> <p>4 features – 2 marks</p>
iii)	<p><b>Definition of Dispatching:</b></p> <ul style="list-style-type: none"> <li>• It is defined as physical handling over of manufacturing order to the operating faculties through release of orders and instructions in accordance with previously developed plan established by scheduling department.</li> <li>• Dispatch function executes planning function. It ensures that the plans are properly implemented.</li> </ul> <p><b>Functions of Dispatching:</b></p> <ol style="list-style-type: none"> <li>1. To issue work order to different departments.</li> <li>2. To release material orders from stores.</li> <li>3. To ensure release of correct tools, jigs and fixtures.</li> <li>4. Keep a record of starting and completion date of each operation.</li> <li>5. Collection of route sheet and other document from the shops.</li> <li>6. Issue of inspection order of each operation.</li> </ol>	<p>2 Mark Definition</p> <p>4 functions – 2 marks</p>
iv)	<p><b>Methods of measurement of productivity</b></p> <p>Various sources are utilized for production like labour, raw material, machine etc. accordingly productivity is called as labour productivity , raw material productivity, machine productivity etc.</p> <ul style="list-style-type: none"> <li>• Productivity of labour = Productivity in standard hours/actual man hours</li> <li>• Productivity of raw material = numbers of units produced/material cost</li> </ul> <p>Productivity of machines = output in standard hours /actual machine hours</p> <p><b>Material Productivity:</b></p> <ul style="list-style-type: none"> <li>• Material consist of direct material and indirect material, Direct material means which goes with the product and indirect material means other consumable like fuel,</li> </ul>	<p>Any One Method correct explanation – 4 marks</p>



chemicals in heat treatment, cutting tools, coolant etc. Material productivity measures in terms of goods produced.

- Therefore, Material Productivity =

$$\frac{\text{Cost of number of unit produced}}{\text{Total material cost}}$$

- Material productivity is a technique of measurement of productivity in terms of cost of material whereas total productivity is the efficiency of the plant.

**Explanation similarly for any one labour or machine productivity**

**Labour Productivity:**

- In case of labour productivity input and output can be measured in terms of money or in terms of man hour.
- Labour productivity measures in terms of man hours utilised.

- Therefore, labour Productivity =

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

**Machine productivity:** It is measured in terms of hours.

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

**Capital productivity** = Output / unit value of fixed production assets

b) Attempt any ONE of the following

6

i) **Definition of Plant layout**

- It is defined as the systematic arranging of various facilities like equipments, machines manpower, and inspection areas, etc and services within the area of plant site selected for production /service activity.
- All the facilities are located in a such a way that it will help for smooth flow of materials, effective use of space, better working conditions, etc

