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.	Answer	Marking Scheme
1.	a)	Attempt any THREE of the following:	**12**
	(i)	State any six techniques used for 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 it various elements, eliminating all unnecessary movements and estimating the time taken to do this job with the help of stopwatch. Second aim is to ensure that all workers engaged in the job are trained to do it in the best way. b) **Human Relations:** - Good human relations help in co-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. Works will not give 100% unless their interest in work is created by some kind of reward. d) **Cost Control:** - Productivity can be increased by reducing the cost of production. This can be done by keeping careful watch over expenditure, reduction in wastage, reducing machine breakdown time, reducing waiting time for inventory avoiding excessive	Any six techniques = 4 M.

		handling, minimizing overtime expenses etc. e) **Product design:** - A good design of product helps in economical and convenient manufacturing. It will also minimize wastage or scrap and reduce the cost of production. In order to achieve high productivity, product design must be simple to understand, standardization and simplification increases the production efficiency, research and development contributes improvement in product design, product development reduces ineffective time due to change in design, design must considered the current the current available technology. f) **Working Conditions or ergonomics:** - It is nothing but the design the man machine system in such a way that to ensure high productivity and safety of workers. Working conditions like lighting, ventilation, working hours, supervision etc definitely affects the productivity. Also water facility, sitting room, bathroom, and toilets in sufficient numbers are considered to maintain working conditions. To motivate workers productivity related statement are displayed in a firm such that workers can read it frequently. g) **Management by objectives:-** It is process where the superior and subordinate management jointly identify common goal and define individual responsibility in terms of results expected from him h) **Total Quality Management:** - By this it obtained the greater customer satisfaction, fewer defects and less waste improved profitability and increased productivity.	
	(ii) Ans:	What is productivity of materials? How it differs from total productivity? **Material Productivity:** i. Material consist of direct material and indirect material, Direct material means which goes with the product and indirect material means other consumable like fuel, chemicals in heat treatment, cutting tools, coolant etc. Material productivity measures in terms of goods produced. ii. Therefore, Material Productivity = $\frac{Cost\ of\ number\ of\ unit\ produced}{Total\ material\ cost}$ **Difference between material productivity and total Productivity:** - For measuring total or overall productivity of any firm following relation is used,	Concept of material productivity – 2 M Difference – 2 M.

		Overall or Total Productivity = Value of total output / Value of total input Where, Inputs = Labour + Materials + Machinery + Money. - As total productivity is a ratio of total outputs and inputs of industry or plant and materials are included in inputs of plant therefore material productivity consider only cost of materials as input. Therefore material productivity can't indicate total productivity of the plant and it is always greater than total productivity. - Material productivity is a technique of measurement of productivity in terms of cost of material whereas total productivity is the efficiency of the plant.	
	(iii) Ans:	Suggest most appropriate type of production system for manufacturing. 1) Sugar – Process Production System. 2) Nuts and bolts – Batch Production System. 3) Connecting rods – Batch Production System. 4) Plastic bottles – Mass Production System.	1 M for each point.
	(iv)	State different activities involved in dispatching function of PPC. **Activities involved in dispatching function:** 1. To issue work order to different departments. 2. To release material orders from stores. 3. To ensure release of correct tools, jigs and fixtures. 4. Keep a record of starting and completion date of each operation. 5. Collection of route sheet and other document from the shops. 6. Issue of inspection order of each operation. 7. Return of surplus material back to store. 8. Forwarding finished part to store.	Any eight points – 4 M. (consider related points also other than these points)

b) Attempt any ONE of the following: **06**

(i) Differentiate between product layout and process layout on the basis of

1) Initial investment cost.
2) Cycle Time.
3) Types of machines used.
4) Skill of labour required.
5) Inventory level.
6) Arrangement of machine.

1M for each point, total-06 M**.**

Ans:

Parameter	Product layout	Process layout
1) Initial investment cost.	It requires higher initial investment.	Less initial investment.
2) Cycle Time.	Less cycle time for manufacturing a product.	More cycle time for manufacturing a product
3) Types of machines used.	Special purpose machines are used.	General purpose machines are used.
4) Skill of labour required.	Comparatively less skill labours are required.	Comparatively High skill labours are required to operate number of general purpose machines.
5) Inventory level.	Less	More
6) Arrangement of machine.	Machines are arranged in a sequence in which the operations are performed on the product.	All the machines of similar operation are grouped together to make a section, like lathe section, milling section etc.

