

**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 Types- 2 marks Feature – 1 mark for each point.
	(i) Ans.	State the types of production system. Enlist four features of mass production system. 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. Features of mass production system. 1. In this type of production system production goes on continuously. 2. Regularity of output, quantity and workmanship need to be a higher order. 3. Simplification and standardization of the product. 4. The layout also fixed for uniform product comes out. 5. Definite machine assigned to definite work. 6. There is less wastage at all level of production. 7. Raw material is purchased in huge quantity; therefore cost of material is less as compared to other production system. 8. Labour is more efficient and specialized on account of constant repetition of the same job. 9. Per unit cost of product is less	
	(ii) Ans.	Differentiate between production and productivity (any four points) Following points differentiates production from productivity. 1. Production is step by step transformation process of inputs into outputs having desired utility and quality whereas productivity is defined as human effort to produce more and more with less and less inputs of resources.	Any 4 points – 1 mark for each point



2. Production refers to absolute output whereas productivity is a relative term where the output is always expressed in terms of inputs.
3. Production is value addition process while productivity is efficiency of production system.
4. The production may rise without the corresponding rise in productivity and vice versa i.e. increase in production may or may not be an indicator of increase in productivity and vice versa.

(iii) **Describe various techniques of improving productivity.**

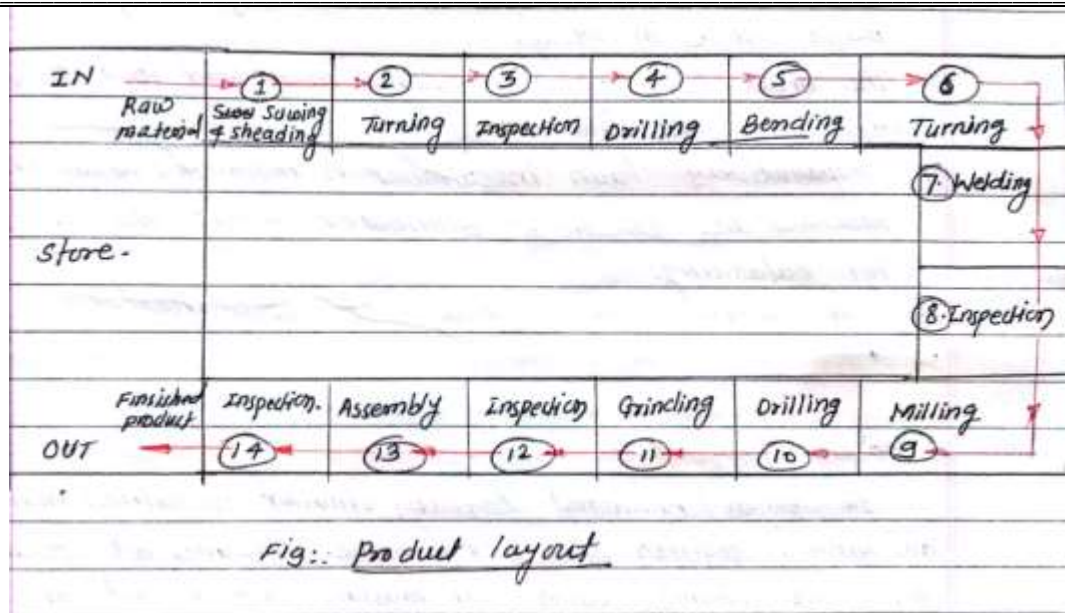
Ans. Technique for improving Productivity

- 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 its 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-operative 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. Workers 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 be considered 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. 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 4
points with
explanation
-4 marks