**Process layout**

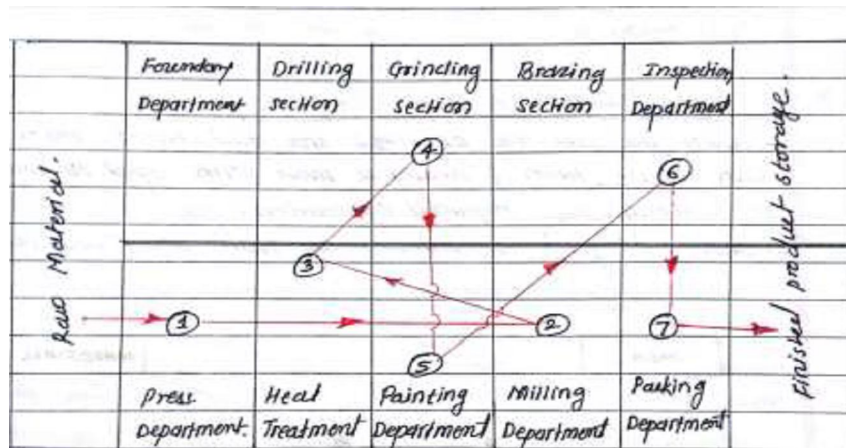


Fig: A typical process layout-

2 Mark  
Definition

Layout  
sketch – 2  
marks

Explainatio  
n-2 marks



	<ul style="list-style-type: none"> <li>• All the machines of similar process or operations are grouped to make section like drilling, milling, heat treatment ,etc</li> <li>• More movement of material and manpower</li> <li>• More cycle time is required for product manufacturing</li> <li>• Less cost of investment</li> <li>• General purpose machines are used</li> </ul>	
<p>ii)</p>	<p><b>Various functions of PPC</b></p> <p><b>Production Planning:</b></p> <ul style="list-style-type: none"> <li>• This is the preliminary function of PPC in which planning of production activity is determined considering forecasting, market research, etc</li> <li>• In this function annual production is planned to decide planning of material, manpower, inspection, machinery and equipments need considering time frame.</li> </ul> <p><b>Routing:</b></p> <ul style="list-style-type: none"> <li>• Routing lays down the flow of work in the plant. It determines what work is to be done and where and how it will be done.</li> <li>• Taking from raw material to the finished product, routing decides the path and sequencing of operations to be performed on the job from one machine to another.</li> </ul> <p><b>Scheduling:</b></p> <ul style="list-style-type: none"> <li>• To decide when the work will start and in certain duration of time how much work will be finished. It deals with the orders and machines.</li> </ul> <p>The aim is to schedule as large amount of work as the plant facilities can conveniently handle by maintaining free flow of material along the production line. Schedule may be called as time phase of loading.</p> <p><b>Sequencing:</b></p> <ul style="list-style-type: none"> <li>• To select the order in which jobs will be processed.</li> <li>• When numbers of machines are used for one or more components then sequencing is most essential.</li> </ul> <p><b>Loading:</b></p> <ul style="list-style-type: none"> <li>• It means assignment of work to the manpower, machinery without specifying when work is to be done.</li> <li>• It shows relationship between load and available capacity at the workplace or plant.</li> </ul> <p><b>Dispatching:</b></p> <ul style="list-style-type: none"> <li>• Dispatch function executes planning function. It ensures that the plans are properly implemented.</li> </ul>	<p>Any 6 functions – 6 marks</p>



	<ul style="list-style-type: none"> <li>It is physical handling over of manufacturing order to the operating facilities through release of orders and instructions in accordance with previously developed plan established by scheduling department.</li> </ul> <p><b>Control:</b></p> <ul style="list-style-type: none"> <li>It is the last function which compares planning with actual results of production to determine the deviation if any.</li> <li>It will help to rectify or suggest corrective action if progress is not satisfactory.</li> <li>A control system involves four stages namely observation, analysis, corrective action and post operation evaluation.</li> </ul>	
2	<b>Attempt any TWO of the following</b>	16
a)	<p><b>1. Planning :</b>All activity should be planned. Plan a system which include all the handling activities &amp; co-coordinating the operations.</p> <p><b>2. Simplification principle:</b> Reduced or eliminate unnecessary movements and equipment.</p> <p><b>3. Gravity principle:</b> Utilize the gravity whenever possible to move material.</p> <p><b>4. Space utilization:</b> Make optimum utilization of building cube.</p> <p><b>5. Safety principle:</b> Provide for safe handling methods and equipment</p> <p><b>6. Minimum movement:</b> As per this principle, movement of material and manpower should be minimum</p> <p><b>7. Mechanization/ automation principle:</b> Use mechanized or automated handling equipment when practicable.- Equipment selection according to movement &amp; method of material handling</p> <p><b>8. Standardization principle:</b> Standardize the method as well as type of sizes of handling equipment.</p> <p><b>9. Flexibility principle:</b> Use methods and equipment's that can perform a variety of tasks and application.</p> <p><b>10. Maintenance principle:</b> Plan for preventing maintenance and schedule repair of all handling equipment</p>	any 8 principles- 8 marks
b)	<p><b>Factors affecting process planning:</b></p> <p><b>a. Size and shape of part:</b> The size and shape of many components decides the basic operations for the manufacturing of part. 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.</p>	4 factors Explanation – 8 marks



**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.

c) **Definition of Route sheet**  
Route sheet is written document which includes operation number, description of operation, machine used, tools and gauges used and standard time for any particular operation. The Route or 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.

**Explanation:**

Route sheet(Operation sheet)						
<b>Component No. Name:</b>		<b>Drawing:</b>				
<b>Material:</b>		<b>Quantity:</b>		<b>target date:</b>		
Section	machine	Operation description	Tools	Fixture	Time	
					setup	operation

Definition -2  
marks

Explanation –  
3 marks

Significance-  
3 marks



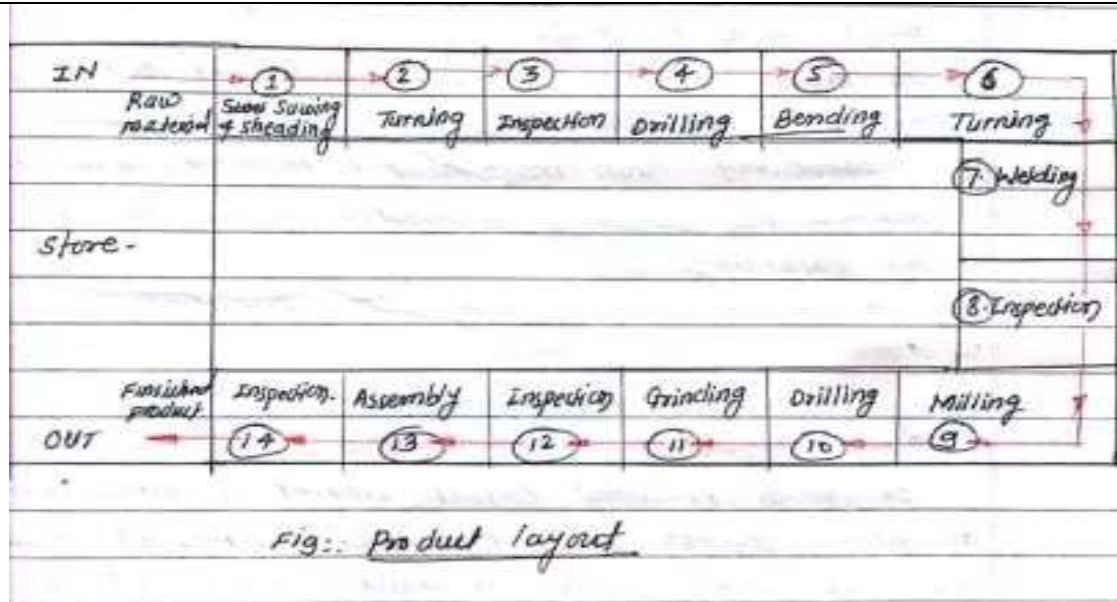
It consists of details of operations, sequences, types of machinery used and operation time. It includes information of all manufacturing operations to be performed on the work part, listed in the order in which they are to be accomplished. It is a listing of sequence of operations which must be performed on the component.