(ii) Describe use of Gantt chart for scheduling and recording actual progress of work by considering suitable data.

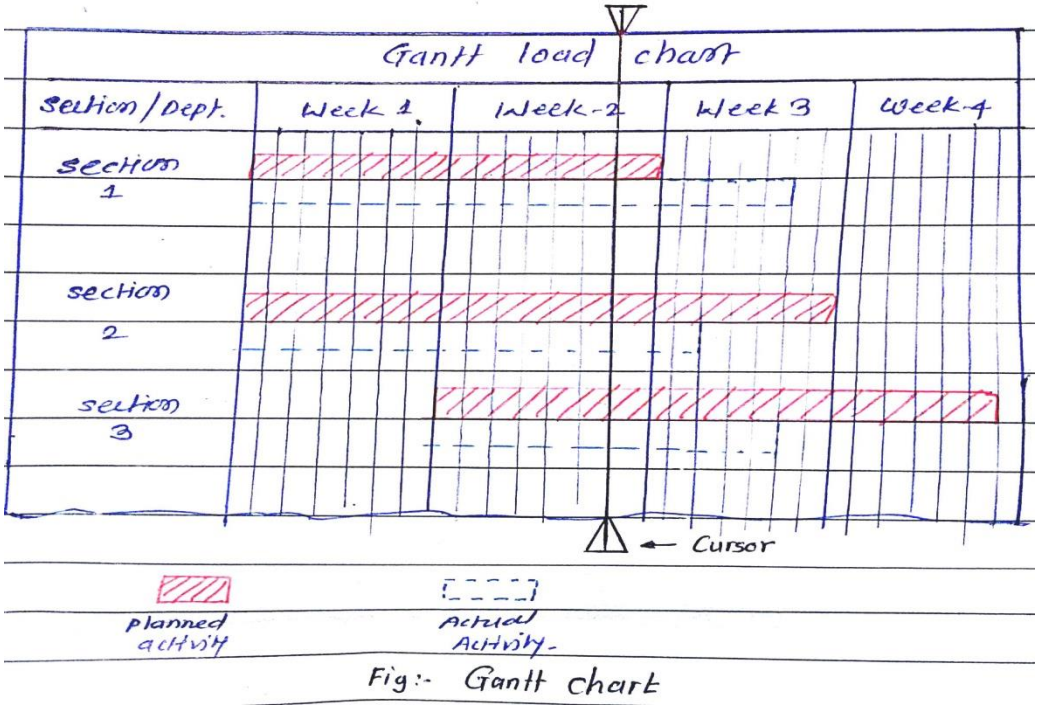
Explanation – 4 M.

Ans:

Gantt Chart:

1. The Gantt chart is actually modified bar chart in which horizontal bars are drawn for each activity in proportion to the time required for completing it.

Sketch – 2 M.

		2. It is frequently used to keep track of multiple machine schedules. 3. This chart provides an immediate comparison between schedule and reality (i.e. planned work and actual progress of work.) 4. This is achieved simply by marking the planned work and the actual progress of work on the chart. 5. A cursor attached to Gantt chart can be moved across the chart to compare between the actual progress and planned work till any particular date. 6. A typical Gantt chart is shown in following figure.  Fig:- Gantt chart	
2.		Attempt any TWO of the following:	**16**
	a)	What are the important factors affecting selection of site for a new plant	
	Ans:	**Factors affecting selection of site for new industry/plant:** 1. **Availability of raw material:** As far as possible the site selected should be near the source of raw materials so that cost of transportation can be minimized and storing cost can be reduced especially when the raw material is heavy and bulky or cheap but looses a good amount of weight during processing. For example most of the iron and steel industries are situated in Orissa and Bihar, Paper industries in Ballarpur due to availability of raw material in these areas.	Any eight points with short explanation – 1 M for each point, total- 8 M.

2. **Availability of labour:** Available of right kind of labour in required numbers of reasonable rates is also deciding factor in site selection. Unskilled labours are amply available at major industrial areas and rural areas but however firms requiring skilled labour be situated near the urban industrial area.