<p>(iv)</p> <p>Ans.</p>	<p>State any four functions of production planning and control.</p> <p>Functions of PPC:</p> <ol style="list-style-type: none">1. Function related to material selection.2. Function related to selection of method.3. Function related to selection of machines and equipment.4. Routing: Routing concern with selection of path which raw material should follow to get transformed into finished product.5. Estimating: - In relation with method and routing this function determines the standard time for operation to set performance standard.6. Loading: - Assignment to different workstation is called loading.7. Scheduling: - Scheduling is the establishing amount of work to be done and fixed starting and completion time of each operation.8. Dispatching: - Dispatching is nothing but execution of planning. It is a function to issue work orders and instructions.9. Expediting: - It keeps closed watch on the progress of work.10. Inspection: - It checks actual production with production plan.11. Evaluating: - It is most essential link between control and future planning to improve the utilization of methods and facilities through feedback mechanism.	<p>Any 4 points - 1 mark for each point</p>
<p>b)</p> <p>(i)</p> <p>Ans.</p>	<p>Attempt any ONE of the following.</p> <p>State types of plant layouts. Describe product layout with neat sketch.</p> <p>Types of plant layout:</p> <ol style="list-style-type: none">1. Product or line layout2. Process or functional layout3. Fixed or static layout4. Combination layout. <p>Product layout:</p>	<p>06</p> <p>Types- 2 marks, sketch- 2 marks, explanation - 2 marks</p>



1. This layout is also called flow-line layout, line layout or production line layout.
2. 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.
3. To justify the product layout, the product must be standardized and manufactured in large quantities. Hence, this system is best suited for mass production.
4. Examples are: automobile assembly lines, bottling plant and so on.
5. 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.

(ii) Define routing. Explain in short various steps in routing procedure.

Ans. Definition of routing: -

Routing is defined as the decision to follow the path and sequence of operations to be performed on the work piece from one machine to another.

Following steps are follow in routing procedure:

1. Analysis of finished product:

The finished product is analyzed thoroughly in order to determine as to how many parts are to be manufactured in the plant and how many parts of the finished product should be purchased from outside.

2. Bill of material:

Definition – 2 marks,

Steps – 4 marks



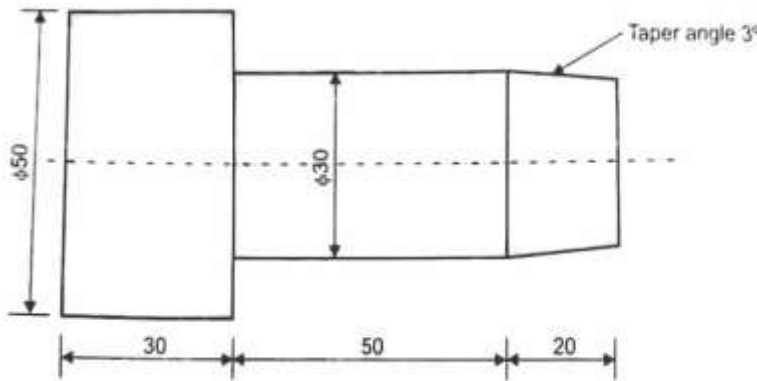
	<ul style="list-style-type: none">- A list of parts to be purchased from outside is prepared.- From this list, a bill of material is prepared showing name of the part, quantity, material, specification etc.- This bill of material is submitted to the purchasing department for processing the material. <p>3. Sequence of operation:</p> <p>The operation to be performed at each stage of manufacturing and their sequence is determined.</p> <p>4. Preparation of route sheets:</p> <ul style="list-style-type: none">- This is the last step of routing procedure. In this route sheet is prepared.- Route sheet shows the sequence of operations, their department, machines and tool used.	
2.	<p>Attempt any TWO of the following.</p> <p>a) Describe various principles of material handling in details.</p> <p>Ans.</p> <p>A) Related to planning.</p> <ul style="list-style-type: none">- All activity should be planned.- Plan a system which include all the handling activities & co-coordinating the operations.- Simplification principle: Reduced or eliminate unnecessary movements and equipment.- Gravity principle: Utilize the gravity whenever possible to move material.- Space utilization: Make optimum utilization of building cube.- Safety principle: Provide for safe handling methods and equipment. <p>B) Related to equipment.</p> <ul style="list-style-type: none">- Mechanization/ automation principle: Use mechanized or automated handling equipment when practicable.- Equipment selection according to movement & method of material handling.- Standardization principle: Standardize the method as well as type of sizes of handling equipment.- Flexibility principle: Use methods and equipment's that can perform a variety of tasks and application.- Maintenance principle: Plan for preventing maintenance and schedule repair of all handling equipment.- Idle time principle- reduced idle time: Reduced idle or unproductive time of both handling equipment and manpower. <p>C) Related to Operation.</p> <ul style="list-style-type: none">- Control principle- Use material handling equipment to improve production control, inventory control etc.- Capacity principle- to achieve full production capacity.- Performance efficiency principle: Determine efficiency of material handling	<p>16</p> <p>Any 8 points – 1 mark for each point.</p>



performance in terms of expense per unit handled.

b) **Redraw the sketch; prepare operation sheet and sequence of operations for the component shown in figure no. 1. Assume suitable cutting parameters.**

Ans.