**Significance :**

- [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.

**3 Attempt any FOUR**

a)



**Product layout**

1. This layout is also called flow-line layout, line layout or production line layout. In this layout, the machines, equipment and work centers are arranged in a straight or curved line, in the order in which they have to be used, that is, according to the sequence of operations needed to manufacture a product.
2. To justify the product layout, the product must be standardized and manufactured in large quantities. Hence, this system is best suited for mass production.
3. The raw material enters at one end of the line and moves from one machine to another in the line without back-tracking or cross-movements and finally the end product leaves from the other end of the line.

2 marks  
Diagram

2 marks  
explain



		4. Examples are automobile assembly lines, bottling plant and so on		
<b>b)</b>	<b>List four material handling devices and its application</b>			
<b>Ans</b>	<p><b>1. Fork lift truck</b> - To move and stack material at height.</p> <p><b>2. Cranes</b> - To lift heavy stones at height.</p> <p><b>3. Conveyor</b> - To move cement bags at a short and fixed distance.</p> <p><b>4. Pipelines</b> - To move chemical from store to storage tank.</p>			2marks types and 2marks application
<b>c)</b>	<b>Differentiate between jig and fixture</b>			
<b>Ans</b>	<b>Sr.No</b>	<b>Jigs</b>	<b>Fixtures</b>	4 marks
	1	A jig may be defined as a device, which holds and locates a work piece as well as guides and controls one or more cutting .	A fixture is defined as a device used for holding and locating a component or work piece securely in a definite position but it does not guide the cutting tool.	1 mark Each 4 points necessary
	2	More as compare to fixture as it includes tool guiding and holding arrangement.	Less as compare to jig.	
	3	Jigs are lighter in weight for quicker handling.	Whereas fixtures are generally heavier in construction.	
	4	It is used in drilling, reaming or tapping operations.	It is used for operations like milling, planning, Shaping, turning etc.	
<b>d)</b>	<b>Explain in detail 5S</b>			
<b>Ans</b>	<p>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. <b>Meaning of each 'S' in '5S' is as below:-</b>  <b>SEIRI (Tidiness)</b> - Sort out the necessary and unnecessary things, eliminate unnecessary parts and keep essential items.  <b>SEITON (Orderliness)</b> - Set everything in proper for quick storage and retrieval.  <b>SEISO (Cleanliness)</b> - Clean the workplace on time and keep it clean, tidy and organized.  <b>SEIKETSU (Standardization)</b> - Keep and maintain in a clean and organized condition.  <b>SHITSUKE (Discipline)</b> – Everyone stick to the rule and makes in a habit.</p>			4 marks
<b>e)</b>	<b>Define method study and its four objectives</b>			
<b>Ans</b>	<p><b>Method study:</b> It is defined as the systematic investigation (i.e. recording and critical examination) of the existing method of doing a job in order to develop and install an easy, rapid, efficient, effective and less fatigue procedure for doing the same job and at lower costs.</p>			1 mark