3. **Climatic condition:** Climatic conditions largely affect certain production processes and also the efficiency of employees. For example textile industries required moist climate due to which these types of industries are situated near Ahmadabad and Mumbai; similarly Tea and Coffee near Assam.

4. **Proximity of market:** Market is another important factor affecting site selection. Industrial units using raw material should be located near the markets to serve the customer with minimum service cost.

5. **Transport and communication facilities:** While selecting the site, adequate transportation facilities should be considered. The optimum site is the site which is well connected by various modes of transportation.

6. **Availability of water:** Water is required for drinking and sanitary purpose of all industries. Therefore, clean and adequate water should be available near the site.

7. **Availability of power and fuel:** All industries require power and fuel to run the prime movers. Therefore, the site selected should have these facilities available at cheaper rate.

8. **Legal Aspects:** Local bye laws, taxes etc. are also important because they directly reflect in total cost. So while selection, it should also consider legal aspects.

9. **Amenities and recreational facilities:** Facilities like schools, hospitals, garden, and play grounds should also be needed for employee and their family.

10. **Scope of Future expansion:** Site selected should be in such a way that a plenty of land other facilities must be available for future expansion.

	b) Ans:	Write stepwise procedure for converting raw material into finished product. **Planning of process from raw material to finished product:-** **Steps involved in process planning:** **1. Analysis of Product and its specification: -** During analysis, following parameter should be considered, a. Drawing and specification of product. b. Quality of product. c. Number of parts/components per product. **2. Make or buy decision:** Process planning determines what parts are to be manufactured in the firm itself and what parts are to be purchased from outside. **3. Selection of basic manufacturing process:** Once the decision is taken what parts to be manufactured, next step is to decide the manufacturing process. The alternative methods are compared and most practical and economical method is decided by calculating and comparing total cost for two or more feasible method. **4. Determining sequence of operation:** Once the best manufacturing process is selected, sequence of operation to be performed on each component is determined. **5. Combine the operations:** If possible practically, combine as many operations as possible. As it is economical to combine the operations. **6. Selection of machine tools/equipments:** Selection of correct machine is closely related to the process of manufacture. While selecting the machine, following factors should be considered: a. Size and form of work piece. b. Accuracy and surface finish required. c. Quantity required. **7. Inspection:** At this stage, inspection devices and stages are decided. **8. Requirement of tools, gauges etc.:** To determine and order the tools and gauges required to manufacture the part. **9. Labour requirement:** Kind/Skill of labour required to do the job. **10. Time standards:** To determine the time standards for performance of the job and fixing the rates of payment. **11. Prepare the route sheet and operation sheet.**	Minimum 8 steps – 01 M each

c) Prepare operation sheet and sequence of operation for component shown in figure No.1. Assume suitable cutting parameters.

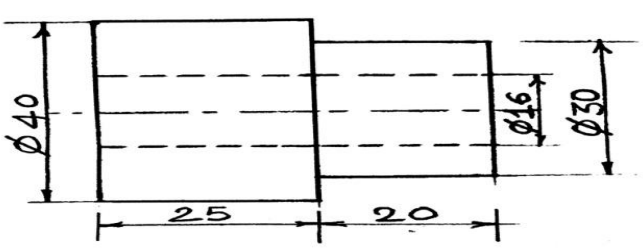


Fig. No. 1

Ans:

Part Name: XYZ — Material: M.S.

Part No: 1234 — Material Specification: ø45 × 55 mm.

Sr. No.	Description of operation.	Machine	Tools or Fixtures	Feed Mm/rev.	Speed m/min.	Depth of cut mm.	Time required min.
01	Clamp the blank in chuck projected 50 mm outside.	Center lathe	-	-	-	-	1 min
02	Face one side	Center lathe	H.S.S., R.H. Turning tool	0.025	30	1.00	1 min
03	Reverse the blank and face other side for 45 mm length.	Center lathe	H.S.S., R.H. Turning tool	0.025	30	1.00	1.5 min
04	Turn blank for Ø40, of 45 mm length.	Center lathe	H.S.S., R.H. Turning tool	0.2	40	1.00	2 min.
05	Drill hole, Ø16 by fitting drill in tail stock spindle.	Center lathe	Drill of Ø16	Medium	30	-	2 min.
06	Turn blank for Ø30, of 20 mm length from right side.	Center lathe	H.S.S., R.H. Turning tool	0.2	40	1.00	2 min.