Sketch – 1 mark,
Layout of operation sheet – 1 marks,
operations with logical sequence and other parameters – 6 marks

Operation Sheet:

Op . No .	Description of operation	Machine used	Tool/Fixture used	Cutti ng Speed	Feed mm/rev .	Dept h of cut
1.	Clamp the blank in chuck with a projecting length of 110 mm	Centre lathe	3 jaw chuck	-----	-----	----- -
2.	Facing operation.	Centre lathe	HSS, RHS tool	35	0.05	0.25
3.	Turn diameter to 50 mm for a length of 100 mm.	Centre lathe	HSS, RHS tool	40	0.05	0.5
4.	Turn diameter to 30 mm for a length 70 mm.	Centre lathe	HSS, RHS tool	40	0.05	0.5
5.	Adjust the tail stock for taper turning operation.	Centre lathe	HSS, RHS tool	-----	-----	----- -
6.	Taper turning to 3 ⁰ for 20 mm length.	Centre lathe	HSS, RHS tool	25	0.05	0.25



7.	Cutting off the job at 100 mm length.	Centre lathe	Parting tool	20	0.05	0.5
----	---------------------------------------	--------------	--------------	----	------	-----

<p>c) Ans.</p>	<p>Define process planning. State the factors affecting process planning and explain it.</p> <p>Definition of Process planning:</p> <p>Process planning can be defined as the systematic determination of the process by which a product is to be manufactured economically and competitively.</p> <p>Factors affecting process planning :</p> <p>a. Size and shape of part: The size and shape of many components decides the basic operations for the manufacturing of part. For example : For manufacturing a shaft, the necessary 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> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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</p>	<p>Definition – 2 marks,</p> <p>Any 6 factors with explanation- 1 mark for each point.</p>



		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.	
3.	a) Ans.	Attempt any FOUR of the following. Name the material handling devices for following activities: (i) To move and stack material at height:- Fork lift truck (ii) To lift heavy stones at height:- Cranes (iii) To move cement bags at a short and fixed distance:- Conveyor (iv) To move chemical from store to storage tank:- Pipelines	16 1 mark for each correct answer
	b) Ans.	State the information required to determine operation sequence. Following information required to determine operation sequence; <ol style="list-style-type: none">1. Specification of raw material.2. Specification of final product.3. Time availability for dispatch.4. Types of machine available.5. Availability of require worker.6. Quality of product.7. Degree of safety.8. Plant layout.9. Quantity to be manufactured.10. Tolerance and accuracy.	Any 4 points - 1 mark for each point.