		<p><b>Objective:</b></p> <ol style="list-style-type: none"> <li>1. To improve the working processes.</li> <li>2. To obtain better work place layout, neat &amp; clean environment and working conditions.</li> <li>3. To eliminate the fatigue to operators.</li> <li>4. To achieve better product quality.</li> <li>5. To utilize effectively the men, machine and materials.</li> <li>6. To obtain efficient and fast material handling</li> <li>7. To reduce health hazards.</li> <li>8. To plan the section efficiently.</li> </ol>	<p>define</p> <p>3 marks</p> <p>objective</p>
	f)	<b>State and explain how different operations can be combined</b>	
	Ans	<p><b>Combined Operation:</b></p> <p>In order to save the operation and setting time of part, while the part is subjected to machining process, the different operations to be performed are combined together or arranged one after the other, during one setting of the part. This combination process helps not only in saving the setting time but also the accuracy of the operation.</p> <p><b>The operations can be combined in two ways:</b></p> <p><b>Simulation method:</b> Operations combined together and performed simultaneously. Gang milling operations, Straddle milling operation, slot making are some example of simulation method.</p> <p><b>Integration method:</b> Operations to be performed combined together in one setting but arranged one after other. Operation on turret lathe, multi spindle automats, CNC operations etc. are the example of Integration method</p>	<p>4marks</p>
4	a)	<b><u>Attempt any THREE</u></b>	12
	i)	<b>Necessity of modern trends in manufacturing</b>	
	Ans	<p>To survive and remains competitive in the global economy.</p> <ol style="list-style-type: none"> <li>2. To developed best method, system, and practices to enhance the process.</li> <li>3. To meet increasing market demand for high quality product at lower cost.</li> <li>4. To improve skilled resources.</li> </ol>	<p>1 mark each</p> <p>Any 4 points</p>
	ii)	<b>Classification of sensors used in robots</b>	
	Ans	<p><b>Robotic sensor can be classified by number of method. Some of them are listed below:</b></p> <p><b>a) According to quantity to be measured</b></p> <ol style="list-style-type: none"> <li>[1] Mechanical sensors</li> <li>[2] Electronic sensor</li> <li>[3] Magnetic sensor</li> <li>[4] Thermal sensor</li> </ol>	<p>4 marks</p>



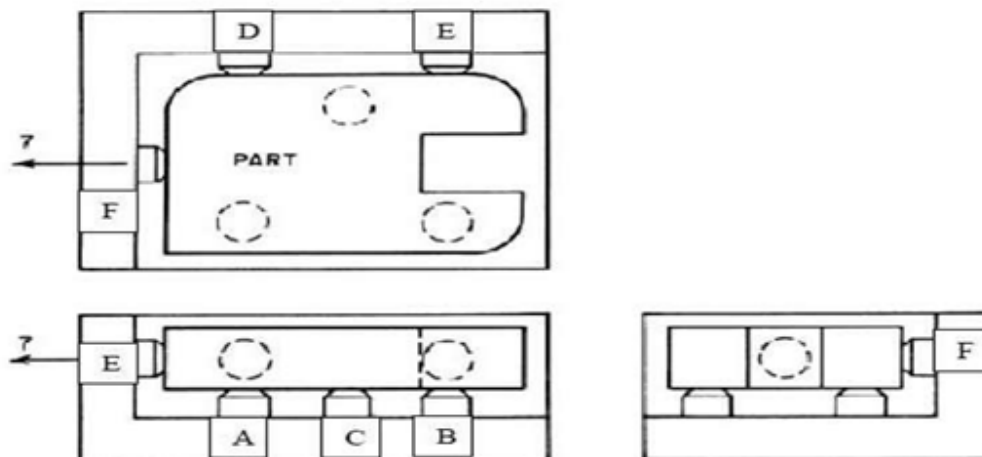
		<p><b>b) According to type of detection</b> [1] Internal state sensors [2] External state sensors</p> <p><b>c) According to nature of contact</b> [1] Contact type sensors [2] Noncontact type sensors</p>	
	<b>iii)</b>	<b>Advantages and Disadvantages of Lean manufacturing:-</b>	
	<b>Ans</b>	<p><b>Advantages</b></p> <ol style="list-style-type: none"> <li>1. Increased overall productivity.</li> <li>2. Reduced amount of floor space required.</li> <li>3. Reduced manufacturing lead time.</li> <li>4. Improved flexibility to react to changes.</li> <li>5. Improved quality.</li> </ol> <p><b>disadvantages of Lean manufacturing:-</b></p> <ol style="list-style-type: none"> <li>1. Difficulty involved with changing processes to implement lean principle.</li> <li>2. Long term commitment required.</li> <li>3. Very risky process.</li> </ol>	<p>2 Marks</p> <p>2 Marks</p>
	<b>iv)</b>	<b>Concept of KAIZEN</b>	
	<b>Ans</b>	<p><b>Kai = Change Zen = for the better</b></p> <p>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 &amp; more value with less &amp; less waste, attaining better working environment &amp; <b>explanation</b> 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</p>	4 marks
4	<b>b)</b>	<b>Attempt any ONE</b>	
	<b>i)</b>	<b>3-2-1 principle of location</b>	
	<b>Ans</b>	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.

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.