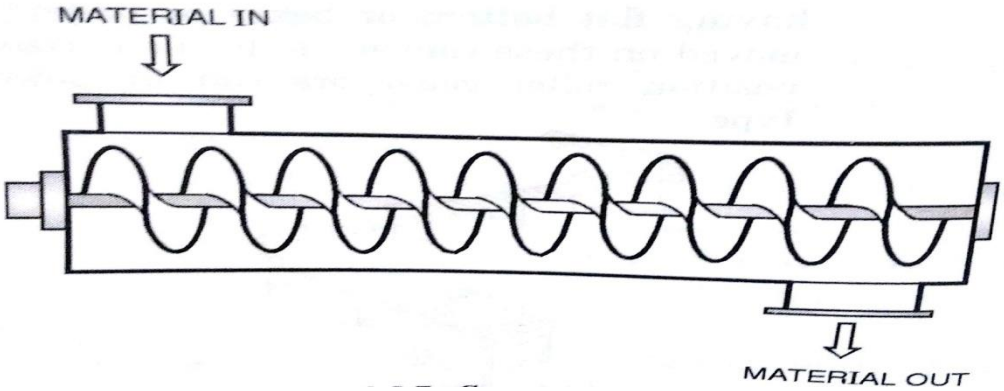
Logical Description of operations---4M

Format of Operation sheet ----2M

Logical selection of matl.,Tools, Machines etc –2M

3.		Attempt any FOUR of the following:	**12**
	a) Ans:	Suggest appropriate material handling device for (i) Transporting coal in thermal power plant – Belt Conveyor. (ii) Transporting cotton in ginning unit – Trucks, Tractors and trailers. (iii) Transporting pallets – Fork lift truck, hand lift truck. (iv) Transporting packed boxes of biscuits within industry – Hand wheel barrow or hand trolley or Porter's trolley.	1 Mark for each point, total 4M.
	b) Ans:	State the different factors affecting process planning. **Factors affecting process planning.** **a. Size and shape of part:** The size and shape of many components decides the basic operations for the manufacturing of pert. For example : For manufacturing a shaft, the necessity information is shape of raw material, size of shaft, according to that we select the sequence of operations, machines to be used and material handling activities. **b. Strength characteristics of the part:** The part strength also decides that which type of process is employed for producing it. Because the different types of load acted on the part during its working such as impact load, tensile load or shock load etc. according to that process planning is done. **c. Quantity required:** According to the no. of output produced, the process planning is decided. For example: Part which is manufacture in large no. for that general purpose machine is used and for large size and less no. of part special purpose machines are used. **d. The accuracy and surface quality required:** For achieving accuracy, product should be manufactured such a way that it should give higher dimensional accuracy and high degree of surface finish according to that machines and process is to be selected. **e. Utilization of existing equipments:** While selecting the process, full capacity of existing machines & its tooling must be utilized, otherwise the existing machinery will remain idle and more capital will be invested on new machines. **f. Skill of manpower:** Skill of available manpower must be known to determine the need for added operations to avoid defectives due to poor workmanship. **g. Delivery date of components or product:** Short time period of delivery generally do not allow process engineer to select most economical process and tool for economic production. Due to insufficient time, he may use less efficient machine and tool on hand. On other hand, longer delivery schedule give process engineer sufficient time to go details of each aspect to select most economical process.	Any four points with explanation – 4 M.
	c)	What is combine operation? Give two examples of combined operations.	

	Ans:	**Combined Operation:** 1. 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. 2. This combination process helps not only in saving the setting time but also the accuracy of the operation. 3. The operations can be combined in two ways I. Simulation method: Operations combined together and performed simultaneously. II. Integration method: Operations to be performed combined together in one setting but arranged one after other. **Examples:** 1. Simulation Method: Gang milling operations, Straddle milling operation, slot making operations on CNC machining centers etc. 2. Integration Method: Operation on turret lathe, multi spindle automats, CNC operations etc.	Concept – 2 M and two examples– 2 M
	d) Ans:	Describe working of screw conveyor with neat sketch. 1. A Screw conveyor consist of a continuous or broken blade helix or screw fastened to the shaft (or a pipe) 2. This helix or screw rotates in trough so that revolving screw advances the material. 3. This type of conveyor is used for handling material in the form of finely divided solids or pasty solids. 4. This conveyor can also be used as mixture or blender.	Explanation – 2 M. Sketch – 2 M.