<p>c)</p> <p>Ans.</p>	<p>Compare floor inspection and centralized inspection on the basis of</p> <p>(i) Definition.</p> <p>(ii) Measuring instruments used</p> <p>(iii) Suitability.</p> <p>(iv) Mode of inspection.</p> <table border="1" data-bbox="203 567 1295 1144"><thead><tr><th>Parameters</th><th>Floor Inspection</th><th>Centralized Inspection</th></tr></thead><tbody><tr><td>Definition.</td><td>Inspection is done at the place where the part is made or assembled is called floor inspection.</td><td>The inspection is done at a particular centralized place is called centralized inspection.</td></tr><tr><td>Measuring instruments used</td><td>Generally small and light weight instruments are used for floor inspection.</td><td>Sensitive and delicate instrument can be used for centralized inspection as it is done in lab.</td></tr><tr><td>Suitability.</td><td>Heavy parts are inspected in floor inspection</td><td>Light weight parts can be chosen for centralized inspection.</td></tr><tr><td>Mode of inspection.</td><td>Online inspection is possible</td><td>Offline inspection needs to be done.</td></tr></tbody></table>	Parameters	Floor Inspection	Centralized Inspection	Definition.	Inspection is done at the place where the part is made or assembled is called floor inspection.	The inspection is done at a particular centralized place is called centralized inspection.	Measuring instruments used	Generally small and light weight instruments are used for floor inspection.	Sensitive and delicate instrument can be used for centralized inspection as it is done in lab.	Suitability.	Heavy parts are inspected in floor inspection	Light weight parts can be chosen for centralized inspection.	Mode of inspection.	Online inspection is possible	Offline inspection needs to be done.	<p>4 points - 1 mark for each point.</p>
Parameters	Floor Inspection	Centralized Inspection															
Definition.	Inspection is done at the place where the part is made or assembled is called floor inspection.	The inspection is done at a particular centralized place is called centralized inspection.															
Measuring instruments used	Generally small and light weight instruments are used for floor inspection.	Sensitive and delicate instrument can be used for centralized inspection as it is done in lab.															
Suitability.	Heavy parts are inspected in floor inspection	Light weight parts can be chosen for centralized inspection.															
Mode of inspection.	Online inspection is possible	Offline inspection needs to be done.															
<p>d)</p> <p>Ans.</p>	<p>State the objectives of plant layout.</p> <p>Objectives of plant layout:</p> <ol style="list-style-type: none">1. To optimize utilization of floor area.2. To reduce material handling and internal transportation.3. To optimize design of stores.4. To minimize production delays.5. To make supervision easy.6. To improve quality control.7. To improve working condition.8. Flexibility in changes of plant design and workplace expansion.9. To provide workmen safety, convenience and comfort.	<p>Any 4 points - 1 mark for each point.</p>															



10. To improve overall productivity of plant.

e) **Draw an outline process chart to change the SIM CARD of a mobile phone.**

Task/Job : Change SIM card of mobile phone

Charted by :XYZ

Chart begins with: Open the cover of mobile phone.

Charted at : ABC

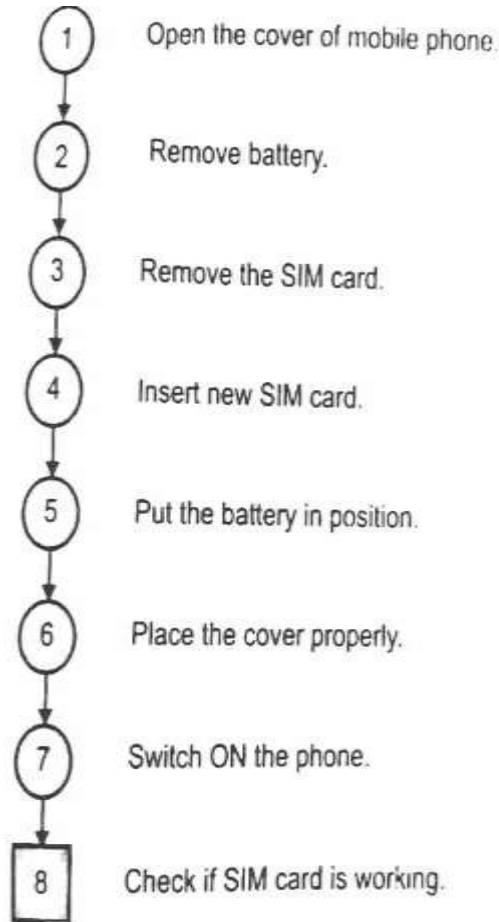
Chart ends with: Check SIM card working or not.

Date : 18/04/2018

Heading of chart – 1 mark,

Body of chart – 2 marks,

Summary of chart – 1 mark.



Summary : ○ 7 □ 1



f)	Differentiate between jigs and fixture (any four points)				Any 4 points - 1 mark for each point.
Ans.	Sr • No •	Parameters	Jigs	Fixtures	
	01	Definition	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 tools	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.	
	02	Cost	More as compare to fixture as it includes tool guiding and holding arrangement.	Less as compare to jig.	
	03	Construction	Jigs are lighter in weight for quicker handling	Whereas fixtures are generally heavier in construction.	
	04	Application	It is used in drilling, reaming or tapping operations.	It is used for operations like milling, planning, Shaping, turning etc.	
4	a)	Attempt any THREE of the following			
	(i)	Describe Pull type manufacturing system			
	Ans	<p>[1] Pull Type Manufacturing System:</p> <p>[1] Just in Time (JIT) is a pull system which is also known as Make to Order Production.</p> <p>[2] Pull System means that parts are produced to order and the production is matched with demand for the final assembly of products.</p> <p>[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.</p> <p>Characteristics of Pull (Make to Order) Manufacturing System:</p> <p>[1] Direct interaction with customers</p> <p>[2] Production schedule changes with changes in customer order</p> <p>[3] Capacity utilization is lower</p> <p>[4] Capacity requirements planning are critical</p>			4 Marks for Explanation