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**.
8. The above method of locating a work piece in a fixture is called the 3-2-1 Principle

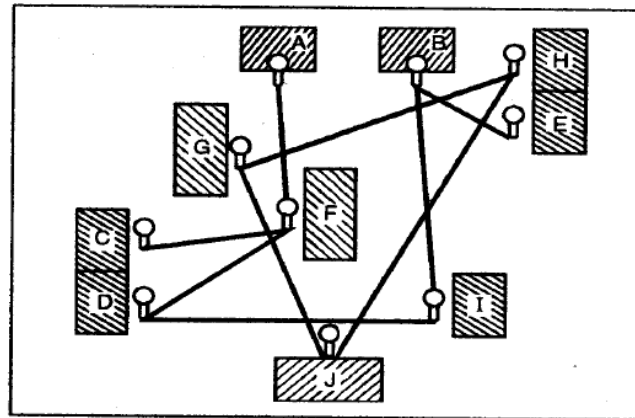
4 marks  
explain



2 Marks for  
diagram



ii)	<b>Two handed process chart:-</b>																																																
Ans	<p><b>Two handed process chart</b> <span style="float: right;"><b>Date of charting – 20/11/2019</b></span></p> <p><b>Activity- Replacing old refill from ball pen</b> <span style="float: right;"><b>charted by - XYZ</b></span></p> <p><b>Chart begins – both hands free before activity</b></p> <p><b>Chart ends – both hands free after activity</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Left hand activity</th> <th style="width: 15%;">Symbol</th> <th style="width: 15%;">Symbol</th> <th style="width: 45%;">Right hand activity</th> </tr> </thead> <tbody> <tr> <td>Pick up the pen</td> <td style="text-align: center;">○</td> <td style="text-align: center;">D</td> <td>Idle</td> </tr> <tr> <td>Hold</td> <td style="text-align: center;">▽</td> <td style="text-align: center;">→</td> <td>Move to left</td> </tr> <tr> <td>Hold</td> <td style="text-align: center;">▽</td> <td style="text-align: center;">○</td> <td>Unscrew cap</td> </tr> <tr> <td>Hold</td> <td style="text-align: center;">▽</td> <td style="text-align: center;">○</td> <td>Unscrew neck</td> </tr> <tr> <td>Hold</td> <td style="text-align: center;">▽</td> <td style="text-align: center;">○</td> <td>Remove the old refill</td> </tr> <tr> <td>Hold</td> <td style="text-align: center;">▽</td> <td style="text-align: center;">→</td> <td>Reach for new refill</td> </tr> <tr> <td>Hold</td> <td style="text-align: center;">▽</td> <td style="text-align: center;">○</td> <td>Insert the new refill</td> </tr> <tr> <td>Hold</td> <td style="text-align: center;">▽</td> <td style="text-align: center;">○</td> <td>Screw the neck</td> </tr> <tr> <td>Hold</td> <td style="text-align: center;">▽</td> <td style="text-align: center;">□</td> <td>Check if the pen writes</td> </tr> <tr> <td>Idle</td> <td style="text-align: center;">D</td> <td style="text-align: center;">○</td> <td>Screw the cap</td> </tr> </tbody> </table>				Left hand activity	Symbol	Symbol	Right hand activity	Pick up the pen	○	D	Idle	Hold	▽	→	Move to left	Hold	▽	○	Unscrew cap	Hold	▽	○	Unscrew neck	Hold	▽	○	Remove the old refill	Hold	▽	→	Reach for new refill	Hold	▽	○	Insert the new refill	Hold	▽	○	Screw the neck	Hold	▽	□	Check if the pen writes	Idle	D	○	Screw the cap	<p>4 marks Chart</p>
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<b>Frequency (LH)</b>	1	-	8	1	-																																												
5	<b>Attempt any Four of the following</b>				16																																												
a)	<b>Explain string diagram with neat sketch</b>																																																
Ans	The string diagram is a scale plan or model on which a thread is used to trace and measure the path of workers, material or equipment during a specified sequence of events.																																																



String diagram

**Use of string diagram**

- 1) To trace the path of workers
- 2) To trace material and equipment
- 3) To measure path of worker , material , equipment
- 4) To find time required for processing

2 Marks for  
Explanation  
&

2 Marks for  
diagram

**b) List the types of locators and explain any one with a neat sketch**

Ans

- 1) Adjustable locators ( Flat locators)
- 2) Cylindrical locators
- 3) Fixed V Locators
- 4) Conical locators

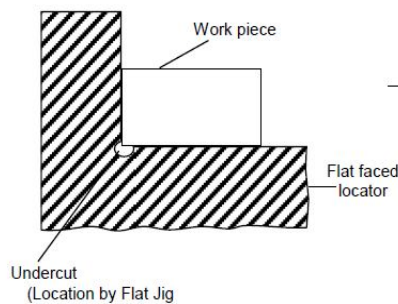
**1) Flat Locator:** -These are employed for locating flat machined faces of the component. The Jig body may incorporate under cut at the bottom for swarf clearance.

**2) Cylindrical locators:** - Cylindrical locators are very useful when finely finished holes are available for the positioning of components.