		 **Fig: Screw Conveyor.**	
	e) Ans:	State basic procedure for carrying out method study. The steps followed for method study are as follows: 1. **Select:** Select the job to be considered for method study based on economical, technical and human consideration and define the objectives to be achieved. 2. **Record:** Record all the relevant facts about the present method by direct observation. 3. **Examine:** Examine the recorded events or facts about the job under consideration very critically. 4. **Develop:** Develop the best alternative by short listing of the ideas generated at critical examination. It should be economical, efficient and practically feasible. 5. **Define:** Define the new method with respect to process or procedure, layout, equipment, material, quality, working conditions etc. 6. **Install:** Install the new method as a standard practice. 7. **Maintain:** Maintain that standard practice by regular routine checks.	Stepwise procedure with proper explanation – 4 M.
	f) Ans:	State different components of Jigs and Fixtures. **Different components of Jigs and Fixtures:** 1. **Body:** It is a plate, box or frame type structure in which the components to be machined are loaded. It should be quite sturdy and rigid. 2. **Locating Elements:** These elements position the work piece firmly in the proper position against the action of cutting forces. 3. **Clamping elements:** These elements held the work piece firmly in located	Any four components – 4M.

position.

4. **Guiding and Setting elements:** In jig, the guiding element used is drill bush. It guides the cutting tool till the surface of work piece where hole is to be drilled. In fixtures, the setting element is setting block.
5. **Positioning elements:** These elements include different types of fastening devices which are used in securing the jigs and fixture to the machine at proper position.
6. **Indexing Elements:** Sometimes the work piece may have to be indexed to different position in order to perform machining operations at different locations. In such case indexing elements are to be used.

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

i) **What is fool proofing of jigs and fixtures? State its importance.**

Ans

Fool Proofing of Jigs and Fixtures:

It can be defined as "the incorporation of design feature in the jig or fixture that will make it possible to lead the work into jig and fixture, in an improper position, but will not interfere with loading and unloading the work piece." There are many fool proofing devices, such as fooling pegs, blocks or pins which clears correctly position parts but prevent incorrectly loaded parts from entering the jig and fixture body.

2 Marks for Definition

And

Importance of Fool Proofing:

[1] Rate of rejection is reduced substantially

[2] Productivity increases

[3] Wrong positioning of the work piece is avoided

[4] Loading and Unloading time reduces

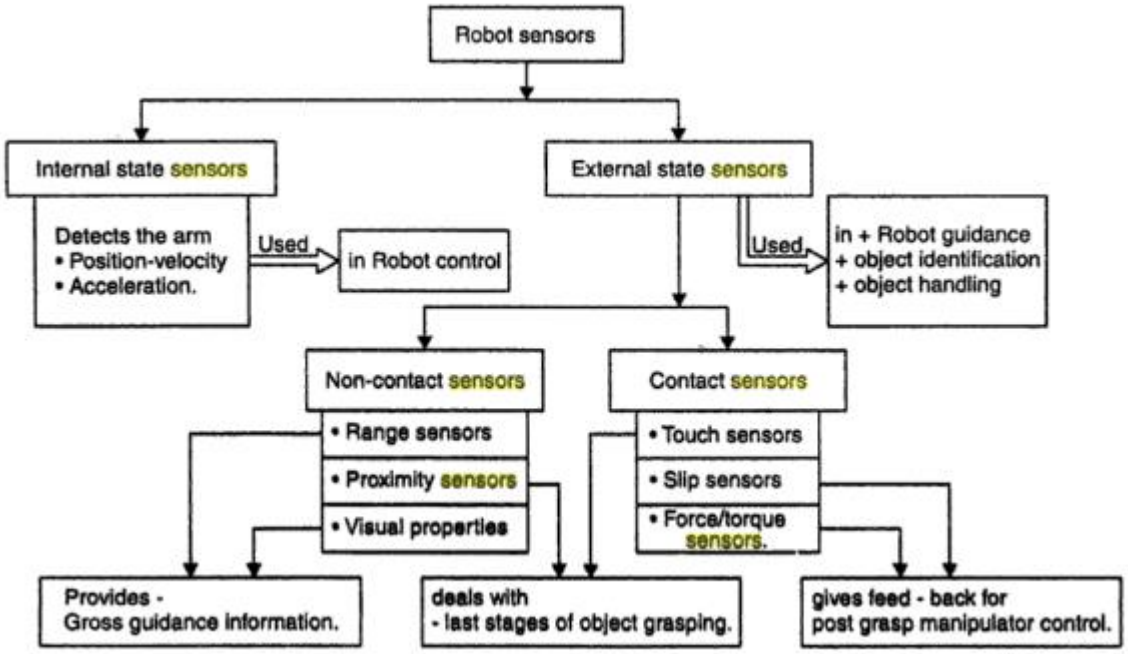
2 Marks for Importance

ii) **State basic difference between pull and push type of manufacturing system**

Ans

Sr. No.	Pull Type	Push Type
1	Production is based on actual demand	Production is not based on actual demand. It means make to stock.
2	Production schedule changes with changes in customer order	Production schedule remains unchanged despite of customer order
3	Capacity utilization is lower	Capacity utilization is higher
4	Capacity requirements planning are critical	Capacity requirements planning are comparatively simple
5	Just in Time (JIT) is a pull system which is also known as Make to Order Production	It is often said that Material Requirements Planning (MRP) is a Push system

1 Mark each for any 4 correct points

	iii) Ans	**Give classification sensors used in robot** **Classification of Robot Sensor:** Robot Sensors senses and capability includes vision and hand eye coordination, touch, hearing. Sensors will be divided into the following categories. [1] Vision Sensor: [2] Tactile Sensor: [A] Touch Sensor [B] Stress Sensor [3] Proximity Sensor: [4] Voice Sensor: OR  	4 Mark for correct classification
	iv) Ans	**Which technique is used for continuous improvement? What is the concept behind it?** **KAIZEN** is used for the continuous improvement. **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.	1 Mark for Name & 3 Marks for Concept
4	b)	**Attempt any ONE of the following**	
	i)	**A particular activity of shop floor consists of three elements. The allowances are expressed as percentage of normal time. calculate standard time for each of the**	

activity from following data

Sr. No.	Element	a	b	c
1	Observed time in min	1.5	2.1	1.8
2	Rating Factors	125	90	100
3	Allowances	20%	15%	10%

Ans

Sr. No.	Element	Observed Time	Rating	Basic Time (Normal Time)
1	A	1.5	125	=1.5 X (125/100) = 1.875 min
2	B	2.1	90	= 2.1 X (90/100) = 1.89 min
3	C	1.8	100	= 1.8 X (100/100) = 1.8 min

2 Marks for Basic time calculations

Total Normal Time = 1.875 + 1.89 + 1.8 = 5.565 min

2 Marks for Allowances

To Allowances:-

For A :- (20/100 X 1.875) = 0.375 min

For B:- (15/100 X 1.89) = 0.2835 min

For C:- (10/100 X 1.8) = 0.18 min

2 Marks for Standard time calculations

Standard Time = Normal Time + Allowances

Standard Time For A :- 0.375 + 1.875 = 2.25 min

Standard Time For B:- 0.2835 + 1.89 = 2.1735 min

Standard Time For C:- 0.18 + 1.8 = 1.98 min**tal**

ii) What is meant by 5'S'? Explain each 'S' in details

Ans

5 'S' Concept:-

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.

3 Marks for concept

Objectives of 5'S:-

- Enhancement in productivity
- Keep the inventory at needed level only.

<table>
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Keep the workplace in order and clean.
Identify and Retrieve items fast.
Eliminate unwanted items.
Maintain the discipline at work place
Improved safety