		[5] Shop floor control is critical [6] Distribution is less complicated Examples: Custom Tailored Clothing, Special Purpose Machinery and product made to customer specifications.	
(ii)		Discuss the concept of Kaizen	
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.	4 Marks for explanation
(iii)		Give classification of sensors used in robots	
Ans		Robotic sensor can be classified by number of method. Some of them are listed below: (a) According to quantity to be measured [1] Mechanical sensors [2] Electronic sensor [3] Magnetic sensor [4] Thermal sensor (b) According to function [1] Sensors for manipulation [2] Sensor for data acquisition (c) According to type of detection [1] Internal state sensors [2] External state sensors (d) According to nature of contact [1] Contact type sensors [2] Noncontact type sensors	1 Mark each for nay 4 correct points
(iv)		How 5's Can be used as waste management technique	
Ans		5's as Waste Management Technique:- 5's can be used as a waste management technique as it has the main objectives to eliminate the waste.	4 Marks for explanation



	<ul style="list-style-type: none"> ➤ It keeps the inventory at needed level only. ➤ It Keeps the workplace in order and cleans. ➤ It aims to eliminate unwanted items. <p>SEIRI in 5's refers to the removal of unrelated material from the work place.</p> <p>SEIKETSU refers to the standardization of work being done which eliminate the wasteful work and material.</p> <p>So, with the help of such waste prevention approach in 5's it can be efficiently used as waste management technique.</p>	
b)	Attempt any ONE of the Following	
(i)	If worker takes 15 min as a standard time for as job in which total allowance is 20% of normal time. If the rating of the worker is 100 %. Find the actual time required by the worker	
Ans	<p>Standard Time (ST) = 15 Minutes</p> <p>Rating Factor (RF) = 100 %</p> <p>Allowance = 20 % of Normal Time (NT)</p> <p>Standard Time (ST) = Normal Time (NT) + Allowance</p> $15 = NT + (20/100) NT$ $15 = NT + (1 + 0.2)$ $NT = 15/1.2$ $NT = 12.5 \text{ Minutes} = \text{Basic Time (BT)}$ <p>We Know That,</p> $\text{Basic Time} = (\text{Observed (Actual) Time} \times \text{Rating Factor}) / 100$ $12.5 = (\text{Observed (Actual) Time} \times 100) / 100$ $12.5 = \text{Observed (Actual) Time}$ <p>Actual (Observed) Time (AT) required by the worker to complete the job is 12.5 Minutes.</p>	<p>3 Marks for NT calculation</p> <p>And</p> <p>3 Marks for AT calculation</p>
(ii)	Explain general principles of jigs/fixture design	
Ans	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

1 Mark each for any 4 correct points

5 Attempt any FOUR of the following

(a) Describe 3-2-1 principle of location used in jig and fixture with suitable sketches

[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.