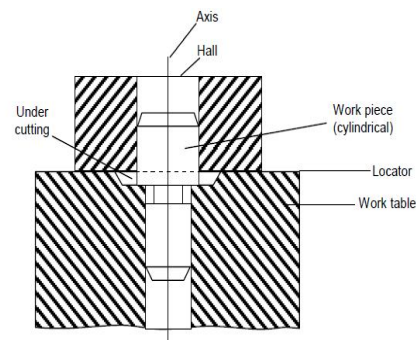
**3) Conical locators:** - A conical locator is used for locating work piece with drilled holes.

**4) Jack pin locator:** - These locators are used for supporting rough work pieces from the bottom. The height of pin can be adjusted to accommodate variation in the surface texture of the component.

**5) V locator:-**It is used for locating components having circular profile.



Flat Locators



Cylindrical Locators

½ Mark for  
4 correct  
points

&

1 Marks for  
explanation

and

1 Mark for  
Sketch

		<p style="text-align: center;"><b>Conical Locators</b>                      <b>Jack pin locator</b></p>	
c)		<p><b>Explain cylindrical configuration with neat sketch</b></p>	
Ans		<p><b>Cylindrical Configuration:-</b> These uses a vertical column and a slide that can be moved up and down along the column. The robot arm is attached to the slide so that it can be moved radially with respect to the column. By rotting the column the robot is capable of retrieving a cylindrical work envelope.</p> <p style="text-align: center;"><b>Cylindrical Configuration</b></p>	<p>2 Marks for Explanation and 2 Marks for neat sketch</p>
d)		<p><b>State the necessity of grippers. Explain vacuum actuated grippers in brief</b></p>	
Ans		<p><b>Necessity</b></p> <ul style="list-style-type: none"> <li>[1] It enables holding of the object</li> <li>[2] It helps to release the object</li> <li>[3] It handles the object</li> <li>[4] Objects can be tightening</li> </ul> <p><b>Vacuum Actuated Grippers</b></p> <p>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</p>	<p>½ Mark each for 4 Correct points</p> <p style="text-align: center;">&amp;</p> <p>2 Marks for explanation</p>

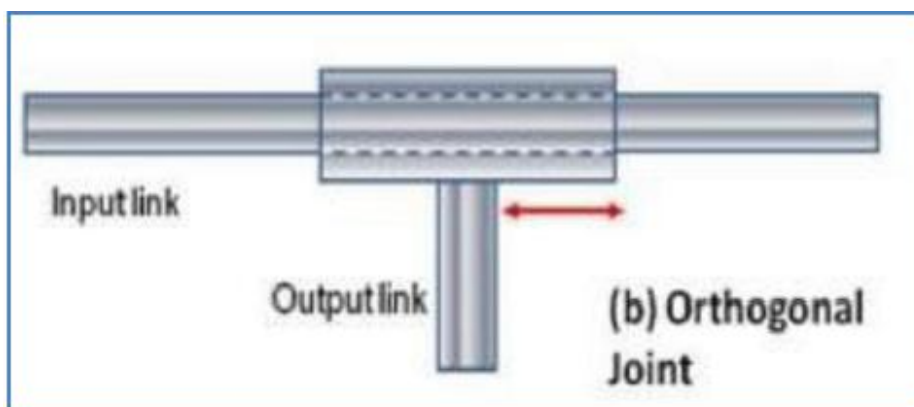
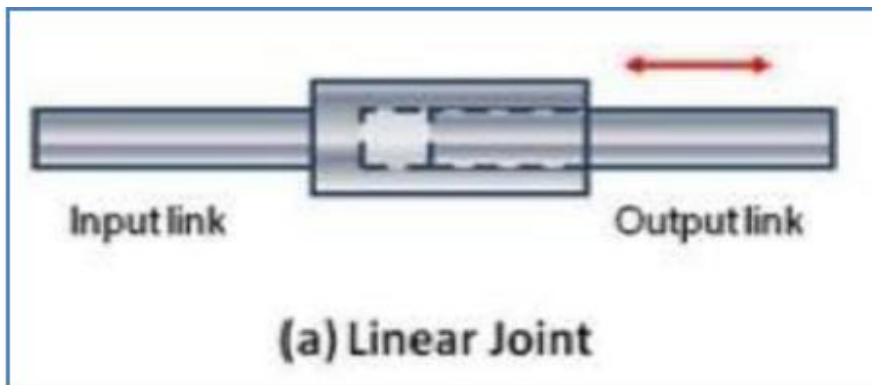
vacuum system. The Vacuum pump or venture system.  
 [1] Usually the cups are available in round or oval shape. The common diameter size of cups is in between 30 mm to 200 mm. The selection of cup and number of cups required depends on:  
 [2] Weight of the part.  
 [3] Part size and shape.  
 [4] Nature 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.  
**Examples:** Vacuum cup or Suction Cup, some vacuum grippers use a closed-cell foam rubber layer for gripping application.