<table>
<tr><th>Japanese Term</th><th>English Equivalent</th><th>Meaning</th></tr>
<tr><td>SEIRI</td><td>Tidiness</td><td>Unrelated materials in workplace</td></tr>
<tr><td>SEITON</td><td>Orderliness</td><td>Set everything in proper for quick storage and retrieval</td></tr>
<tr><td>SEISO</td><td>Cleanliness</td><td>Clean the workplace, everything should be janitor</td></tr>
<tr><td>SEIKETSU</td><td>Standardization</td><td>Standardize the way of manipulating the cleanliness</td></tr>
<tr><td>SHITSUKE</td><td>Discipline</td><td>Practice 5’s daily, make it a way of life this also means a commitment</td></tr>
</table>
</td><td>3 Marks for Explanation</td></tr>
<tr><td>5</td><td></td><td>Attempt any FOUR of the following.</td><td></td></tr>
<tr><td></td><td>i)
Ans</td><td>State any four principles of jig and fixture design
1. Before planning the design of a tool, compare the cost of production of the work with present tools with the expected cost of production, using the tool to be made. Confirm that the cost of building jigs & fixture is not in excess of expected gain.
2. Before laying 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.</td><td>1 Mark each for any 4 Correct Points</td></tr>
<tr><td></td><td>ii)</td><td>Draw proportionate sketch of template jig. State its use.</td><td></td></tr>
<tr><td></td><td>Ans</td><td>Use of Template jig:-
1) This jig avoids the marking operation completely
2) Drilling is done quickly</td><td>1 Mark each for any two</td></tr>
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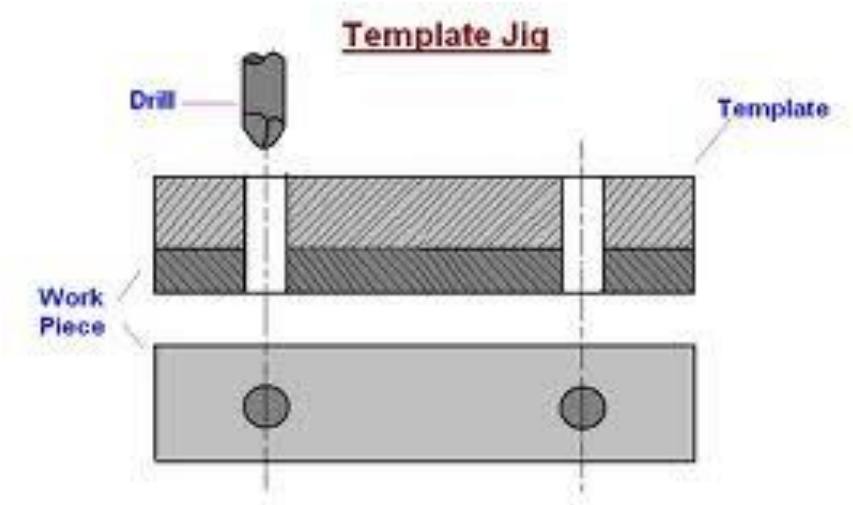
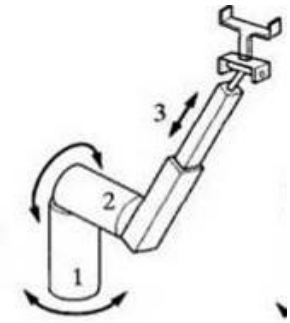
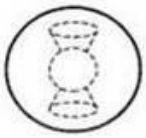
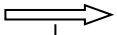
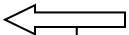
		3) Easy and Fast loading and unloading of work pieces 4) For drilling flat work pieces they can be accommodated in this jig **Sketch :-**  	correct points 2 Marks for Sketch
	iii) **Ans**	**What is lean manufacturing? state its benefits** **Lean manufacturing** or **lean production**, often simply "**lean**", 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. Lean is the management philosophy developed by Toyota production system. It focuses on reducing waste. **Benefits of Lean manufacturing:-** 1) It eliminates waste 2) It enhances productivity 3) It helps to obtain higher customer satisfaction 4) It reduces per unit cost 5) It controls inventory	2 Marks for Concept & 2 Marks for Benefits
	iv) **Ans**	**State any four types of grippers used in robots with one applications of each.** [1] Vacuum Gripper:- Flat and light weight Surfaces / Palletizing materials [2] Pneumatic Gripper:- Slightly weight parts [3] Hydraulic Gripper:- Heavy parts in industry	1 Mark each for any 4 Correct