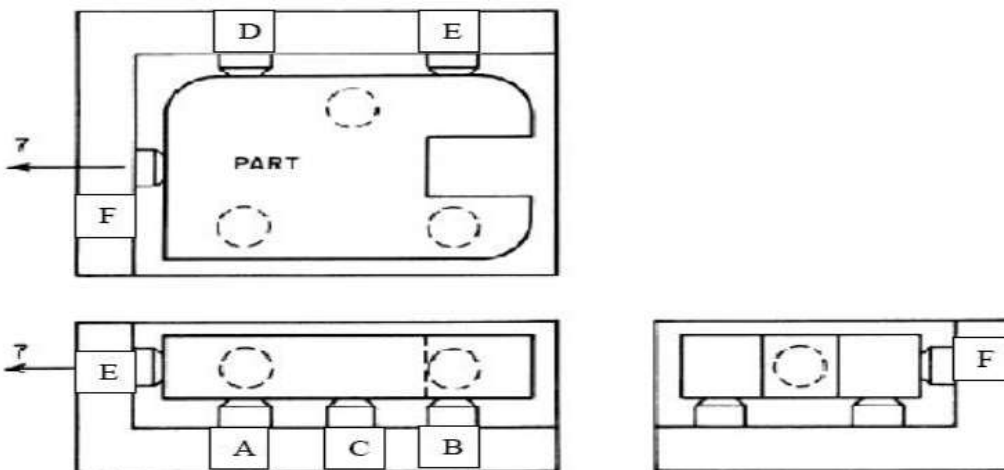
[2] The rest three degrees of freedom are arrested by three external forces usually provided directly by clamping.

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

2 Marks for Explanation

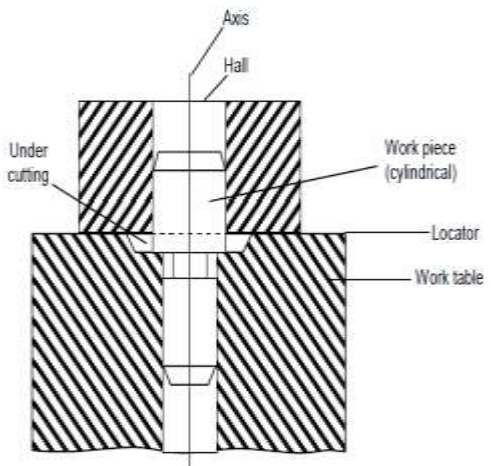
and

2 Marks for Sketches



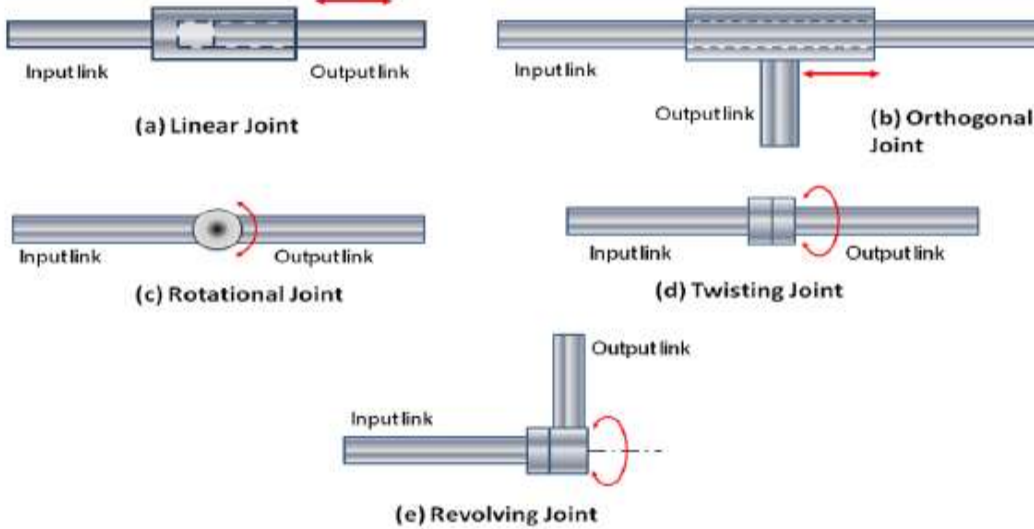
(b) Explain cylindrical locator with neat sketch



<p>Ans</p>	<p>Cylindrical locators: - Cylindrical locators are very useful when finely finished holes are available for the positioning of components.</p> <p>It is used for locating components having drilled holes. The cylindrical component to be located is gripped by a cylindrical locator fitted to the jig's body and inserted in the drilled hole of the component. The face of the jig's body around the locator is undercut to provide space for swarf clearance</p> 	<p>2 Marks for Explanation</p> <p>and</p> <p>2 Marks for Sketch</p>
<p>(c)</p>	<p>Explain the concept of lean manufacturing</p>	
<p>Ans</p>	<p>Lean manufacturing or lean production, often simply "lean", is a systemic method for the elimination of waste ("Muda") within a manufacturing process. Lean manufacturing is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. Working from the perspective of the customer who consumes a product or service. It gives values for processes that a customer would be willing to pay for.</p> <p>Lean is the management philosophy developed by Toyota production system. It focuses on reducing waste.</p> <p>Objectives of Lean manufacturing:-</p> <ol style="list-style-type: none"> 1) To eliminate waste 2) To enhance productivity 3) To obtain higher customer satisfaction 4) To reduce per unit cost 5) To control inventory 	<p>4 Marks for explanation</p>