e) **Enlist types of joints used in robotic arm and draw sketch of any two**

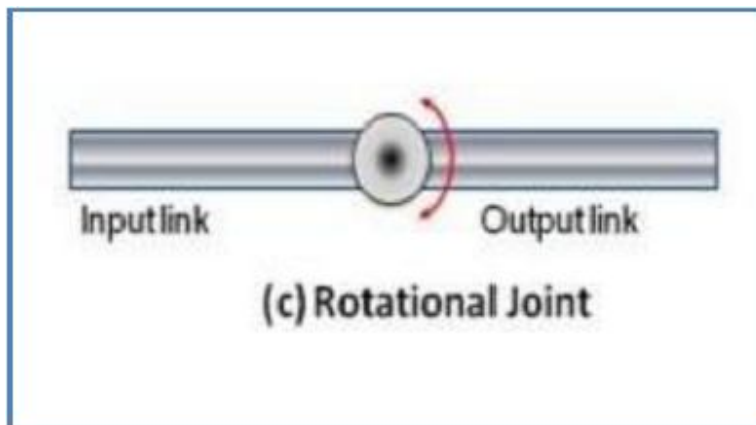
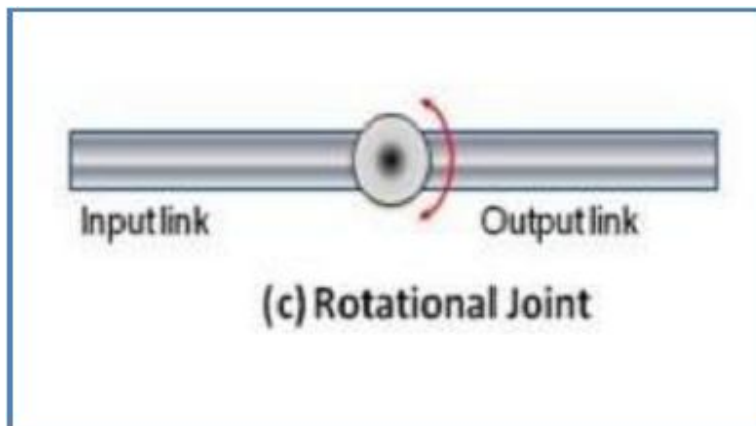
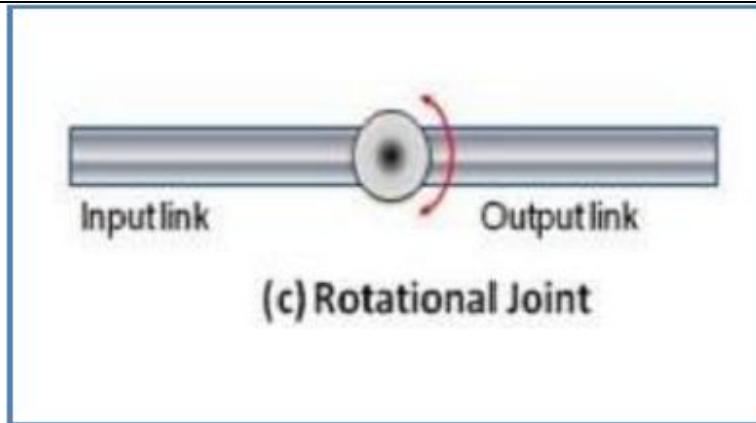
Ans

**Types of Joints**

- [1] Linear Joint or Prismatic joint
- [2] Orthogonal Joint
- [3] Rotational joint
- [4] Twisting Joint
- [5] Revolving joint



½ Mark each for any 4 points  
 &  
 1 Mark each for any 2 neat sketch



f) Enlist general principles of jigs and fixtures

- Ans** Principles of Jigs and Fixtures:-
- [1] Location Principle
  - [2] Clamping and guiding Principle
  - [3] Loading and unloading Principle
  - [4] Motion Economy
  - [5] Fool proofing
  - [6] Rigidity
  - [7] Clearance between jig and component
  - [8] Swarf clearance

1/2 mark  
each for  
any 8  
correct  
points





- [9] Locating points and supports
- [10] Easy loading and unloading of the work
- [11] Clamping
- [12] Fool proofing
- [13] Design for safety
- [14] Ejectors
- [15] Truninos
- [16] Inserts
- [17] Provision of coolant
- [18] Economy

6 Attempt any TWO of the following

16

a) Draw the symbols and write color code of any eight therbligs

Ans

Sr. No.	Therbligs	Symbol	Abbreviation	Color
1	Assemble	#	A	Voilet
2	Select	→	ST	light Grey
3	Grasp	∩	G	Red
4	Use	U	U	Purple
5	Find	◊	F	Gray
6	Search	◊	SH	Black
7	Transport Loaded	⊂	TL	Green
8	Position	∩	P	Blue
9	Disassemble	#	DA	Light Voilet
10	Carmine Red	◊	RL	Release Load
11	Transport Empty	◊	TE	Olive Green
12	Grasp	∩	G	Red