		[4] Servo electric Gripper:- Lightweight parts [5] Magnetic Gripper:- Metal objects such as steel sheets or tables [6] Claw Grippers:- Pick and lace and Assembly operations	types & Application
	v) **Ans**	**Describe spherical configuration used in robot with neat sketch** **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.  Spherical 	Fig 2 M Expl 2M
	vi) **Ans**	**What are the advantages of hydraulic actuators?** [1] These are cheapest form of actuators. [2] Components are readily available. [3] Compressed air is available in factories. [4] Compressed air can be stored, and [5] Conveyed easily over long distances. [6] Compressed air is clean, explosion-proof & insensitive to temp. variation [7] Few moving parts hence these are reliable [8] Relevant personnel are familiar with the tech. [9] Very quick Fast work cycles [10] No mech. transmission is required. [11] Safe in explosive areas as no elect. contact [12] Systems are compact. [13] Control is simple. Mechanical stops. [14] Components are easy to connect.	1/2 Mark each for any 4 Correct Points 8 pts
6		**Attempt any Two of the following**	
	a	**What is scheduling? State internal and External factors Affecting Scheduling**	

		Scheduling:-Scheduling means when and in what sequence the work will be done. It involves deciding as to when the work will start and in certain duration of time how much work will be finished. Scheduling deals with orders and machines – it determines which order will be taken up on which machine and which department by which operator. It ensures free flow of material along the production line. **Factors affecting Scheduling** Internal Factors :- 1) Stock of finished goods 2) Availability of men , machine , material 3) Availabilities of Manufacturing facilities 4) WIP External Factors :- 1) Customers Demand 2) Customers delivery dates 3) Stock of good already lying with dealers and retailers	2 Marks for definition and 1/2 Mark each for any 2 correct Factors 1/2 Mark each for any 2 correct Factors
	b)	**(i) Sketch symbols of the following therbligs** **1) Transport Loaded 2) Search 3) Rest 4)Assemble**	
	Ans)	**Transport Loaded:-**  **Search:-**  **Rest:-**  **Assemble:-** #	1 Mark each for correct Symbol
	An s	**ii) Construct Two handed process chart for assembly of nut, bolt, washer**	3 Marks for Chart and 1 Mark for Summary

Left Hand		Right Hand	
Description	**Symbol**	**Symbol**	**Description**
Washer to the workstation			Bolt to the workstation
Position Washer on bolt			Grasp the bolt securely
Nut to the Workstation			Wait/Delay
Positioned &Thread nut			Hold the bolt
Inspect			Hold

Wait			Transfer assembly to left hand	
Drop the assembly to bin			Wait/Delay	

Summary:-

Symbol					
Frequency (LH)	3	2	1	1	0
Frequency (RH)	2	1	0		2

c) iii) Describe any two types of joints used in robotic arm and wrist

Ans

[1] Rotational joint [2] Linear joint [3] Twisting joint [4] Orthogonal & [5] Revolving joint

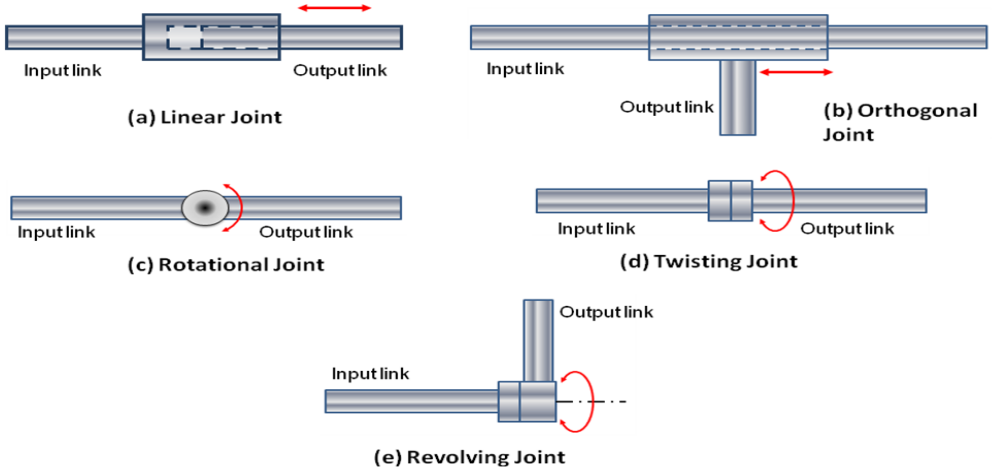
Rotational Joint: Rotational joint can also be represented as R – Joint. This type will allow the joints to move in a rotary motion along the axis, which is vertical to the arm axes.

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.

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.

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.

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.



2 Marks each for any 2 Correct explanation and 2 Marks each for their Sketches