(d)	Explain any one non tactile sensor used in robot	
Ans	<p>Non Tactile Sensor</p> <p>[1] Vision Sensor:</p> <p>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.</p> <p>[2] Proximity Sensor:</p> <p>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.</p> <p>[3] Voice Sensor:</p> <p>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.</p>	4 Marks for any 1 correct Point
(e)	State types of mechanical joints used in robots. Explain any one with sketch.	
Ans	<p>[1] Rotational joint [2] Linear joint [3] Twisting joint [4] Orthogonal & [5] Revolving joint</p> <p>Rotational Joint: Rotational joint can also be represented as R – Joint. This type will allow the joints to move in a rotary motion along the axis, which is vertical to the arm axes.</p> <p>Linear Joint: Linear joint can be indicated by the letter L – Joint. This type of joints can perform both translational and sliding movements. These motions will be attained by several ways such as telescoping mechanism and piston. The two links should be in parallel axes for achieving the linear movement.</p> <p>Twisting Joint: Twisting joint will be referred as V – Joint. This joint makes twisting motion among the output and input link. During this process, the output link axis will be vertical to the rotational axis. The output link rotates in relation to the input link.</p> <p>Orthogonal Joint: The O – joint is a symbol that is denoted for the orthogonal joint. This joint is somewhat similar to the linear joint. The only difference is that the output and input links will be moving at the right angles.</p> <p>Revolving Joint: Revolving joint is generally known as V – Joint. Here, the output link axis is perpendicular to the rotational axis, and the input link is parallel to the rotational axes. As like twisting joint, the output link spins about the input link.</p>	2 Marks each for any 2 Correct explanation and 2 Marks each for their Sketches



(f) Differentiate between hydraulic and pneumatic actuator

Ans	Sr. No.	Hydraulic Actuator	Pneumatic Actuator	1 Mark each for any 4 correct points
	1	They are used to carry heavy loads	They are used to carry lighter loads	
	2	They are more efficient	They are less efficient	
	3	Maintenance cost is high	Maintenance cost is low	
	4	Delivers better performance	Comparatively poor performance	
	5	They utilize fluid i.e. oil for actuation	They utilize air for actuation	
	6	Requires more floor space	Require less floor space	
	7	More Expensive	Less Expensive	
	8	They are employed where speed requirement is comparatively low	They are employed where fast cycles are required	

6 Attempt any TWO of the following

a) Explain with neat sketch Gantt chart. State its importance and application in production planning and control

Ans	<p>Gantt Chart</p> <p>Gantt Chart is a project planning tool that can be used to represent the timing of tasks required to complete a project. Because Gantt charts are simple to understand and easy to</p>	2 Marks for Explanation
-----	---	-------------------------



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.