1 Mark each  
for any 8  
correct  
points

b) Explain the GANTT chart used in PPC. Enlist advantages and disadvantages of it

Ans

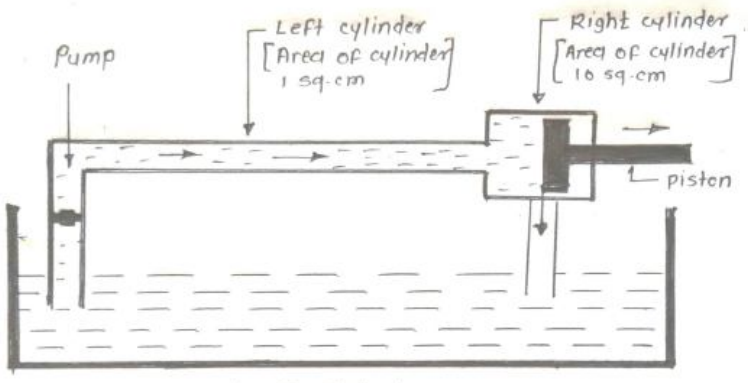
**Gantt chart used in Production Planning & Control:**

- [1] Gantt chart is a basic tool used for both loading and scheduling.
- [2] Gantt chart is developed by the Henry Gantt, an American Engineer.
- [3] Gantt chart is consists of simple rectangular grid, divided by series of parallel horizontal and vertical lines.
- [4] Vertical lines divided the chart in to units of time. The scale units can be years, moths, weeks, days or hours according to duty for which chart is required.
- [5] The horizontal lines divided the chart into sections, which can be used to represent either work tasks or work centers.

**Advantages of Gantt chart:**

2 Marks for  
Significance  
of GANTT  
Chart in  
brief,

1 Mark each  
for any 3

	<p>[1] Gantt Chart is simple graphical display technique, suitable for less complex situations [2] Gantt charts are extremely easy to understand. [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</p> <p><b>Disadvantages of Gantt chart:</b> [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.)</p>	<p>Advantages,             1 Mark each for any 3 Disadvantages</p>
<p>c)</p>	<p><b>List the different actuators. Explain any two types of actuators with advantages and disadvantages</b></p>	
<p>Ans</p>	<p><b>Actuators</b> [1] Hydraulic Actuator [2] Electrical Actuator [3] Pneumatic Actuator [4] Mechanical Actuator</p> <p><b>Hydraulic Actuator</b> 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). 2. To understand how hydraulic actuators works, let's take an example of two cylinders connected together as shown in the figure. Suppose one cylinder has cross sectional area of 1 sq.cm. and the second one has cross section area of 10 sq.cm. If the cylinders are filled with incompressible fluid and 1 unit of pressure is applied to the left cylinder pushing the pump (actually liquid) by 10 cm. Then the resulting force acts on the right cylinder pushing the piston by 1 cm, but with a force of 10 units. This means applying 1 unit of force produces 10 units of force on the other side</p>  <p style="text-align: center;">Hydraulic Actuator</p> <p><b>Advantages of hydraulic actuators:</b> 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</p>	<p>½ Mark each for 4 points  &amp;  2 Marks for explanation  &amp;  1 Mark each for 2 advantages  &amp;  1 Mark each for 2 Disadvantages  (For any 2 Actuators)</p>



**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. The operation of mechanical actuators is based on combinations of structural components, such as gears and rails, or pulleys and chains.

**Advantages:-**

- [1] Simple in construction
- [2] Reliable

**Disadvantages:-**

- [1] Slightly lower efficiency compare to other
- [2] Frequent Maintenance required

**Pneumatic Actuator**

Energy, in the form of compressed gas, is converted into linear or rotary motion, depending on the type of actuator. Pneumatic energy is more desirable for main engine controls because it can quickly respond in starting and stopping as the power source does not need to be stored in reserve for operation. Also, pneumatic actuators are preferred in places where cleanliness is important, since the fluid in hydraulic actuators might leak and contaminate the surroundings. They are employed where fast cycles are required

**Advantages**

- [1] Maintenance cost is low
- [2] Require less floor space.
- [3] Less Expensive.

**Disadvantages**

- [1] They are less efficient.
- [2] Comparatively poor performance.

**Electric Actuators**

Electric actuators are devices powered by motors that convert electrical energy to mechanical torque. The electrical energy is used to create motion in equipment that require multi-turn valves like gate or globe valves. Since no oil is involved, electrical actuators are considered to be one of the cleanest and readily available forms of actuators. Electric actuators are typically installed in engines, where they open and close different valves. There are many designs of electric actuators and this depends on their function in the engine that they are installed in.

**Advantages**

- [1] They are used to carry higher loads
- [2] More efficiency

**Disadvantages**

- [1] Requires more power
- [2] Possibilities of fire hazards / accidents