Importance of Gantt Chart

[1] It provides actual state of operation

[2] It helps to decide exact duration of completion of the activity

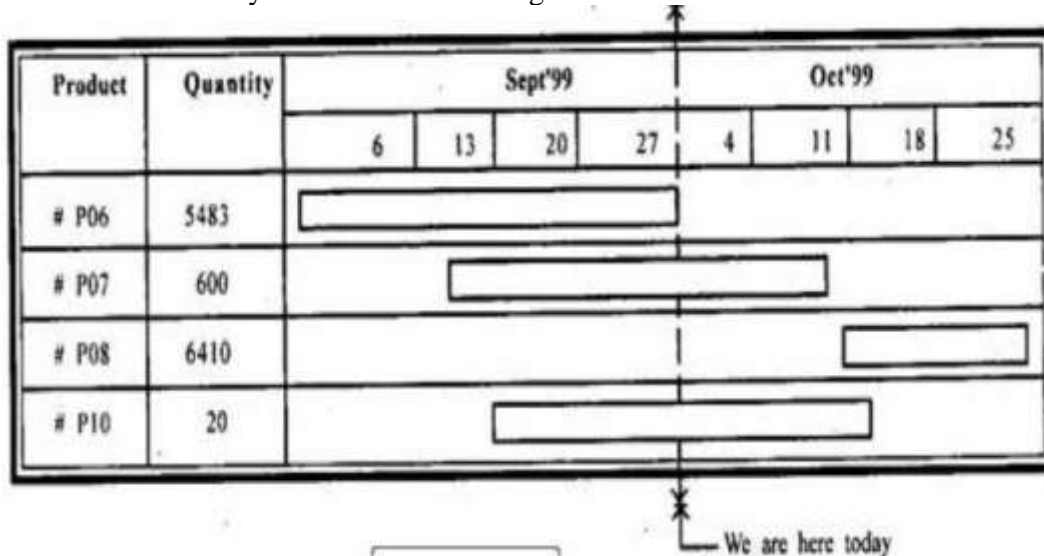
[3] It is useful to find manufacturing lead time

[4] Comparison of standard and actual time is possible

Application of Gantt Chart in Project Planning:

Gantt Chart represents graphically on a time scale as to when certain operation would be performed. It is useful in recording the progress of the schedule. For example, a Gantt Chart in below figure, shows the work already completed as on today (Say on 4th Oct. 1999),

1. Job #P06 is complete.
2. Job #P07 and #P10 are partially over.
3. Job #P08 has not yet started as its starting date is 18th Oct. 1999.



2 Marks for importance

2 Marks for Applications

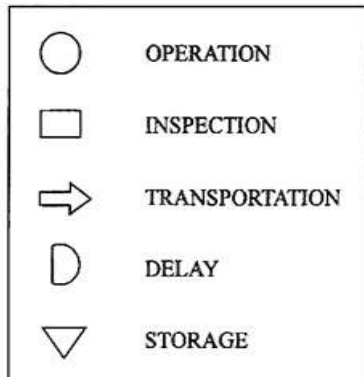
2 Marks for Sketch



	b)	Explain the symbols used in process charts	
Ans		<p>[1] Operation (○):-</p> <p>An operation occurs when an object is intentionally changed in one or more of its characteristics (physical or chemical). This indicates the main steps in a process, method or procedure.</p> <p>An operation always takes the object one stage ahead towards completion.</p> <p>[2] Inspection (□):-</p> <p>An inspection occurs when an object is examined and compared with standard for quality and quantity. The inspection examples are</p> <p>[i] Visual observations for finish.</p> <p>[ii] Count of quantity of incoming material.</p> <p>[iii] Checking the dimensions.</p> <p>[3] Transportation (⇒):-</p> <p>A transport indicates the movement of workers, materials or equipment from one place to another.</p> <p>Ex: - Movement of materials from one work station to another. Workers travelling to bring tools.</p> <p>[4] Delay (□):-</p> <p>A delay occurs when the immediate performance of the next planned thing does not take place.</p> <p>Examples: [i] Work waiting between consecutive operations.</p> <p>[5] Storage (▽):-</p> <p>Storage occurs when the object is kept in an authorized custody and is protected</p>	2 Mark each for any 4 correct points



against unauthorized removal. For example, materials kept in stores to be distributed to various work centres.



c) Explain various configurations with sketches

Robot Configurations

1) Rectangular Configuration:- This uses three perpendicular slides to construct the x, y, z axes. By moving three slides relative to one another, the robot is capable of operating within a rectangular work envelope. These are also called as Cartesian configuration robots.

2) Cylindrical Configuration:-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.

3) Spherical Configuration:-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.

4)Jointed arm Configuration:-It consists of two straight components whose shoulders and elbow joints rotate about horizontal axes corresponding to the human forearm and upper arm. Its work envelope is of irregular shape.

5) SCARA Configuration:-It is a special version of the jointed arm robot whose shoulder and elbow joints rotate about the vertical axes instead of horizontal. Its work envelope is cylindrical and much larger than all other configurations, which provides a substantial rigidity in the vertical direction for many essential tasks.

Ans

1 Mark each for 4 correct points

and

1 mark each for their sketch

